Psychology of Addictive Behaviors

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Online First Publication, November 10, 2022. https://dx.doi.org/10.1037/adb0000885

AMERICAN PSYCHOLOGICAL ASSOCIATION

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ISSN: 0893-164X

https://doi.org/10.1037/adb0000885

Safer Gambling and Consumer Protection Failings Among 40 Frequently Visited Cryptocurrency-Based Online Gambling Operators

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Objective: Online gambling has increased the accessibility and range of gambling products available to people all over the world. This trend has been particularly noticeable in the United Kingdom. Cryptocurrency-based gambling is a new, largely unregulated, way to gamble online, which uses mostly anonymous blockchain-based technologies, such as Bitcoin. The present research investigated consumer protection features of 40 frequently visited and U.K.-accessible cryptocurrency-based online gambling operators. ***Method:*** A content analysis was performed by visiting all 40 cryptocurrency-based online operators and recording their safer gambling and consumer protection practices. Coded features included aspects of the sign-up process, features of any safer gambling pages, customer support practices, and Identity verification. ***Results:*** Results revealed significant failings in the account registration process; none of the operators verified the identity of new users, and 35% required only an email or no personal information for sign-up. Overall, 37.5% of operators offered no safer gambling tools and a further 20% offered only one. Additionally, 64.7% of operators continued to email promotional material after being informed of a user's impaired control when gambling. Less than half of the analyzed operators held a valid license (47.5%), and none of the operators with an available deposit page required identity verification before enabling deposits. ***Conclusions:*** These results highlight the potential risks for young and vulnerable individuals, especially when a lack of identity verification is paired with the inherent anonymity of cryptocurrencies. Furthermore, it emphasizes the need for greater policy and research attention toward cryptocurrency-based online gambling.

Public Health Significance Statement
Cryptocurrency-based gambling is a fast-growing gambling format, and top operators are heavily investing in consumer reach through sports advertisements. However, information on the safer gambling and consumer protection practices of frequently visited operators is nonexistent. The findings in this study showed significant failings in consumer protection and safer gambling practices, which suggest an increased risk of gambling-related harm in cryptocurrency-based gambling.

Keywords: crypto gambling, online betting, safer gambling, responsible gambling, regulation

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Steve Sharman is currently funded by the Society for the Study of Addiction as a Griffith Edwards Academic Fellow, at the University of East London. He is also funded by the National Addiction Centre, part of the NIHR Biomedical Research Centre for Mental Health, which is based at the Institute of Psychiatry, Psychology, and Neuroscience. In the last 3 years, Steve Sharman has also contributed to projects funded by the National Institute for Health and Care Research (NIHR) Research for Patient Benefit (RfPB) program and The Howard League. Maira Andrade has no conflicts of interest to declare.

Maira Andrade played lead role in data curation, formal analysis and writing of original draft and equal role in writing of review and editing. Steve Sharman played equal role in conceptualization and writing of review and editing. Leon Y. Xiao played supporting role in data curation and equal role in writing of review and editing. Philip W. S. Newall played equal role in conceptualization and writing of review and editing.

Materials, data, and the preregistration document are available from: https://osf.io/nwxtq.

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Online gambling has grown significantly in the United Kingdom over the last two decades, due to a combination of a permissive regulatory regime and a significant rate of technological innovation (Cassidy, 2020; Davies, 2022; Orford, 2019). By comparison, the range of legal online gambling products has been more restricted in otherwise similar countries such as the United States (Van der Maas et al., 2022) and Australia (Gainsbury et al., 2012, Hing et al., 2022). However, a range of Canadian and U.S. states are introducing new regulated online gambling markets, bringing them into closer alignment with the current U.K. model (Bevington, 2022a, 2022b). The latest official figures show that 24% of adults in Great Britain (the United Kingdom excluding Northern Ireland) have gambled online during the last 4 weeks, a 6% increase since 2016 (Gambling Commission, 2021). The U.K. public's losses on online gambling also reached £6.9 billion between April 2020 and March 2021, an 18.4% increase from the same period in 2019/2020 (Gambling Commission, 2020b; Gambling Commission, 2021). This makes the United Kingdom the world's largest regulated market for online gambling, which was worth U.S.$58.9 billion globally in 2019 (Gainsbury et al., 2020a). Online gambling can have consequences for gambling-related harm (Muggleton et al., 2021), as it is always available and provides access to many gambling opportunities (Gainsbury et al., 2013; 2020b; Wardle et al., 2011). A meta-analysis of global prevalence studies found that gambling online was the strongest risk factor for disordered gambling[1] (Allami et al., 2021). These factors explain why U.K. regulators are increasingly seeking policies to make online gambling safer (Department for Digital, Culture, Media & Sport [DCMS], 2020; Gambling Commission, 2019; Select Committee on the Social & Economic Impact of the Gambling Industry, 2020).

Online gambling is regulated to maintain a certain level of safety for its users. In the United Kingdom, the Gambling Commission, which is the national gambling regulator, enforces a range of licensing conditions for operators, including the prevention of underage gambling, customer identity verification, and the provision of safer gambling information and help for people looking to moderate their gambling (Gambling Commission, 2020a). The Gambling Commission imposes stiff fines on operators acting in breach of its licensing conditions, with for example, over £10 m in fines handed out in March 2022 alone (Gambling Commission, 2022a, 2022b). Operators can also go beyond this minimum set of standards and use additional online resources to further enhance the safety of online gambling. Examples include self-exclusion options, reality checks, time-outs, and limits on deposits, losses, and sessions (Bonello & Griffiths, 2017; Heirene et al., 2021). However, other developments in online gambling can be disruptive and introduce new challenges with respect to keeping gamblers safe. Some recent discussions have focused on "black market" operators, who accept customers from a jurisdiction without being duly licensed to operate there (Wardle et al., 2021). The present research focuses on another technological innovation which might present a unique set of regulatory challenges for online gambling: cryptocurrency (colloquially known as "crypto").

