Video game age rating, age assurance, and identity verification in Mainland China: Policy implementation insights from popular iPhone games

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Abstract

Background: Playing video games is a popular activity globally across age groups. Concerns have been raised about potentially problematic engagement both in terms of spending too much time ('gaming disorder' as defined by the World Health Organisation) and money, including on gambling-like in-game purchases, such as loot boxes. Giving games different advisory age ratings based on their potentially problematic content and advising consumers and parents as to what age group the game is suitable for is a non-restrictive policy approach that is widely adopted internationally. In contrast, aiming to address 'internet addiction' and 'excessive monetary spending,' East Asian countries have adopted (and in the South Korean case since repealed) stricter legal restrictions on how long and when young people can play video games for and how much money they are permitted to spend. These restrictions are enforced by software means through age assurance and identity verification procedures. A prominent example is how Mainland China restricts under-18s from playing online games except for one hour only between 8–9 PM on Fridays, weekends, and public holidays. Different monetary spending limits are also imposed against children based on age groups, with older children being allowed to spend more. Previous research presented conflicting evidence as to whether restrictions on gameplay time were beneficial and achieved the regulatory aims, with certain studies suggesting that some young people circumvent the restrictions.

Objective: Policy implementation evidence can inform both future domestic and international policymaking (including repealing ineffective policies). Whether and how major technology companies implement age rating, age assurance, and identity verification procedures to enforce video game-related regulatory restrictions in Mainland China was novelly assessed.

Methods: A content analysis of the account creation process of the 100 highest-grossing Mainland Chinese iPhone games was conducted.

Results: 95.0% of games did conduct identity verification as required. However, notably, 5.0% of games were accessible without the user having been required to complete identity verification processes, which means the companies acted in breach of regulations. Further, confusingly, two age rating systems often providing conflicting information are presented simultaneously to Mainland Chinese consumers.

Conclusions: The currently widely adopted identity verification process has many flaws, including being easily circumventable. Actionable improvements, such as transmitting sensitive personal data only to a third-party identity verification provider rather than many individual companies, are recommended. The implementation of a single, unified, and culturally appropriate age rating system that includes an adult-only rating would ensure better child protection. How the age assurance-related policy implementation insights from the Mainland Chinese video game restriction context are also relevant to technology regulation globally is also discussed, as many other countries are depending on such software solutions to address online harms young people might encounter, ranging from pornography to online gambling.

Keywords:
Age assurance; Identity verification; Age rating; Video games; Video gaming regulation; Interactive entertainment law; Information technology law; Consumer protection; Mainland China; Policy implementation; Regulatory compliance

1. Introduction

Playing video games is now one of the most popular past-times worldwide. For example, more than half of Western Europeans aged between 6–64 play video games, and young people are even more likely to participate: 70% of 6–10-year-olds, 83% of 11–14-year-olds, and 78% of 15–24-year-olds self-reported doing so [1]. The benefits of video games beyond providing entertainment are increasingly being properly recognised, such as developing social relationships [2]; reducing stress and anxiety [3]; and helping young people learn better [4]. Many initial concerns about the harms of video games have also been researched and largely debunked more recently: for example, playing violent video games is *not* associated with increased aggression in real life [5,6].

However, stakeholders remain concerned about certain potential problems. In particular, firstly, there are concerns relating to video game 'addiction' in the sense of over-engagement in temporal terms that leads to harmful consequences [7], as recognised by the World Health Organisation as 'gaming disorder' [8]. Recent research suggests that, broadly speaking, time spent playing video games is unlikely to affect wellbeing in relation to most players [9,10], but certain individual players may experience harm [11].

Secondly, recent developments in how video games generate revenue has meant that players can now spend large sums of money to purchase virtual items [12], including through gambling-like mechanics that provide random rewards (*e.g.*, loot boxes and gacha [13–15] representing a convergence between video gaming and traditional gambling [16]). Accordingly, there are further concerns about the overspending of money and the normalisation of gambling behaviour, which might be harmful, especially to children.

