The impact of cash-out availability on online betting behavior
Stage 1 Registered Report

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Abstract

The rise of online sports betting, facilitated by technological innovations such as the cash-out feature, has transformed the gambling landscape. While cash-outs have been suggested to intensify problematic gambling behaviors, empirical studies to date have been correlational, leaving a gap in determining causal evidence. In the present Registered Report, the proposed study will investigate the direct impact of the perceived availability of the cash-out feature on various facets of gambling behavior in an online experiment. Hungarian residents with online gambling history will be informed that they will have the chance to gamble with real money on sports events. Following random allocation, half of the participants will be told that they will have the option to cash out their bets before the outcome of the sports event is known, while the other half will not. The study will compare the proportion of participants placing bets, bet sizes, and bet risks between the two groups. Furthermore, the study will explore the differential effects of the cash-out feature on specific high-risk subgroups. The findings are likely to have significant implications for the design of online betting platforms, contribute to regulatory frameworks, and inform the design of interventions aimed at minimizing gambling-related harm.

Keywords: sports betting, cash-out, online experiment, risky gambling, problem gambling, gambling disorder

Introduction

Online sports betting has significantly increased in recent decades, reaching 19 million players in the US alone in 2022 (Lebow, 2022). This popularity can be partly attributed to the introduction of cash-outs, which allow gamblers to close a bet early before the final outcome of a sports event is known. While cash-outs provide bettors with an additional decision point during gambling, their impact on betting behavior remains unclear. Much of prior research has focused on in-play betting more broadly, highlighting its association with a greater risk of harm (Hing et al., 2016, 2017; Killick & Griffiths, 2019). For example, a British gambling prevalence study (Gambling Commission, 2018) reported that the proportion of gamblers classified as problem gamblers was much higher among those who bet in-play compared to online gamblers who do not (27.4% vs. 5.4%). However, in-play betting is a broader concept than cash-outs because it refers to bettors' ability to place, adjust, or close bets while a match is ongoing. Prior studies have not isolated the specific role of cash-outs in gambling behavior and were based on correlational designs. The present study aims to bridge this gap by conducting an online experiment. The study will investigate several dimensions of betting behavior, including the proportion of participants placing bets, bet sizes, and bet risks, both in the presence and the absence of cash-out options. Importantly, the study will also examine the differential effects on specific high-risk subgroups.

Ever since the British gambling operator *William Hill* first introduced cash-outs in 2012 (Gaming Intelligence, 2014), they have become a common feature on online sports betting sites (Killick & Griffiths, 2019; Lopez-Gonzalez & Griffiths, 2016). The increased penetration of smartphones and the 'always-on' culture have significantly facilitated this trend, increasing the availability of gambling, which has important implications for bettors' decision-making (Lopez-Gonzalez et al., 2019; Lopez-Gonzalez & Griffiths, 2017). There are different forms of cash-out, including full cash-out, partial cash-out (only part of the bet is cashed out), and automatic cash-out (if at any point during an event, the cash-out value matches a preset amount, the bet is automatically cashed out). Similar to other bets, the amount offered for the cash-out is calculated by the gambling provider based on several factors, including the odds and amount of the original bet, as well as how the given event is progressing. For example, if the home team scores a goal in a football match, their odds of winning increase, resulting in an increased cash-out offer to players compared to before the goal was scored. The mere availability of cash-outs for sports events can have important implications even if nobody cashes out their bet, because it can influence key decisions during gambling. For instance, it could impact how many individuals bet, how much money they wager, and the level of risk in their betting.

One key cognitive heuristic by which cash-outs influence gambling behaviors is the illusion of control (Langer, 1975) it creates. By offering the option to close bets early, cash-outs can – falsely – increase the perceived control over the success of the bets even though the objective level of control over the final success of the bets remains unchanged. Therefore, cash-outs can nudge players to take greater risks by giving them the impression that they can close their bets with minimal losses. Bennett et al. (2024) demonstrated this effect by utilizing a card-betting task (Bennett, 2022). In this task, participants predicted the color of a randomly selected card (red or blue) from 10 cards, and participants could wager points on each prediction. During some trials, participants were offered a "cash-out" option for a partial payout based on the expected value of their wager. The authors found that participants' bet amounts increased by up to 35% when the cash-out option was available. They posited that the perception of the initial bet being reversible may have increased their perception of control over the outcome. Consequently, this perceived control could appeal to inexperienced or low-risk gamblers, increasing their risk tolerance as an effect of the greater perception of control. Similarly, Lopez-Gonzalez and Griffiths (2017) suggested that the cash-out feature can potentially increase the vulnerability of the bettors, because they can view gambling on sports as an investment, such as trading on the stock market, where they can control when to open and close their positions. Moreover, some sports betting advertisements appear to encourage gamblers to see themselves as professionals by promoting game analysis to beat the service providers (Lopez-Gonzalez et al., 2018).