Cryptocurrency is a broad term referring to a range of decentralized electronic currencies and stores of value. "Bitcoin" is the first cryptocurrency, and allowed, for the first time, two parties to transfer some value of bitcoin among themselves anonymously and reliably, without either party needing to know the other's actual identity. This is achieved via a distributed peer-to-peer network which records transactions via a shared "blockchain." Bitcoin was released in 2009, and within 2 years over U.S.$300,000 in Bitcoin was being traded everyday (Grinberg, 2012). From 2011, other newer cryptocurrency "coins," termed Altcoins, were released and achieved varying degrees of success; some were based on the same algorithm as Bitcoin, while others (e.g., Litecoin) promised more advantages, such as speed and more anonymity (Yadav et al., 2022). Currently, cryptocurrencies are traded on exchanges as speculative assets; to pay for products and services; and to gamble (Delfabbro, King, & Williams, 2021; Scholten et al., 2020). In the United Kingdom, 4.4% of adults currently hold cryptocurrencies, up from 3.9% in 2020 (Financial Conduct Authority, 2021a). Perhaps because of their anonymity, cryptocurrencies are also associated with frauds and criminal activity, and cryptocurrencies have become the most used payment method in "dark web" activities involving illicit drugs, ransomware, and cyberattacks (Ahvanooey et al., 2021).

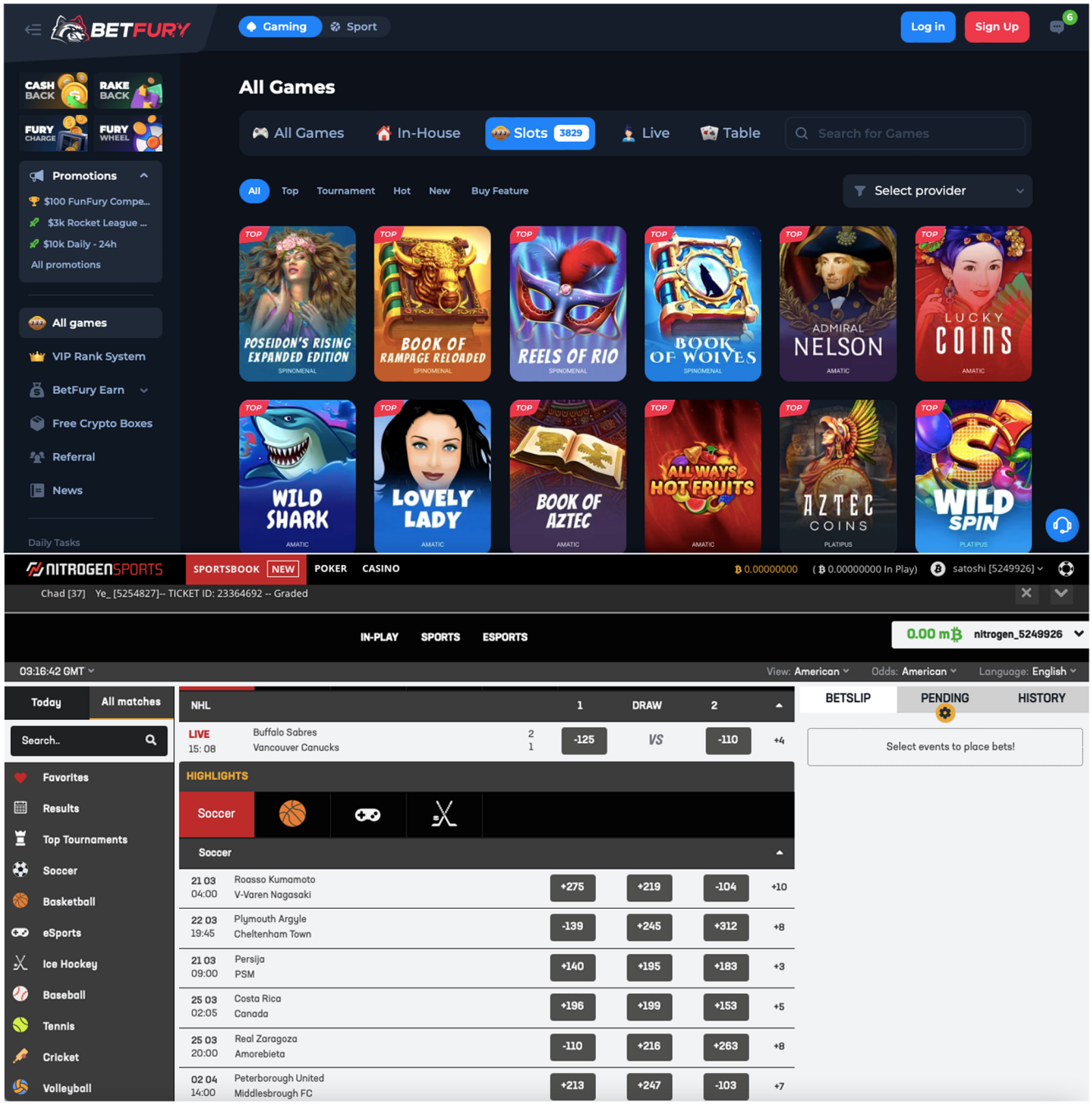
A second issue with cryptocurrencies is the extreme volatility of their prices. While the overall trend of increasing prices has benefited early cryptocurrency investors, these increases in value can also attract new investors who face a fundamentally different risk/return trade off. Bitcoin is risky for new investors since it has crashed several times since 2011; in April 2021, a drop brought its value from U.S.$63,500 to U.S.$37,000 in just over a month (https://coinmarketcap.com). Prices can change rapidly simply because of celebrity endorsements or the popularity of the cryptocurrency on social media forums, such as Reddit or Twitter (Delfabbro, King, & Williams, 2021). The U.K.'s financial regulator, the Financial Conduct Authority (FCA), found that the top reason U.K. investors gave for investing in cryptocurrency (38%) was "as a gamble to make or lose money"; 29% of respondents said they checked their values daily, up from 13% in 2020 (Financial Conduct Authority, 2021a). Mills and Nower (2019) found that greater cryptocurrency trading frequency was strongly associated with high-risk stock trading, a preference for gambling online, and a greater severity of disordered gambling among U.S. adults. Similarly, Delfabbro, King, Williams, and Georgiou (2021), showed that rates of disordered gambling symptomology and engagement in gambling could predict the frequency of cryptocurrency trading. The volatility of cryptocurrencies means that cryptocurrency-based gambling involves risks on two distinct levels: any wins and losses from gambling can be magnified by the intrinsic volatility of the underlying cryptocurrency.