One strategy to deal with potentially problematic content in video games is to restrict who is allowed to play them. A widely adopted global approach is to give video games different age ratings based on their content to advise players and parents what age groups a game is suitable for: different countries use different age rating systems with slightly different criteria, but the broader principle remains the same [17,18]. For example, a game that features strong and realistic violent and sexual content is likely to be deemed suitable only for adults and not any children, whilst a

game featuring only cartoon violence might be deemed suitable for teenagers and above but not young children. In most countries, the age ratings are advisory only and not legally binding or are not followed by children and parents in practice, thus reducing their efficacy at restricting access [19]

A more interventionist regulatory approach that has only been taken by a few Asian countries is to technically restrict young people's access to video games using software solutions [20]. User accounts are required to pass through real-life identity (ID) verification and age assurance. Confirmed adult accounts are allowed to play without restrictions, whilst various limits are imposed against child accounts [21,22].

Mainland China requires particularly strict ID and age verification procedures to be conducted before online video game services may be provided to users. This is to allow underage users to be identified and ensure that regulatory limits on when and how long under-18s can play online games and how much money they are permitted to spend can be effectively enforced [20,21]. Article 1 of the 'Notice on the Prevention of Online Gaming Addiction in Juveniles' required that all new user accounts for online video games be ID verified from November 2019 (hereinafter, the '2019 Notice') [23]. This was reiterated in Article 2 of the 'Notice on Further Strictly Regulating and Effectively Preventing Online Video Gaming Addiction in Minors' effective from September 2021 (hereinafter, the '2021 Notice') [24].

For context, per the 2021 Notice, under-18s are only allowed to play for one hour between 8 and 9 PM on Fridays, Saturdays, Sundays, and public holidays [24,25]. As to monetary spending, per the 2019 Notice, the amount of permitted spending varies by age group [23,26]. Players under 8 years of age are not allowed to spend any money. Players aged between 8 and 15 are not allowed to spend more than CN¥50 per individual in-game purchase transaction and not more than CN¥200 cumulatively per month. Finally, players aged 16 and 17 are not allowed to spend more than CN¥100 per individual transaction and not more than CN¥400 total per month. These rules are imposed due to concerns about young people developing online gaming addiction and excessively spending money, thus affecting their health and education [23].

Empirical evaluations of the implementation and effectiveness of video game and, indeed, broader technology-related regulatory policy is highly important. Ineffective policies with potential negative consequences on consumers and the industry and without obvious practical benefits should be considered for repeal. For example, South Korea historically prohibited under-16s from playing PC and console online games between midnight and 6 AM citing a need to prevent internet addiction and increase young people's sleeping time. However, relying on empirical, public health research finding that the policy did not realise obvious benefits for young people (*e.g.*, sleeping time did not practically significantly increase) and achieve the regulatory aims following implementation [27–29], the law was repealed [30].

There has been limited and conflicting research examining the consumer side on whether young people in Mainland China follow the limits and whether their behaviours have changed, with suggestions that a non-insignificant group circumvent those rules, *e.g.*, by using their parent's adult ID-verified account to play without restrictions [20,22,31]. However, as to the industry side, whether and how companies implement age rating systems, age assurance, and ID verification in Mainland China have never been empirically assessed. Young people would not even need to circumvent rules that are not enforced well, and the impact of those rules would also be severely curtailed such as the unenforced ban on loot boxes in Belgium that both companies and consumers evade [32,33]. The present study therefore assessed whether and how the most popular Mainland Chinese mobile games conducted age assurance.