Parke and Parke (2019) conducted an observational study on 19 online sports bettors with problematic gaming patterns and noted that the cash-out feature was associated with prolonged online sports betting sessions and increased bet frequency by enabling bettors to rapidly re-stake the cashed-out funds, reinforcing impulsive and continuous gambling behaviors while minimizing breaks. Enabling bettors to cash-out changes the structure of betting from a previously discontinuous form of gambling (placing a single bet on the sporting event's final outcome) into a continuous one (i.e., bettors can now make multiple bets during a sporting event on many different aspects as opposed to placing a single bet on the winner) (Griffiths & Auer, 2013; Harris & Griffiths, 2018). Hing et al. (2016) similarly reported that a higher frequency of bet placements and impulsive responses to betting opportunities, such as the use of the cash-out feature, was associated with a higher risk of harm from gambling.

Self-report survey-based studies (Lopez-Gonzalez & Griffiths, 2017; Lopez-Gonzalez et al., 2019) have suggested that the use of cash-out functions is more prevalent among problem gamblers. While these studies offer valuable insights into the gamblers' psychological and

demographic attributes (e.g., perceptions, clinical characteristics, income) and their offline gambling activities, they only provide correlational evidence. Moreover, it is not clear whether (i) the availability of cash-out in sports betting increases problem gambling, (ii) problem gamblers are more prone to play more impulsively when cash-out options are readily available, and (iii) the relationship is bidirectional.

While cash-outs are often discussed within the broader context of in-play betting, they also function as a standalone feature, yet research isolating their effects remains scarce. Most prior studies have largely focused on in-play betting as a whole, emphasizing its continuous nature and association with problem gambling. For example, behavioral tracking data (LaBrie et al., 2007; LaPlante et al., 2008; Nelson et al., 2008) and self-report studies (Hing et al., 2016, 2017; Lopez-Gonzalez & Griffiths, 2017) have linked in-play betting to higher gambling risk. However, these studies do not distinguish whether the observed risks stem from cash-outs themselves or from other features of in-play betting, such as the ability to place multiple rapid bets within a single event. Consequently, there is a lack of research specifically isolating the effects of cash-outs on gambling behavior, highlighting the need for experimental research that isolates the effects of cash-outs.

Additionally, the effects of cash-outs may not be uniform across all bettors. Individual differences, such as financial status (Gray et al., 2012), high trait impulsivity (Hing et al., 2018), and lower statistical numeracy skills (Cokely et al., 2012), have been associated with higher gambling risk. Moreover, studies have identified frequent and intensive betting combined with high variability in wagering amounts and an increasing bet size during the first month of actual online gambling to be associated with high-risk subgroups among gamblers (Braverman & Shaffer, 2012), while participating in two different gambling types along with in-play betting has been reported to be an important predictor of gambling problems (Braverman et al., 2013).

Another study found that while demographic differences in cash-out feature use can be reasonably expected, no significant differences were found in participants' demographics – such as gender, sexual identity, ethnicity, education, employment status, household income, and relationship status – regarding their use of cash-out features (Sinclair et al., 2024). The authors recognized that their sample may have lacked diversity and might not be representative of the general population. Moreover, while we might not observe significant demographic differences in cash-out use, other factors such as bet risk, bet size, or betting behavior may still vary. Taking this into account, demographics could still play a role in cash-out use under different conditions. Additionally, heterogeneity in the impact of cash-outs may exist due to factors beyond demographics.

While the extant literature provides insight regarding the potential risks and motivations underlying the cash-out feature, a comprehensive understanding of its direct impact on gambling behavior remains elusive. To date, most studies have been correlational, leaving a gap in determining causal mechanisms. The present study seeks to address this by employing an experimental methodology, offering a more robust examination of the effects of cash-out options. Furthermore, recognizing the potential heterogeneity in responses, the study will examine more deeply the differential impacts on specific high-risk subgroups, including those with low income, low numeracy skills, high impulsiveness, or mental health issues. By doing so, the study will provide a nuanced understanding of the cash-out feature's influence, enriching the literature and offering actionable insights for both policymakers and stakeholders in the gambling industry.