The fast growth of cryptocurrency-based gambling means that research on this topic is limited. In only a few years, the sector started from a largely theoretical possibility (Gainsbury & Blaszczynski, 2017), before producing a limited number of stylized games for a limited number of tech-savvy gamblers (Scholten et al., 2020, 2019). Today, the latest generation of sophisticated cryptocurrency-based gambling operators can offer almost as wide a range of gambling opportunities as can be found via more established forms of online gambling (Figure 1 shows example screenshots of

[1] Terminology in gambling research is frequently changing (Blaszczynski et al., 2020). In the present work, we use the term "disordered gambling" to be largely synonymous with what has previously been called "problem gambling." The term "safer gambling" is also used as an updated version of "responsible gambling," albeit one which places more emphasis on the gambling operator to prevent gambling-related harm than what was commonly meant by the term responsible gambling.

Figure 1

Example Screenshots of Operators



Note. VPN = virtual private network. Top panel: A "VPN not required" website provided casino gambling options. Copyright 2022 by betfury.io. Reprinted with permission. Bottom panel: A "VPN required" website provided sports betting options. Copyright 2022 by nitrogensports.eu. Reprinted with permission. See the online article for the color version of this figure.

cryptocurrency-based gambling operators). Cryptocurrency-based gambling is marketed toward a wide range of consumers: Two cryptocurrency-based operators were the main sponsors of soccer teams in the 2021/2022 season of the English Premier League, one of the world's most watched sporting leagues (Newall & Xiao, 2021). This mirrors the tactics of other online gambling companies, who also market themselves heavily via professional sports (Newall et al., 2019). However, these two cryptocurrency-based gambling operators do not allow users from the United Kingdom to make bets in cryptocurrency, as the Gambling Commission's standards around identity verification have so far precluded any cryptocurrency-based operators from obtaining a U.K. license (Infolaw, 2021). Instead, it

has been suggested that cryptocurrency-based gambling operators may instead be seeking out the exposure from professional sport to market themselves to other black markets, such as China (D'Urso, 2021), where cryptocurrency can be used to evade tight restrictions placed on gambling. However, it is possible to circumvent technological blocks on cryptocurrency-based gambling, including these blocks on U.K. customers, via widely used virtual private network (VPN) services, and the inherent anonymity of cryptocurrencies places an intrinsic limitation on government authorities' ability to limit this activity.

Cryptocurrency-based gambling might also offer some unique advantages for consumers. For example, a significant majority of online gamblers distrust the fairness of online gambling games (Gainsbury et al., 2013; Wood & Williams, 2009). This is despite the U.K. Gambling Commission, for example, requiring the testing and verification of random outcomes as a part of its licensing process. However, consumer mistrust in the fairness of outcomes could be enhanced in cryptocurrency-based gambling: The sharing of data via peer-to-peer networks can produce a feature known as "provably fair" (Chatterjee et al., 2019), by which third parties could, for example, determine that a cryptocurrency-based online roulette wheel produces outcomes equal to a fair, real-world counterpart, based on a large statistical sample. Therefore, the implementation of a verifiable provably fair system could significantly increase customers' trust in online gambling, compared to conventional online gambling (Gainsbury & Blaszczynski, 2017).

Cryptocurrency-based gambling could become the intersection where all of the challenges posed by online gambling and cryptocurrencies collide. The lack of regulation and anonymity of cryptocurrency make this activity more complex and potentially more risky than traditional online gambling. Furthermore, cryptocurrency gambling websites might not offer the same level of consumer protection and safer gambling features as have previously been documented among conventional regulated online operators (Auer et al., 2020; Bonello & Griffiths, 2017; Catania & Griffiths, 2021; Cooney et al., 2021; Heirene et al., 2021). However, little is known about the practices of the latest generation of sophisticated cryptocurrency-based online gambling operators. The present study, therefore, assessed the safer gambling and consumer protection practices of 40 cryptocurrency-based gambling operators. The study builds on the methodology of previous studies looking at similar features of traditional online gambling operators (Bonello & Griffiths, 2017; Catania & Griffiths, 2021; Cooney et al., 2021), whilst also investigating novel consumer protection features of cryptocurrency-based gambling operators.

Method

Ethics

As this study did not involve human participants, ethical clearance was not required. However, the study protocol was assessed by the King's College London Research Ethics and Governance team and was deemed safe and ethically compliant. The research protocol was also assessed against the King's College London Security Sensitive Research Registration process and deemed to not require any additional security protocols.

Open Science Practices

The present study was preregistered and study materials relevant to assessing the reliability of this study are publicly available at Andrade et al. (2022). This link contains the preregistration, underlying data, codebook, results of the dual-coding process, and screen recordings of all the sites visited. Further information as to how the sample was compiled is also available therein. The present study was purely descriptive, meaning that no inferential statistics were planned as part of the preregistration. The preregistration did prevent us from being able to engage in other potential data-dependent "questionable research practices," however (John et al., 2012), as the preregistration, which was created before data collection, set out procedures for sample size and composition.

Sample Selection

As of March 2022, there are 497 gambling websites, in English, accepting Bitcoin globally, and 237 of these operators claim to be accessible from the United Kingdom (https://casinocity.com). An assessment of all of these sites was beyond the practical scope of the present study. The following procedures were used to produce a subsample of 40 popular gambling operators dealing frequently in cryptocurrencies. A preliminary list of 96 cryptocurrency-based gambling operators was created by a research team member between November 8, 2021, and November 18, 2021. The selection of online operators was carried out via Google and Yahoo search engines, using the keywords "crypto gambling," "crypto casino," "crypto betting," "bitcoin casinos," "crypto sports betting," "crypto poker," and "casinos that accept cryptocurrency." These keywords were chosen using search volume analysis via https://semrush.com. Search engines provided a low number of direct results, but a high number of third-party websites offering reviews of popular cryptocurrency-based gambling operators, which were then used to compile the list. To confirm that this lack of direct results was not caused by personalized search results, searches were conducted using different methods, such as using a private browser (i.e., incognito) and a VPN service with different IP addresses.

The 40 most visited websites according to https://semrush.com, with an average visit time above 9 min, were selected for coding. Websites with average visit times below 9 min were not selected to form the sample, as traffic data revealed that websites with very high levels of referred visits had an average visit of 1–2 min, while truly popular websites, with high direct visits and likely a higher volume of gambling activity, had an average visit of 9 min and above. Overall, 22 of the websites in the sample were directly accessible from the United Kingdom. Another 18 required a VPN in order to appear to be from another country and access the site.