Such policy evidence informs both domestic lawmaking and enforcement and international policymaking (*e.g.*, other countries considering adopting similar measures in relation to video games and beyond). Indeed, countries around the world are relying on age assurance to 'solve' many other aspects of potential technological harm. For example, Australia intends to require social media companies to conduct age assurance to ban under-16s from accessing social media (Section 4 of the Online Safety Act 2021 (Cth) as amended by the Online Safety Amendment (Social Media Minimum Age) Act 2024 (Cth)). Similarly, in the UK, online pornography providers are obligated to implement 'highly effective' age assurance measures to prevent access and reduce potential harm (Section 81 of the Online Safety Act 2023). Therefore, evidence from the Mainland Chinese video game

context, which is one of the first examples of the systematic implementation of widespread age assurance to combat online harms affecting young people, has much broader implications for global child protection and technology regulation.

2. Method

As part of a broader project on video game regulation [34], a list of the 100 highest-grossing games for the iPhone platform in Mainland China on 5 January 2024 was collated through data.ai, a leading analytics company. This list formed the sample as all games remained available for download from the Mainland Chinese Apple App Store and playable during the data collection period.

The following variables were measured:

Apple age rating

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

CADPA age rating and *age-appropriate guidance*

Besides the international, platform-based Apple age rating system, the China Audio-video and Digital Publishing Association [中国音像与数字出版协会] (CADPA), a national industry body that represents, *inter alia*, the video game industry, has its own advisory-only age rating system [35]. This information was copied from the relevant age rating information displayed on the game's login, initial loading, or equivalent page. Further *age-appropriate guidance*, if provided, alongside the age rating was also recorded.

Presence of ID verification

Each game was downloaded from the Mainland Chinese Apple App Store. Upon start-up and as part of the process for new account creation, it was checked whether and how the game conducted ID verification. Qualitative aspects of those procedures were noted and screenshotted. Each game was played for one hour for other research purposes [34] with the view of recording any additional ID verification that might be encountered (*e.g.*, biometric age verification during and interrupting gameplay [36]); however, none was observed.

Date and time of data collection

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

In accordance with the *Danish Code of Conduct for Research Integrity*,[37] as adopted by the IT University of Copenhagen, the present study did not require research ethics assessment and approval because no human participants or personal data were involved, and only publicly available information was examined and recorded.

3. Results

3.1. Age ratings and age-appropriate guidance information

Two age rating systems for video games on the Apple App Store are in force in Mainland China concurrently for iPhone games: the propriety one of the Apple App Store (which is also used internationally [38]) and that of the CADPA. For context, both are advisory only, and neither has legal effect. Notwithstanding, because of the mandated age and ID verification process, game companies could in theory block certain users' access based on their age and the relevant Apple or CADPA age ratings. The Apple age rating was copied from the App Store product listing page, whilst the CADPA age rating was copied from the information displayed inside each game. It is not known why the Apple App Store does not provide both age ratings on the product listing page, even though the non-Apple CADPA one would in nearly all cases be inevitably shown inside the game. The age ratings of the 100 games studied are shown in Table 1.

Table 1

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

Age Rating	# of games	%
Apple 4	7	7.0%
Apple 9	17	17.0%
Apple 12	36	36.0%
Apple 17	40	40.0%
CADPA 8	12	12.0%
CADPA 12	37	37.0%
CADPA 16	45	45.0%
CADPA 17[a]	1	1.0%
No CADPA rating shown	5	5.0%