Methods

The study was approved by the Institutional Review Board of the Faculty of Education and Psychology, Eötvös Loránd University (registration number 2023/690/2) and complies with all relevant ethical regulations. The ethical approval will be updated based on the final accepted version of the Stage 1 Registered Report.

Design and procedure

The proposed study is designed as an online experiment to delineate the effect of the perceived availability of the cash-out option on online gambling behavior. Participants in the cash-out condition will be informed that they can cash-out their bets during the betting process, although in reality, the experiment will end before the actual cash-out could happen. Such deception is a necessary and crucial part of the study because it addresses the potential hypothetical bias (Harrison, 2024) and ensures that the decision of the gamblers accurately reflects their natural responses to the availability of the cash-out option. Participants will complete the study online. All participants who complete the study will be paid a total fee of 6000 Hungarian Forints (HUF) at the end of the experiment. During recruitment, they will be offered 3000 HUF in exchange for their participation. During the experiment, they will be told that they can receive an extra 2300 HUF by decoding randomly generated sequences of letters and numbers from distorted images (i.e., CAPTCHAs). At the end of the study, participants will be debriefed about the purpose of the study and that their bets were simulated. They will receive a 700 HUF consolation prize for not winning or losing what they thought they had made on the bet, contrary to what they were informed before the experiment began.

After providing informed consent, participants will receive instructions to avoid any non-experiment-related activities, such as listening to music or chatting. Afterwards, participants will be informed that if they complete seven or more Captcha codes correctly, they will receive a bonus payment of 2300 HUF. The completion of Captcha codes will serve two purposes. First, they will be used as an attention check. Participants who fail to complete at least seven of the ten Captcha codes will be excluded from the main analyses. Second, by making participants work for the financial reward, it is expected to increase their sense of ownership of the financial bonus (for a similar approach, see Newall et al. [2022]). The financial reward offered is in line with the median online bet sizes on sports events in the Hungarian gambling population[1].

Following this task, half of the participants will be randomly assigned to the cash-out condition, while the other half will be randomly assigned to the no-cash-out condition. Participants in both conditions will be told that they can gamble some or all of their financial bonus on one sports game, choosing from a list of potential events, or they can opt not to gamble. The only difference between the two groups will be that in the cash-out condition, participants will be informed about the option to cash out the following way: *"If you place a bet, after placing the bet, before and during the sporting event, you will have the possibility to use the cash-out function to collect your winnings (see Experiment Flow Diagram)."* The study uses a description of the cash-out feature closely adapted from the *Betfair* website. *"Cash-out lets you take profit early if your bet is coming in or get some of your stake back if your bet is going against you—all before the event you're betting on is over. Cash-out offers are made in real time on your current bets, based on live market prices. Cash-out is available on a wide range of sports, including football, tennis, horse racing, and many more! You can cash-out of bets pre-play, in-play, and between legs".* Participants will be provided with a link to the webpage where they can cash out their bet.

All participants will be given instructions on how they can make their bets. They will be told that they can gamble on a sporting event that will take place a few days after they have completed the experiment. To make the experience of the participants as close as possible to real-life online gambling, the structure and the content of the gambles will follow the commonly used format of online gambling providers in Hungary. That is, the sporting event will be described (e.g., a football match: Barcelona vs. Real Madrid), along with the time and date of the match, the odds for the 'home win', 'away win', and - when relevant - the 'draw'

[1] Based on the information provided by the service provider *Vegas.hu*.

option. Next to each option, participants will be able to manually enter the amount of money they want to bet. Participants can only make one bet. The amount of the bet cannot exceed the financial bonus they are given.