Dual-Coding Reliability Checks

To check for intercoder reliability, 4 "VPN required" and 4 "VPN not required" websites were randomly selected for dual coding. The first coder created a screen recording of their visit used to record their data, and this recording was used by the second coder to independently fill out the codebook. This is similar to the dual-coding practices used in recent studies of probability disclosures for loot boxes in mobile video games (Xiao et al., 2021, Xiao et al., 2022). This method was used to prevent disagreements based on the

collection of differing data, for example, if the two coders interacted with different customer service representatives. Percentage agreement was used to calculate interrater reliability with a preregistered acceptable threshold of 75% for each variable, which is slightly higher than the 70% agreement threshold which has been previously suggested by methodologists (Stemler & Tsai, 2008). Percentage agreement varied from 100% to 75% across each variable, which indicated a satisfactory level of agreement, meaning that the first coder then proceeded to code the remainder of the sample. Further details on how this level of agreement was determined are available via the data deposit link above.

Coded Features

Two groups of features were coded from each site, as detailed in Table 1, which also includes details of all minor deviations from the preregistration document which was created prior to data collection. First, a list of 7 "safer gambling practices" was adapted from previous investigations of the harm reduction measures contained on traditional online gambling sites (Bonello & Griffiths, 2017; Cooney et al., 2021). These seven features included details of the: account registration process, availability of safer gambling information, the extent to which promotional material was present on any dedicated safer gambling pages, the availability of safer gambling tools such as deposit limits, the accessibility of account gambling history, the extent to which safer gambling information was sent via email, and operators' responses to a user who requested help with controlling their gambling. Second, three features uniquely relevant to cryptocurrency-based gambling were developed by the authors and grouped under the term "cryptocurrency-based consumer protection." These three features included details of: any licensing information provided, whether proof of identity was required before a deposit was facilitated, and information provided about the fairness of gambling outcomes.

Results

This study was preregistered to present the results only descriptively, and patterns are shown for the overall sample ($N = 40$) and also for the "VPN not required" ($N = 22$) and "VPN required" ($N = 18$) subgroups. Since these subgroups have a rather small number of observations in each, no formal statistical tests are reported to compare them.

Safer Gambling Practices

Table 2 summarizes the findings relating to the account registration process. Thirty-eight of the 40 operators (95.0%) required at least one piece of personal information for registration. However, 12 (30.0%) asked only for an email, and only 15 (37.5%) required name, email, phone number, and address. Overall, 22 (55.0%) operators required a phone number for sign-up. Out of the 40 operators, 33 (82.5%) required the user to either provide a full date of birth, to agree or confirm they were over the age of 18 or 21, or both. Seven websites (17.5%) did not display any age restriction during registration and did not request any age-related information.

None of the operators requested identity documents for age verification to complete the sign-up. In the 21 websites that requested a full date of birth and allowed for a birth year below 18 years old (52.5%), an attempt was made to register as a minor. It was possible to register with the fictitious date of birth (April 19, 2004) of someone who would have then been aged 17 years old on two websites.

Table 3 summarizes each operator's approach toward providing safer gambling information. Overall, 31 online operators (77.5%) had a dedicated safer gambling page, under various names such as "responsible gambling," "gamble aware," "safe play," "fair play," and "self-exclusion." However, many pages contained inappropriate content or were difficult to access. Nine operators (22.5%) included promotional material encouraging further participation in gambling on their safer gambling page, such as free spins and deposit bonuses. Three safer gambling pages (7.5%) were unlinked to the operators' websites. Two of the unlinked pages (5.0%) could only be found via a search engine. One (2.5%) page was linked to a different address; thus, it was not discoverable via a search engine when using the operator's domain; the page was only discovered when a link was provided via email by customer support.

Thirty operators (75%) had a statement of commitment to safer gambling. Twenty-seven operators (72.5%) had their statements in their safer gambling pages only; one (2.5%) had a commitment to safer gambling statement in their "about us" section; two further operators (6.9%) had a commitment statement in the safer gambling page and elsewhere(i.e., deposit and withdrawal page).

Twenty-seven (67.5%) operators offered information about the safer gambling tools they offered. One website (2.5%) had safer gambling tools information located in their self-exclusion section, which could be found via the homepage. Three operators (7.5%) provided the information in their safer gambling page and at another location (e.g., self-exclusion page, cashier, and frequently asked questions [FAQs] page). One operator (2.5%) had information on available safer gambling tools on the safer gambling page, but these tools could not be found on, or accessed through, the website.

Thirty-two (80%) operators had a warning that gambling can be harmful. However, exploratory analyses suggested that most of these messages contained inappropriate themes (a spreadsheet with the text of all 32 warnings can be accessed from Andrade et al., 2022). Twenty-two of the 32 messages in the subsample (68.7%) suggested that gambling is either fun or entertaining (e.g., "[This operator is] a reliable and safe place where you can always have fun and keep yourself entertained. Sometimes, however, playing at a casino, instead of bringing joy into your life, may become quite an unpleasant experience"). Two additional messages (6.3%) went beyond suggesting that gambling is entertaining and also implied that it can be a potential way to make money (e.g., "Gambling is a form of entertainment. Yes, there is a chance of winning vast amounts of money but, if not treated as entertainment only and nothing more, irresponsible gaming can have dire consequences for the player [sic]" and "Playing with [this operator] can be an enjoyable form of entertainment and You might even win some money. But You cannot win every time [sic]."). Overall, therefore, only eight out of the 32 harm warnings messages in the subsample (25%) focused strictly on the potential negative consequences of gambling.

Twenty-nine operators (72.5%) had a warning on their safer gambling page; two operators (5.0%) had a warning on their homepage. One website (2.5%) had a harm warning in their safer gambling page and on their homepage.