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

Five games did not display a CADPA age rating. Two of these games, Games 067 (*重返帝国*) and 073 (*光与夜之恋*), stated in text on the login screen in a very small font that they were not suitable for players under 18, so no appropriate CADPA could be shown for them as the CADPA 18 rating originally proposed in draft was not included as part of the finalised system [35], and the highest possible CADPA 16 would not have been appropriate. The other three games, Games 092 (*皇家捕鱼电玩城*), 093 (*足球在线*), and 099 (*海王捕鱼*), did not give an explanation as to why no CADPA age rating or relevant information was provided. Notably, a CADPA 8 age rating was found to have been shown on Game 093's official website, which suggests it was an implementation error (specifically, an omission) in relation to this game's iPhone client. The remaining two games were social or simulated casino games that were likely deemed as requiring an age rating that is higher than the highest possible CADPA 16 (as they were both rated Apple 17) and so had no appropriate CADPA age rating information to display. (So-called simulated or social casino games allow players to spend real-world money to participate in traditional gambling, *e.g.*, playing on slot machines, without the possibility of converting any potential winnings back into real-world money.) However, many other social casino games simply displayed CADPA 16 (*inter alia*, Games 079 (*乐鸿捕鱼*) and 100 (*捕鱼炸翻天*)). One other social casino game (Game 025 (*途游休闲捕鱼*)) showed a non-existent CADPA 17 age rating, which is not part of the official age rating system but was shown by the video game company at its own volition possibly to adhere to the game's Apple App Store 17 rating, which is higher than the highest possible CADPA 16. Another game, Game 010 (*捕鱼大作战*), was observed as having initially shown a CADPA 17 age rating but then changed this to CADPA 16 at some point during the data collection period.

The CADPA age rating icons when tapped would usually provide further details about the game through a '适龄提示 [age-appropriate guidance],' *e.g.*, providing a synopsis of the gameplay; justifying the age rating; and detailing what regulatory measures would be applied in relation to underage users of various age groups (such as limits on gameplay time and in-game spending to comply with relevant regulations, *i.e.*, the 2019 and 2021 Notices [20,21,25]). For the 95 games that showed a CADPA age rating, 93 games (97.9%) provided this, whilst the other two games' age

rating icon (2.1%) were not interactable and could not be prompted to show further information.

Inconsistencies between the two age ratings given for the same game by the two separate systems were identified in relation to some games. Firstly, there were obvious errors: for example, if a game was rated CADPA 12, the game's Apple Age Rating should also have been at least 12 (rather than either 4 or 9) to not falsely advertise the game as suitable for children aged between 4 and 11 and thus prevent them (or their parents) from downloading the game only to find out that the game is not actually suitable to them. In total, 12 games had a CADPA age rating of either 12 or 16, but displayed an Apple age rating of either 4 or 9, when at least Apple 12 should have been displayed. Game 008's (部落冲突) age ratings were thusly inconsistent, and its age-appropriate guidance stated that under-12s cannot spend money in-game, which implies that under-12s would still be permitted to access the game despite the CADPA 12 age rating. The law only requires that under-8s be not permitted to make in-game purchases [26], so the company has adopted stricter child-protection measures than are legally required by also prohibiting 8–11-year-olds from spending money. This demonstrates that the CADPA age ratings are indeed merely advisory at present even though companies could voluntarily (or be required in the future by regulations to) restrict access to the games and limit player's in-game spending based on them (because companies have access to information about the user's age through the required ID verification process, as discussed below).

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

reason. Thus, a total of 13 games had arguably inappropriate Apple age ratings that were too low and did not reflect the Chinese cultural sensibilities incorporated into the CADPA age rating system.

3.2. Real-life ID verification

Amongst all 100 games, 95 games (95.0%) duly implemented an ID verification process to determine both the real-life identity of the player and, by implication, their age. Generally, this was done through the game asking the player to input their legal name and their Chinese national identity number (which plainly contains the person's date of birth in the YYYY/MM/DD format, *e.g.*, '19991123,' as part of the number sequence). Some games that were operated by the same company recognised the author's login information (either mobile phone number or WeChat account) as having been inputted into another game operated by the same company that was previously coded and so did not request for the ID information pair to be inputted again for verification. Thus, it was not possible to definitively state (or indeed provide screenshots showing) whether ID verification was properly conducted in relation to those games. However, in fairness to the video game companies involved, it was presumed that this was done correctly as evidence of the lack of ID verification could also not be produced (except in one case detailed below). Many potential issues arise from this implementation of an ID and age verification system: these are detailed in the Discussion section.