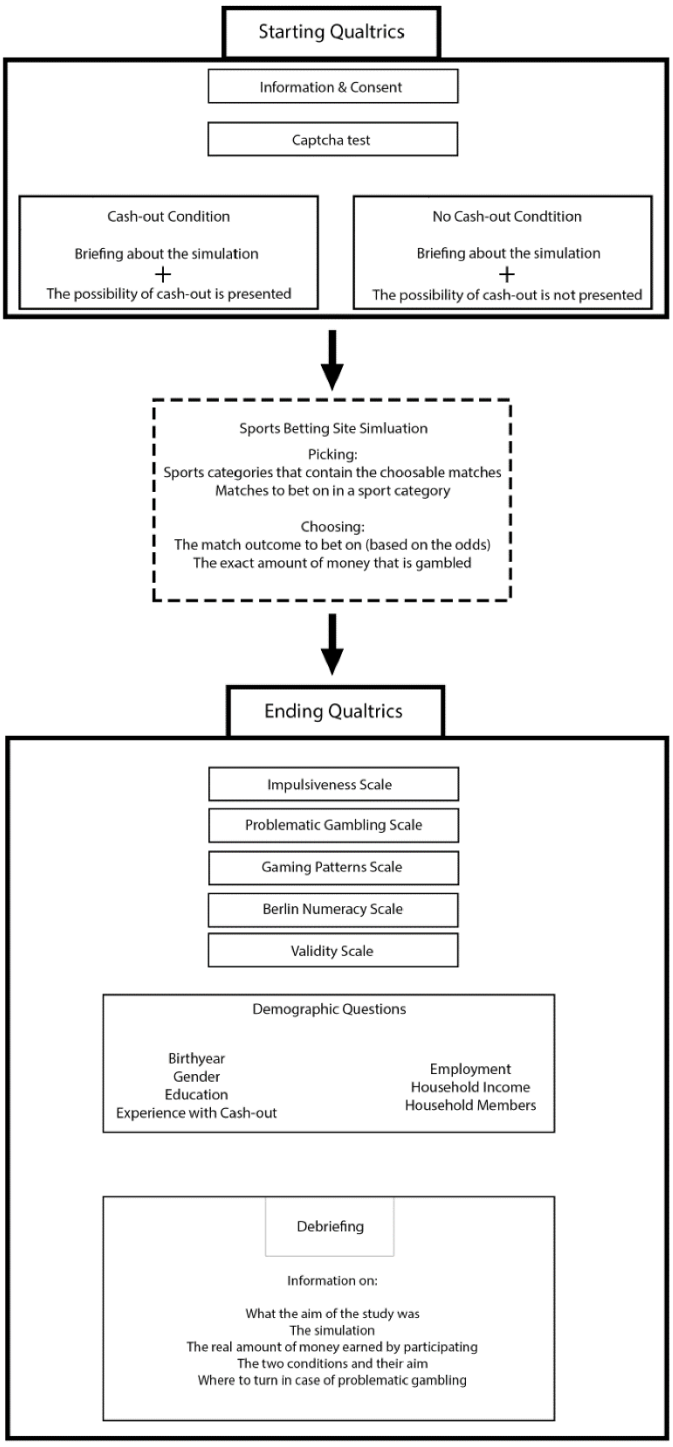
Figure 1. The English translation of the betting platform.

To maximize the probability that participants will find the gambling options appealing, they will be shown approximately 50-100 sports events that they can bet on covering the following sports: football, handball, snooker, rugby, mixed martial arts fighting, e-sports, ice hockey, darts, American football, boxing, cricket, tennis, water polo, motorsports, Aussie rules, golf, basketball, table tennis, baseball, futsal, and floorball. The data regarding gambling events shown in the experiment will be extracted from the largest Hungarian online gambling website (www.szerencsejatek.hu) one day before the data collection starts. The list of sports events will depend on the available events at the gambling website during data collection. This approach yields two distinct advantages. First, participants will be shown a large collection of sports events that will really happen in the target two-week period, so participants' experiences will closely resemble their real-life gambling experiences. Second, participants will be given realistic odds for each of the outcomes as calculated by a gambling service provider.

After participants have placed their bet or chosen not to make a bet, they will be asked to fill out a self-report survey comprising three sections: demographic measures, measures that might moderate the effect of cash-out options on gambling behavior, and data validity measures (see section on 'Self-report measures'). After the experiment, a debriefing will take place, where the true aim of the study will be explained to the participants. They will also be informed

that the bets they made were not real, but they will receive a consolation prize, regardless of how their bet would have played out. Finally, we will offer the contact details of professionals who can help them in case they feel they need help with any gambling-related problems.

Experiment Flow Diagram



Self-report measures

Impulsiveness: Impulsiveness will be assessed across three dimensions—cognitive impulsivity, behavioral impulsivity, and impatience/restlessness—using the BIS-R-21 (Kapitány-Fövény et al., 2020). This instrument is the Hungarian adapted version of the Barratt Impulsiveness Scale (Stanford et al., 2009). The BIS-R-21 comprises 21 items (e.g., *"I plan my trips well in advance", "I act without thinking",* and *"I fidget when I should stay quiet and seated for a longer period"*). Participants will use a four-point Likert scale (never, sometimes, often, almost always) to indicate the degree to which these statements reflect their experiences. The full list of items is available in the Appendix. Scores of the subscales will be used in the regression analyses.