Table 1
List and Explanation of Coded Features

Feature	Summary	Deviations from preregistration?
Safer gambling practices		
Account registration process	Extent to which the website required personal information (e.g., email, phone number) and confirmation of age during the initial account registration stage. An attempt to register with the birth date of a minor was also made for websites that requested a date of birth.	No
A dedicated safer gambling page and safer gambling practices	The existence of a safer gambling page was coded as well as specific criteria related to safer gambling (i.e., statement of commitment to safer gambling, information on safer gambling tools, warning that gambling can be harmful, references to gambling help organizations, and/or self-help groups, presence of self-assessment tests, and links to gambling and age filtering software).	No
Promotional gambling material present in the dedicated safer gambling page	Whether any safer gambling page also contained promotional material, such as bonus offers.	No
Availability of safer gambling tools	All websites were analyzed for the presence and accessibility of 10 safer gambling tools. These were: deposit, loss, wager, and session limiting tools and deposit limits on the deposit page, cooling-off periods (breaks lasting less than 6 months), voluntary self-exclusion (breaks lasting more than 6 months, including permanent exclusion), reality checks, educational videos, gambling diaries, and budget calculators.	Also coded the presence of a wagering limit. The definition of voluntary self-exclusion was expanded to include permanent self-exclusion (compared to time-limited self-exclusion).
The presence and easy accessibility of gambling history	Presence and easy accessibility of an account's gambling history.	No
Information or links about safer gambling practices in the communication sent by the operator to those registering to gamble on the website	Extent of safer gambling information received via email, and whether any promotional material was sent at the same time. Safer gambling practices were defined by the criteria in the "dedicated safer gambling page and safer gambling practices" variable (see above), with the addition of age restriction reminders.	No
Safer gambling-oriented customer service	Customer service was contacted via a message highlighting that "I want to control my gambling. Can you give me any information on how I can do that? I feel a bit addicted and sometimes I can't control the money I'm spending." Any responses in the next 72 hr were coded as "suggestions related to safer practices," "actions taken by the operator," "harmful practice," and "other suggestions" (e.g., account access restricted by the operator). Operators that continued to send promotional material after customer service communication were also coded.	Creation of an additional "other suggestions" category. After coding was finished the authors found it important to further explore which operators continued to send promotional emails up to 2 weeks after customer service contact as opposed to only 72 hr after.
Cryptocurrency-based consumer protection		
Licensing of cryptocurrency-based operators	Whether the websites were licensed by any regulator; if validity of licenses could be verified, as well as the country of origin of any license.	No
Proof of identity practices when requesting cryptocurrency deposit links	Whether the operator requested any personal documents prior to deposit of cryptocurrency. The type of currency accepted by the operator for deposit was also coded and included "cryptocurrency only" and "crypto/fiat currency."	No
Generation of random outcomes (provably fair)	Whether the operator claimed a "provably fair" (a blockchain-based random number generator) or third-party system used by noncryptocurrency-based operators (i.e., random number generator "RNG" software) for verification of random outcomes. The availability of a third-party software audit certification was also checked for operators that claimed to utilize RNG software.	No

Table 2
Account Registration Process

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
Information required			
Identity documents for age verification	0 (0.0%)	0 (0.0%)	0 (0.0%)
No personal information	2 (5.0%)	1 (4.5%)	1 (5.6%)
Email only	12 (30.0%)	5 (22.7%)	7 (38.9%)
Name and email	3 (7.5%)	3 (13.6%)	0 (0.0%)
Phone number and email	3 (7.5%)	1 (4.5%)	2 (11.1%)
Address and email	1 (2.5%)	1 (4.5%)	0 (0.0%)
Name, email, and phone number	4 (10.0%)	1 (4.5%)	3 (16.6%)
Name, email, phone number, and address	15 (37.5%)	10 (45.5%)	5 (27.8%)
Age verification and restriction			
Full date of birth	16 (40.0%)	10 (45.5%)	6 (33.3%)
User agreement age confirmation	10 (25.0%)	5 (22.7%)	5 (27.8%)
Full date of birth and user agreement	7 (17.5%)	3 (13.6%)	4 (22.2%)
No age restriction displayed/no age verification	7 (17.5%)	4 (18.2%)	3 (16.7%)
Registration as someone under 18			
Successful	2 (5.0%)	1(4.5%)	1(5.6%)
Unsuccessful	38 (95.0%)	21 (95.5%)	17 (94.4%)

Note. VPN = virtual private network. Some totals may not sum to 100 due to rounding.

Twenty-nine (72.5%) operators referenced a gambling help organization and/or a self-help group. However, this information was not provided in a consistent manner across websites and was rarely found at multiple locations. Six operators (15.0%) made reference to an organization or self-help group on their homepage. Four operators (10.0%) displayed the information on their safer gambling page and other sections of the websites (e.g., FAQs, about us, and homepage).

Fifteen (37.5%) operators made a self-assessment tool available to help users identify potential signs of disordered gambling. One of these 15 operators had a dedicated safer gambling page, but the self-assessment was in the self-exclusion section of their homepage.

Only three (7.5%) operators provided links to gambling filtering software. Twelve operators (30%) provided information for age filtering software, but four of these operators either provided links that did not work or just a name of an age filtering software, without providing a direct link.

Table 4 shows that 25 (62.5%) operators offered at least one safer gambling tool. Only six operators (15%) offered limit setting options, five of these (12.5%) offered only deposit limits, and one (2.5%) offered loss, wager, and session limits. Two of the operators offering deposit limits required a 7-day cooling-off period before the tool could be deactivated or the limits increased; three of the operators provided no information regarding waiting periods, with two of these further informing consumers that lower deposits would incur in lower withdrawing limits as well. The remaining operator offering loss/wager and session limit required a waiting period of 24 hr before the tools could be deactivated or limits increased. Operators more commonly offered cooling-off or time-out periods (17 operators; 42.5%), previously defined as any breaks lasting less than 6 months (Bonello & Griffiths, 2017). However, eight of these 17 operators (47.1%) had to be specifically requested via customer support. One operator offered a 1-day cooling-off period to be activated through the safer gambling page, but any longer periods had to be manually requested via customer support. Sites most commonly offered voluntary self-exclusion (24 operators; 60%), previously defined as any breaks lasting more than 6 months (see Method section), including permanent self-exclusion. However, a majority of these had to be requested via customer support (17 operators; 42.5%). None of the operators offered reality checks, educational videos, gambling diaries, or budget calculators, which are safer gambling tools offered by a number of conventional online gambling operators (Cooney et al., 2021).

Operators performed well on the fifth coded safer gambling feature: the provision of accessible information on gambling history. Only one (2.5%) website was coded as not having made the user's gambling history available. The present study did not attempt to gamble on these websites, therefore whether the gambling histories that would be provided would be accurate and updated immediately have not been verified.