The other five games (5.0%) demonstrably did not conduct ID verification. Firstly, Games 022 (*指尖四川麻将*) and 023 (*开心消消乐*) provided a so-called '游客模式 [guest mode]' that allowed users to play the game without providing ID verification. These modes may also be referred to as a '快速游戏 [quick play]' mode. These are now explicitly prohibited by Mainland Chinese regulations, specifically the 2021 Notice, as detailed below under the Discussion section [25]. A number of other games' UI (user interface) still contained remnants of guest modes (*e.g.*, the button still existed), but these either were disabled (*e.g.*, Game 001 (*王者荣耀*)) or nonetheless still required ID verification upon entry (*e.g.*, Game 042 (*倩女幽魂*)), both of which would be compliant with the law.

Secondly, Games 016 (*咸鱼之王*) and 040 (*星球：重启*) allowed the author to begin playing the game by logging in with an Apple ID that, importantly, has *not* been ID verified. The iOS operating system frequently warned the author that a Chinese Apple ID '必须 [must]' be verified with a Chinese phone number (as occurred when the author was assessing Game 049 (*合金弹头：觉醒*) as shown in Figure 1), which would imply ID verification. (This is because Chinese phone numbers are required by law to always be linked to a real-life identity since September 2013 [39], but, in practice, the person actually using the phone number may not necessarily be the person registered against said number, which is a major flaw in the verification process that is discussed below.) However, the author was able to simply choose '以后再说 [Discuss later]' and decline the operating system's request. This meant that the author was able to continue to possess and use an unverified Apple ID that was only linked to an email address and so was neither directly ID verified (which Apple could have required but did not) nor even indirectly ID verified through a Chinese phone number. In contrast, other games like Game 053 (*乐乐捕鱼*) allowed the user to login with their Apple ID but then sought ID verification before gameplay started, which would then be compliant with the law.

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

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

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

4. Discussion

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

Nearly all Mainland Chinese games displayed a CADPA age rating (95.0%) and provided age-appropriate guidance information (93.0%). The few games that did not

provide CADPA age rating information presumably did not do so because the highest possible CADPA 16 rating (suitable for people aged 16+) was still deemed to have been too low and not appropriate for the content found within the game (which might have been suitable only for people aged 18+). There was no appropriate CADPA age rating for the companies operating these adult-only titles to display, even though these games are technically allowed to be marketed and are indeed popular.

Instead of not providing a CADPA age rating at all, some companies chose to simply display CADPA 16 despite its potential inappropriateness. A total of 31 games were rated Apple 17, which is Apple's highest age rating, but were given only CADPA 16. These included simulated or social casino games that are deemed suitable only for adults (18+) in Europe by PEGI (Pan-European Game Information), the relevant age rating organisation [40]. Games with content that might be deemed suitable only for adults are being given Apple 17 and CADPA 16 instead of an adult only age rating, which would be more appropriate. The age-appropriate guidance of Game 100 (*捕鱼炸翻天*), a social casino game that was rated Apple 17 and CADPA 16, even stated that: 'This game … is suitable for users aged 16 and above, but this game provides services only to users aged 18 and above.' This meant that users under 18 could not actually play Game 100 even after downloading it and satisfying all of the age rating information shown. Companies are enforcing an 18+ age rating in practice, whilst misleadingly displaying lower age ratings. Consumers are harmed in that they wasted time and resources to download a game that was advertised as being available to them, but they could not in fact actually play.

There are three justifications for introducing an adult only 18+ rating under both the Apple system and the CADPA system: firstly, to allow games with content that is suitable only for adults (which are both permitted and popular) to actually receive an appropriate adult only rating that is equivalent to, *i.e.*, a new Apple 18 (rather than a misleading CADPA 16 or Apple 17), thus better warning parents about and protecting children from potentially problematic content; secondly, to fix the inability of companies to label some games with content suitable only for adults with a CADPA age rating at all (CADPA 18 could be displayed, instead of no age rating or only some explanation text shown in a very small font being provided); and

thirdly, to reduce the likelihood of misleading age rating information being given by some games that do not take effect in practice.