One operator (2.5%) was not relevant for the sixth coded safer gambling feature—the presence of safer gambling information sent via email—as this operator did not request an email upon registration and there was no option to register an email in the account settings. Only five operators sent emails after registration with safer gambling messages (12.8% of the 39 operator subsample). For all of these five operators, promotions (such as free spins) were the primary content of the emails sent, and all safer gambling content could only be found at the bottom of each email. Nonetheless, these emails included links to gambling help organizations, age restriction reminders, links to the operators' safer gambling page, and statement of commitment to safer gambling.

All 40 online operators were contacted with a request for help controlling the user's gambling. All emails sent contained the exact same text: "I want to control my gambling. Can you give me any information on how I can do that? I feel a bit addicted and sometimes I can't control the money I'm spending." Their types of responses are summarized in Table 5. Seventeen (42.5%) operators replied with suggestions related to safer gambling practices. A further 12 (30%) operators took immediate action and informed the user that their account had been permanently deleted. Five (12.5%) operators were coded under harmful practice: four operators did not respond,

Table 3
A Dedicated Safer Gambling Page and Safer Gambling Practices

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
Dedicated safer gambling page			
Linked	28 (70.0%)	14 (63.6%)	14 (77.8%)
Unlinked	3 (7.5%)	2 (9.1%)	1 (5.6%)
Not found	9 (22.5%)	6 (27.3%)	3 (16.6%)
Promotional material in the safer gambling page			
Found	9 (22.5%)	7 (31.8%)	2 (11.1%)
Not found	31(77.5%)	15 (68.2%)	16 (88.9%)
A statement on the operator's commitment to safer gambling			
Found in safer gambling page	27 (67.5%)	14 (63.6%)	13 (72.2%)
Found in another page	1 (2.5%)	1 (4.6%)	0 (0.0%)
Found in more than one location	2 (5.0%)	2 (9.1%)	0 (0.0%)
Not found	10 (25.0%)	5 (22.7%)	5 (27.8%)
Information about safer gambling tools offered by the operator			
Found in safer gambling page	22 (55.0%)	10 (45.5%)	12 (66.7%)
Found in another page	2 (5.0%)	0 (0.0%)	2 (11.1%)
Found in more than one location	3 (7.5%)	2 (9.1%)	1 (5.6%)
Not found	13 (32.5%)	10 (45.5%)	3 (16.6%)
A warning that gambling can be harmful			
Found in safer gambling page	29 (72.5%)	16 (72.7%)	13 (72.2%)
Found in another page	2 (5.0%)	2 (9.1%)	0 (0.0%)
Found in more than one location	1 (2.5%)	0 (0.0%)	1 (5.6%)
Not found	8 (20.0%)	4 (18.2%)	4 (22.2%)
Reference to a disordered gambling help organization and/or self-help groups			
Found in safer gambling page	19 (47.5%)	9 (40.9%)	10 (55.6%)
Found in another page	6 (15.0%)	2 (9.1%)	4 (22.2%)
Found in more than one location	4 (10.0%)	2 (9.1%)	2 (11.1%)
Not found	11 (27.5%)	9 (40.9%)	2 (11.1%)
A self-assessment test			
Found in safer gambling page	14 (35.0%)	7 (31.8%)	7 (38.9%)
Found in another page	1 (2.5%)	0 (0.0%)	1 (5.5%)
Found in more than one location	0 (0.0%)	0 (0.0%)	0 (0.0%)
Not found	25 (62.5%)	15 (68.2%)	10 (55.6%)
Links to gambling filtering software such as GamBlock and/or Betfilter			
Found in safer gambling page	3 (7.5%)	2 (9.1%)	1 (5.6%)
Found in another page	0 (0.0%)	0 (0.0%)	0 (0.0%)
Found in more than one location	0 (0.0%)	0 (0.0%)	0 (0.0%)
Not found	37 (92.5%)	20 (90.9%)	17 (94.4%)
Links to age filtering software			
Found in safer gambling page	11 (27.5%)	4 (18.2%)	7 (38.9%)
Found in another page	1 (2.5%)	1 (4.5%)	0 (0.0%)
Found in more than one location	0 (0.0%)	0 (0.0%)	0 (0.0%)
Not found	28 (70.0%)	17 (77.3%)	11 (61.1%)

Note. Promotional gambling material present in the dedicated safer gambling page. VPN = virtual private network. Some totals may not sum to 100 due to rounding.

and one replied with guidance on how to gamble on the website and access bonus slots. Four (10%) operators replied with other suggestions, including advising the user to talk to a therapist; requesting the user to call the operator as soon as possible, and offering to block credit card payments. Two operators' (5%) responses were not coded, as one asked for further information (without providing any direct help), and one response stated that the user's registered email could not be found in their system.

Table 5 also shows the emailing patterns of operators after this email asking for help to control gambling was sent. Only the 34 operators who emailed promotional material to the registered user at some point were assessed. Overall, only 12 out of these 34 operators (35.3%) ceased sending emails after the user asked for help with controlling their gambling. Nine operators (26.5%) continued to send emails up to 1 week after contact, after which no further communications were received; thirteen operators (38.2%) continued to send emails up to 2 weeks after contact.

Consumer Protection in Cryptocurrency-Based Gambling

Table 6 summarizes findings relevant to the licensing of operators. Overall, 19 operators' licenses (47.5%) were verified. From the subsample of 19 operators where licenses could be verified, most were obtained from Curaçao (17 operators; 89.5%), with one license each being obtained from the Isle of Man (5.3%) and Antigua and Barbuda (5.3%), respectively. For five (12.5%) operators in the overall sample, license validity could not be verified either because the digital certification was invalid or because the operator claimed to be licensed but no certification was provided. Importantly, none