When the CADPA age rating system was being designed, the inclusion of a CADPA 18 age rating was considered; however, the official press release stated that it was ultimately not included because 'it might be interpreted by people in divergent ways' without providing any further explanation [35]. Given the practical need for a CADPA 18 age rating that the present study has demonstrated (some games do need to display such a rating so as to protect and not mislead consumers and parents), this decision should be reconsidered. Apple should also add an Apple 18 age rating not just in Mainland China but also beyond, so that regional rules, such as how social casino games and online gambling apps should always get an adult-only 18+ rating in Europe, could be effectively implemented. Apple has previously implemented regional age rating settings in Brazil, South Korea, and Australia to comply with regulations [41,42].

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

Cases where the Apple and CADPA age ratings were inconsistent with each other as detailed in the Results section should be fixed. This would prevent players from being misled into downloading games that they thought would be suitable for them only to discover after entering into the game that it is in fact unsuitable or, even worse, that they are not in fact permitted to play it. The provision of both ratings and the age-appropriate guidance on the Apple App Store product listing would also be helpful for consumers by providing more information. The existence of two concurrent age rating systems whose information often conflict is also problematic in of itself. In Mainland China, Apple should consider removing its own proprietary system and exclusively implementing the CADPA age rating, which is presumed to be more culturally appropriate to the Mainland Chinese context, as already similarly done in Brazil with its national age rating system, which replaced Apple's [41], thus demonstrating that Apple could, of course, adapt a specific country's Apple App Store UI to accommodate a different age rating system. Further, as quoted above in relation to Game 100, for example, the age-appropriate guidance of some games provides information that is contrary to the CADPA age rating and should be corrected.

In addition, Game 100's age-appropriate guidance also says that 'this game is a casual and educational board game.' That was evidently untrue, because the game was in fact a 'fishing' social casino game wherein the player fires cannons at various aquatic creatures that have a random chance of turning into the in-game currency that can be used to fire more cannons. There was no educational or board game aspects. Simulated gambling or social casino games are capable of causing and have been known to cause significant financial and social harm [43]. The present study did not conduct a close reading of all the age-appropriate guidance texts and compare them against actual gameplay to check their veracity. This is an important future direction of research: the age-appropriate guidance should, of course, be accurate and informative and not false and misleading.

4.3. ID verification: non-compliance and loopholes

Five games (5.0%) demonstrably did not conduct ID verification before providing the author with gameplay services in Mainland China as required and were in clear breach of regulations, *i.e.*, the 2019 and 2021 Notices [23,24]. The so-called 'guest modes' that allowed users whose ID were unverified to play the game for up to one hour was permitted under Article 1 of the 2019 Notice (and before its publication) but were then explicitly prohibited by Article 2 of the 2021 Notice [24]. The newer Notice supersedes, so the two games that allowed the author to play using guest modes was also in breach of that specific ban, in addition to failing to perform ID verification.

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

Apple ID has been ID-verified. This means that ID verification would no longer need to be conducted on an individual company-by-company basis, which would save costs for companies and also make the player experience smoother (they can simply login with a verified Apple ID to all games that implement the unified system).

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

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

Firstly, the process does not actually verify the identity of the user. The process only verifies that the pair of information (name and ID number) exists in the database and is correct. However, there is no verification that the pair of information provided actually belongs to the player attempting to use it (which would require, *e.g.*, concurrent biometric verification, which has reportedly been implemented [36], but was not encountered by the author through 100 hours of gameplay research).