Table 4
Availability of Safer Gambling Tools

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
Number of tools offered by operators			
0	15 (37.5%)	12 (54.5%)	3 (16.6%)
1	8 (20.0%)	3 (13.6%)	5 (27.7%)
2	12 (30.0%)	4 (18.2%)	8 (44.5%)
3	4 (10.0%)	3 (13.6%)	1 (5.6%)
4+	1 (2.5%)	0 (0.0%)	1 (5.6%)
Limit setting tools			
Deposit limits	5 (12.5%)	4 (18.2%)	1 (5.6%)
Loss/wager/session limit	1 (2.5%)	0 (0.0%)	1 (5.6%)
Deposit limit in deposit page	0 (0.0%)	0 (0.0%)	0 (0.0%)
Not found	34 (85.0%)	18 (81.8%)	16 (88.9%)
Cooling-off periods			
Accessible through website	9 (22.5%)	5 (22.7%)	4 (22.2%)
Accessible only through customer service	8 (20.0%)	1 (4.5%)	7 (38.9%)
Not found	23 (57.5%)	16 (72.7%)	7 (38.9%)
Voluntary self-exclusion			
Accessible through website	7 (17.5%)	4 (18.2%)	3 (22.2%)
Accessible only through customer service	17 (42.5%)	6 (27.3%)	11 (61.1%)
Not found	16 (40.0%)	12 (54.5%)	4 (16.7%)
Other tools			
Reality check	0 (0.0%)	0 (0.0%)	0 (0.0%)
Educational videos	0 (0.0%)	0 (0.0%)	0 (0.0%)
Gambling diary	0 (0.0%)	0 (0.0%)	0 (0.0%)
Budget calculator	0 (0.0%)	0 (0.0%)	0 (0.0%)

Note. VPN = virtual private network. Some totals may not sum to 100 due to rounding.

of the U.K.-accessible websites were licensed by the U.K. Gambling Commission.

Table 7 summarizes the other cryptocurrency-based consumer protection findings. It was possible to request a deposit link with 37 operators (92.5%), thereby effectively facilitating a cryptocurrency transaction. All of these 37 operators provided a cryptocurrency deposit link without the need for the user to provide identity documents. Overall, 14 operators (35%) only accepted cryptocurrency for gambling, and 26 operators (65%) accepted both cryptocurrency and fiat currency. Provision of provably fair information was only relevant for 39 operators, as one operator provided only sports and esports betting, which do not require random outcome generation. Overall, only 12 of these 39 operators (22.5%) displayed provably fair information, while 19 operators (48.7%) provided random number generator fairness information, which is the traditional way for the fairness of online gambling outcomes to be ensured (three of these operators provided both types of information). Eleven websites (27.5%) provided no information on the generation of random outcome systems used.

Discussion

The growth of online gambling has produced an ever-increasing range of always-available gambling opportunities (Cassidy, 2020; Davies, 2022; Orford, 2019). The present study contributed to a better understanding of cryptocurrency-based gambling by exploring the consumer protection features of 40 of the most frequently visited cryptocurrency-based gambling operators. The study found that no operator required identity verification for user registration and that all but three operators then effectively facilitated

Table 5
Safer Gambling-Oriented Customer Service

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
Replies to customer service contact			
Suggestions related to safer gambling practices	17 (42.5%)	9 (40.9%)	8 (44.4%)
Action taken by the operator	12 (30.0%)	6 (27.3%)	6 (33.3%)
Harmful practice	5 (12.5%)	4 (18.2%)	1 (5.6%)
Other suggestions	4 (10.0%)	3 (13.6%)	1 (5.6%)
Not coded	2 (5.0%)	0 (0.0%)	2 (11.1%)
Promotional material sent after contact	($n = 34$)	($n = 19$)	($n = 15$)
Continued to send emails up to 1 week after contact	9 (26.5%)	5 (26.3%)	4 (26.6%)
Continued to send emails up to 2 weeks after contact	13 (38.2%)	7 (36.8%)	6 (40.0%)
Emails stopped after contact	12 (35.3%)	7 (36.8%)	5 (33.4%)

Note. VPN = virtual private network. Some totals may not sum to 100 due to rounding.

Table 6
Licensing of Operators

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
License—validity			
License validity verified	19 (47.5%)	7 (31.8%)	12 (66.6%)
License validity could not be verified	5 (12.5%)	3 (13.6%)	1 (5.6%)
Not found	16 (40.0%)	12 (54.5%)	5 (27.8%)
License—jurisdiction	($n = 19$)	($n = 7$)	($n = 12$)
Curaçao	17 (89.4%)	7 (100%)	10 (83.4%)
Isle of Man	1 (5.3%)	0 (0.0%)	1 (8.3%)
Antigua and Barbuda	1 (5.3%)	0 (0.0%)	1 (8.3%)

Note. VPN = virtual private network. Some totals may not sum to 100 due to rounding.

a cryptocurrency-based deposit without any further verification of the user's real-world identity. Dedicated safer gambling pages contained gambling promotions on nine (22.5%) sites, could not be found for a further nine sites (22.5%), and were unlinked to the main website for three operators (7.5%), making them only discoverable via search engines or via a link provided by the operator. Although warnings about the potential harmfulness of gambling were found for 32 sites (80%), exploratory analyses indicated that only eight of these messages did not contain material suggesting that gambling is fun or a potential way to make money. Twenty-three operators (57.5%) offered no more than one safer gambling tool, and twenty-two (55%) operators continued to email gambling promotions after customer service had been contacted about the user needing help with gambling. Only 12 operators (30%) promoted the use of provably fair, a blockchain-based solution to verify the randomness of gambling outcomes (Chatterjee et al., 2019). Overall, these results suggest a number of failings with respect to safer gambling and consumer protection among the 40 operators in this sample.

The sample can be split into those that did not require a VPN for access in the United Kingdom ($n = 22$) and those that required a U.K.-based user to use a VPN to sign-up ($n = 18$). No statistical tests were preregistered to compare these groups due to the small number of operators in each subgroup. However, some differences will be highlighted here in a descriptive and exploratory manner. While the majority of "VPN required" operators provided information on available safer gambling tools (83.3%), just over half of the operators that did not require a VPN offered this information (54.5%). Furthermore, 83.3% of "VPN required" operators had at least one safer gambling tool available, compared to 45.5% of "VPN not required" operators. Additionally, 61.1% of VPN required operators offered cooling-off periods, compared to 27.3% of operators that did not require a VPN. Last, 66.6% of "VPN required" operators held valid licenses, compared to 31.8% of "VPN not required" operators. These patterns suggest that operators that did not require a VPN, and which are easier for U.K.-based gamblers to access, might provide the weakest levels of consumer protection. These patterns should be further investigated in a confirmatory manner in a piece of follow-up research.