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

Thirdly, the system does not work well when accounts are transferred between users. Because the ID verification is only ever done once when a user account is created when the game is played for the first time and never again, this means that the account will have been marked as verified and would continue to be marked as such even if it has since been (temporarily) transferred to someone else (as the game company would not know that it has been transferred). This means that already ID verified accounts could also be sold instead of the information pair to help underage users circumvent relevant regulations. (Sellers might prefer to do this because their information pair, which is sensitive personal information, would not need to be shared with the buyer and potentially be used for other purposes without their permission.) Either exclusive access to the account could be sold or temporary access for a certain period of time could be rented out. There could also be 'innocent' transfers between players: any phone numbers that are forfeited will be recirculated and given to another new phone user, who upon entering the game would gain access to an already ID-verified account if that phone number was previously registered with the game by the previous user. The mobile phone company would need to inform video game companies if and when a phone number's possession has been transferred to another user to ensure that the new user does not gain unpermitted access as an ID verified account: this probably is not being done given the amount of work it would take to communicate between all relevant companies.

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

Fifthly, there is potential for users' personal data to be compromised. The video game company has obtained a copy of the information pair and then used that

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

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

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

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

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

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

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

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

Firstly, it is a data privacy concern that game companies are getting a copy of the ID information pairs. To fix this, companies could be asked to use a trusted third-party service instead for the verification process. Rather than directly asking players for a copy of their information pair, the game company could redirect the player to a more secure, industry-standard third party (like *Roblox* has done in the UK [44]). The player only gives their information pair to the third party and not the video game company. The third party verifies the information and sends to the game company only a binary yes/no as to whether the information pair has been correctly verified. Such a system would avoid needing each individual game company to hold copies of players' information pair. As described above, Apple and other app store platforms (such as Huawei) could perhaps perform the role of this third-party authenticator.

Secondly, a major problem with the current Chinese system is that there is no guarantee that the user who provides the information pair is the person to whom the information pair belongs. In addition, it cannot be known whether whoever continues to play with the account is that initially ID-verified person. These two issues likely could only be solved by combining the ID verification process with

concurrent biometric verification that is conducted *regularly* during gameplay. Conducting concurrent biometric verification only once upon initial registration would be insufficient because the active user could still change to another person after the first user passes that verification process.

Tencent has, for example, implemented biometric verification in its games offered to Mainland Chinese players since at least 2018 [45]. This was described as combining 'video verification' with 'comparisons with [data held in] the authoritative public security data platform' [45]. This suggests that certain biometric data are being collected and then sent to a centralised system to see whether there is a match between the person attempting to pass facial recognition and the data already held by the company on the person whose ID it is. This is unlike other biometric verification systems that do not attempt to match the newly collected data with a database but instead make certain estimations about a person based on the collected data only (likely because there is no public access to such an authoritative database in most other countries).

Tencent [46] then reported: as of June 2021, on average, per day, 5,800,000 accounts triggered the facial recognition system during the login process, and 28,000 accounts triggered it during the payment process. (Presumably, all of these accounts have already been successfully ID-verified as supposedly belonging to an adult, so that further verification was required to check whether the restrictions should continue to be disapplied; the restrictions would have automatically applied to underage users' accounts, which do not need to be verified again.) As to impact, 91.4% of accounts either refused or failed the verification during the login process thus leading to the anti-addiction measures being applied, and 87% of accounts' payment attempts were stopped for the same reasons [46]. Implementing a combined ID and biometric verification system would be costly and possibly impractical in some countries. However, it is capable of identifying more non-compliant individuals and better protecting them from potential harms. For context, the author failed to encounter any such facial recognition checks during his gameplay of Tencent games lasting one hour for each game.

Thirdly, games should seek to have age verification conducted on a game-by-game basis, regardless of the login method (*e.g.*, Apple ID or WeChat account). The

convenience provided by having an account be verified across multiple games from the same company is appreciated, but it also creates certain risks (described above) that should be avoided. The process is not cumbersome for most users even if it is required upon the initial startup of every game title.