The present results can be compared with previous investigations of the consumer protection features in conventional, noncryptocurrency-based online gambling (Bonello & Griffiths, 2017; Cooney et al., 2021; Catania & Griffiths, 2021). It must be highlighted that the data of prior studies differ in fundamental ways from the present results: The conventional operators investigated previously might have improved their practices since, and the methodology of these previous studies could not always be followed precisely since they did not provide open access to their coding materials. Fifteen percent of cryptocurrency-based operators offered limit setting tools in the present study (i.e., deposit, loss, wager, and session limits), compared to previous estimates of over 85% of conventional online operators (Bonello & Griffiths, 2017; Catania & Griffiths, 2021;

Table 7
Proof of Identity Practices When Requesting Cryptocurrency Deposit Links and Generation of Random Outcomes

Features	All websites ($N = 40$)	VPN not required ($n = 22$)	VPN required ($n = 18$)
Proof of identity request for cryptocurrency deposit links			
No proof of identity requested before deposit	37 (92.5%)	20 (90.9%)	17 (94.4%)
Deposit page was not accessible	3 (7.5%)	2 (9.1%)	1 (5.6%)
Accepted currencies			
Cryptocurrency only	14 (35.0%)	7 (31.8%)	7 (38.9%)
Cryptocurrency and fiat currency	26 (65.0%)	15 (68.2%)	11 (61.1%)
Generation of random outcomes (provably fair)			
Provably fair only	9 (22.5%)	4 (18.2%)	5 (27.8%)
Provably fair and RNG software	3 (7.5%)	3 (13.6%)	0 (0.0%)
RNG software only	16 (40.0%)	9 (40.9%)	7 (38.8%)
No information found	11 (27.5%)	6 (27.3%)	5 (27.8%)
Not relevant	1 (2.5%)	0 (0.0%)	1 (5.6%)

Note. RNG = random number generator; VPN = virtual private network. Some totals may not sum to 100 due to rounding.

Cooney et al., 2021). Sixty percent of cryptocurrency-based gambling websites offered voluntary self-exclusion, compared to rates of over 90% among conventional operators (Catania & Griffiths, 2021; Cooney et al., 2021). Additionally, in Cooney et al. (2021) and Catania and Griffiths (2021), many conventional operators offered reality checks as a gambling management tool (51.3% and 30%, respectively), compared to none of the cryptocurrency-based operators surveyed here. Finally, 64.7% of cryptocurrency-based operators continued to email gambling promotions after customer support had been asked to help the user to control their gambling, compared to previously observed rates of 26% (Bonello & Griffiths, 2017) and 14% (Catania & Griffiths, 2021). In terms of the content of warnings about the harmfulness of gambling, the word "fun" has also been observed in warnings from conventional operators (e.g., "when the fun stops, stop"; Newall et al., 2022; van Schalkwyk et al., 2021). However, no gambling warnings that we are aware of from conventional operators have implied that gambling can be profitable.

Several limitations can be identified in the present study. The sample size was limited to 40 operators, and this represents less than 10% of the current number of operators. Sample selection was based on available metrics of popularity, but actual data on gambling spend from gambling operators would provide a more accurate measure of actual use and popularity. Furthermore, the cryptocurrency-based gambling market is rapidly changing, so this sample only provides a snapshot in time. Future studies should, therefore, revisit this issue over time. The present study followed open science principles, by publishing the underlying data and study materials, to allow future studies to replicate the current methodology or improve upon it. Indeed, future studies should consider executing cryptocurrency-based deposits with operators, in order to investigate potential identity verification procedures based around withdrawals (rather than only deposits, as was done by the present study). Additionally, future studies that are able to carry out cryptocurrency-based deposits can further explore possible issues with accounts being blocked or deleted without notice (as happened in the present study with some operators), even if the customer still potentially has money in their account. Any content analysis study such as this raises the possibility of coder error: The present study aimed to enhance confidence in its findings via the use of a dual-coded subsample and by making the underlying videos openly available. Future work should also attempt to collect data directly from users of cryptocurrency-based gambling operators, to better understand common motivations for using them (e.g., to gamble online illegally, or whether gamblers simply prefer them to available legal alternatives). Screenshots of social media discussion of cryptocurrency-based gambling are provided in the supplementary information folder of Andrade et al. (2022); these suggest that the lack of identity verification and ability to evade self-exclusion blocks could be key motivations to engage in cryptocurrency-based gambling. Further, previous research suggests that people might be more willing to take risk when gambling online than in land-based venues (Hing et al., 2015, Siemens & Kopp, 2011). It may be that cryptocurrency promotes even greater levels of risk taking, either due to its added layer of abstraction from physical money or due to the intrinsic volatility of cryptocurrency. How cryptocurrency-based gambling differs from traditional gambling is an important topic for future research.

The present results provide insights to the current policy debate around safer online gambling, with much attention focused on regulated operators (DCMS, 2020; Gambling Commission, 2019; Select Committee on the Social & Economic Impact of the Gambling Industry, 2020). Spokespeople for the U.K. gambling industry have raised concerns around "black market" operators, who take bets in conventional fiat currency, but without being licensed in a given jurisdiction (Wardle et al., 2021). The present results suggest that cryptocurrency-based gambling operators should also be closely monitored, as another potential driver of harm. With conventional black-market operators, regulators can at least attempt to block gamblers' payments (Rose, 2011). However, the fundamental anonymity of cryptocurrency payments and the potential for gamblers to circumvent regional internet blocks via VPNs means that all jurisdictions might struggle even more to restrict access to cryptocurrency-based gambling. It is critical to emphasize that, during this investigation, all interactions with the cryptocurrency-based online operators, starting at the account registration, involved completely fictitious personal information. The complete lack of identity verification up to the point of requesting crypto-wallet links for deposits is of particular significance. In traditional online gambling, including the black market, some level of information is accessible to the operator because of traditional payment methods (e.g., credit cards or bank accounts). In cryptocurrency-based gambling, however, there is an added layer of anonymity with decentralized payment formats, which protect and encrypts all personal information; this can potentially increase the risks of gambling-related harm to young people and individuals at risk. A regulatory approach built on the precautionary principle could therefore aim to act preemptively, by for example, preventing cryptocurrency-based gambling operators from marketing themselves via professional sports (Newall & Xiao, 2021).

Conclusion

The present research highlights a broad range of limitations with respect to the consumer protection features of 40 frequently visited cryptocurrency-based gambling operators. Given that cryptocurrency-based gambling is presently effectively unregulated in many countries, policymakers with an interest in making online gambling safer should be made aware of these findings. The present results also highlight a range of further issues that should be investigated in future research.

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Received June 14, 2022
Revision received September 8, 2022
Accepted September 23, 2022 ■