The available evidence suggests that the only assured way of guaranteeing that the person playing the game is who they claim to be is to conduct both ID verification and biometric verification by comparing data obtained from the player with a centralised database of existing information about the person whose ID is being used. It would also be necessary for the biometric verification to be conducted regularly (*e.g.*, every 15 minutes) to ensure that whosoever successfully passed the initial verification process is indeed the person that has continued to play the game using that account thereafter. Access to that centralised system containing the 'correct' ID and biometric information appears practically difficult for many countries to implement: such a system may not exist or cannot be made available to private companies. Regular biometric verifications are also extremely intrusive and would significantly negatively affect the gameplay experience. It is necessary for Chinese companies (namely, Tencent and possibly some of the other major companies, because the smaller companies are unlikely to have access to the required technology) to conduct such rigorous age and ID verification because Chinese law so requires.

In a country where the law does not require this to be done so robustly, stakeholders should consider deeming less intrusive age verification processes to be sufficiently robust: *e.g.*, biometric age estimation upon initial registration (a video of the user's face is examined by an algorithm to estimate the person's age without needing to verify their exact identity). For players whose age are very close to the limit (*e.g.*, just around 18), and only for those players, perhaps an ID verification could then be sought. It would then be wise to use behavioural monitoring to potentially flag accounts that are acting contrary to their age verification information and subject them to further scrutiny. Such a nuanced approach would support other principles of data protection and privacy, such as data minimisation and fairness [47].

4.7 Limitations

The present study examined the video games only at specific points in time, meaning that they could have changed since then. We did observe, for example, one game displaying a CADPA 17 age rating but then changing this to a CADPA 16 age rating soon thereafter. The results might have been different if data collection took place at a different time. The analysis is also limited to what could have been observed within one hour of gameplay within each game. It is plausible that biometric age verification procedures would have been triggered if the games were played for longer and during hours when children are not expected to play (*e.g.*, in the early morning after midnight) or if in-game purchases were attempted.

5. Conclusion

Mainland China strictly requires online video games to conduct age and ID verification to enforce limits on how much time and money under-18s can spend. Nearly all popular video games conducted ID (and, by implication, age) verification on user accounts prior to providing any online video game services as required by Chinese regulations. However, importantly, 5% of games culpably provided services *without* conducting mandatory ID verification. It is highly concerning that a number of the most popular games in the country were in clear breach of the law intended to protect young people from video game-related harms (*i.e.*, both the 2019 and 2021 Notices). Further, the current, supposedly state-of-the-art method of merely asking users to provide a pair of information (their legal name and national ID number) to conduct ID verification needs to be improved upon before the process can be deemed as effective age assurance. The information pairs of other people who are adults can be easily used by children to circumvent any protective measures intended to be implemented against under-18s, and a non-insignificant number of children have reported doing so [22]. Additional, regularly conducted biometric verification following ID verification has already been implemented in some games by, *e.g.*, Tencent, and other companies should consider following suit to ensure true compliance with both the letter and the spirit of the law.

Two age rating systems are in place in Mainland China simultaneously. Many Apple age ratings should be increased to align with the game's more culturally aware, national CADPA age rating. Certain games were misleadingly advertised as suitable for young children on the Apple App Store by displaying a very low Apple age rating (*e.g.*, suitable for those aged 4+) but in fact received a much higher CADPA

age rating (suitable only for those aged 16+). Sometimes young people were prohibited from playing games whose Apple age rating suggests that they are allowed to play them because the game company enforces a higher age limit than is advertised. Both age rating systems should additionally adopt an 18+ age rating to signify that certain games are not suitable for minors at all and only suitable for adults. Certain games displayed an Apple 17+ and/or CADPA 16+ age rating only to forbid all under-18s from playing the game once it has been downloaded and following age and ID verification: this was misleading advertising caused arguably by the lack of an appropriate 18+ rating that companies could display under both systems. Having two age rating systems providing conflicting information is also potentially confusing to parents and players, thus it should be considered for the CADPA age rating system to wholly replace the Apple age rating system and be the exclusively age rating system used in Mainland China.

Mainland China has taken first steps towards regulating video games. The implementation difficulties that have been encountered should be taken as lessons that other countries considering regulating the industry should learn from to ensure that future video game regulation are effective at achieving policymakers' aims.

Data Availability Statement

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

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