Problem gambling: The Hungarian adapted version (Gyollai et al., 2013) of the Problem Gambling Severity Index (Ferris & Wynne, 2001) will be used to assess problem gambling. The PGSI-HU comprises nine items (e.g., *"How often did it happen to you in the past 12 months that you risked more money than you could afford to lose?"*). Participants use a four-point Likert scale (never, sometimes, often, almost always) to indicate their responses. The full list of items is available in the Appendix. Participants will be categorized into four categories according to the scoring guide of the PGSI and the Helmert-coded[2] version of it will be used in the regression analysis.

Gambling patterns: Based on Braverman and Shaffer (2012), the following four questions will be asked to assess gambling patterns: (i) *"How frequently do you engage in gambling activities?"* (Never; Once a month or less; 2-3 times a month; Once a week; Multiple times a week); (ii) *"On average, how many bets do you place on a single gambling day?"* (None; 1-5 bets; 6-10 bets; 11-20 bets; More than 20 bets); (iii) *"Over time, how would you describe your tendency regarding the amount of money you wager in gambling?"* (Consistently decreasing; Slightly decreasing; Stable - neither increasing nor decreasing; Slightly increasing; Consistently increasing); and (iv) *"To what degree does the amount you wager change?"* (Consistent; somewhat variable; Moderately variable; quite variable; highly variable). The Helmert-coded version of all four responses will be used individually in the regression analysis.

Numeracy: The computer-adapted version of the Berlin Numeracy Test (Cokely et al., 2012) will be used to assess numeracy. The test consists of two or three questions adaptively selected based on the former answers. The test has been shown to predict the comprehension

[2] Helmert coding is a type of contrast where the second level is compared to the first one, the third level to the mean of the first two, the fourth to the first three and so on. It is suitable for ordinal variables where it is difficult to determine the differences between which two levels are influential.

of everyday risk and the performance on several decision-making tests. The full list of items is available in the Appendix. The performance score as a Helmert-coded variable will be used in the analysis.

Demographic measures: Various demographic information will be collected (adapted from Szecsi et al. [2024]) including (i) age (participants will be requested to select their birth year from a dropdown list); (ii) employment status (participants will be requested to specify their current primary employment status: "Full-time (not entrepreneur)", "Part-time", "Entrepreneur", "Unemployed", "Retired", "Other"). Dummy variables will be created using 'Full-time (not entrepreneur)" and "Other" as reference groups; (iii) gender (participants will be asked to indicate their gender. The available options align with the Hungarian language, which uses a single term that encompasses both biological and social genders ("Female/Woman", "Male/Man", "Nonbinary"). Dummy variables will be created using "Male/Man" as the reference group; (iv) household income (participants will rate their household's net monthly income on a scale ranging from less than 50,000 HUF [~140 USD] to more than 1,500,000 HUF [~4,100 USD], divided into 30 equal increment, with the final bracket for incomes exceeding 1,500,000 HUF). Following the official measure of the Organization for Economic Co-operation and Development (OECD) for household (Organisation for Economic Co-operation and Development, 2023), the income measure will be transformed by dividing it by the square root of the number of household members, in order to adjust for the number of individuals using the income; (v) highest educational attainment (participants will be asked to indicate their highest completed educational level: "Less than elementary school", "Elementary school", "Skilled worker qualification", "High school", "Vocational education", "BA/BSc", "MA/MSc", "Doctorate or higher"). Helmert codes will be used for this variable in the analysis; (vi) number of household members (participants will be asked to indicate the total number of individuals in their household, including themselves). To prevent typos, we will not permit numbers greater than 15; experience with the cash-out feature (participants will be asked whether they have had any prior experience with the cash-out function: "I first heard about it in this study"; and "I knew it from before")

Validity measures: A few validity measures will be used including: (i) under the influence (participants will be asked to determine if they are presently under the influence of drugs or alcohol by answering "Yes" or "No"); (ii) attention check (participants will be presented with the following item: "This question is designed to test participants' attentiveness. Please do not answer this question [Yes/No])". Participants providing any answer to this question will be flagged as inattentive. This item is a modified item from Paas and Morren

(2018); and (iii) understanding cash-outs: to see whether participants had a sufficient understanding of the cash-out feature, they will be asked to choose the correct description of cash-outs from four different options (see Appendix).

Reliability and validity of self-report measures: To assess the reliability of all the self-report measures used (BIS-R-21, PGSI-HU, gambling patterns, and Berlin Numeracy Test), Cronbach's alpha and McDonald's omega for each measure will be calculated to assess internal consistency. The correlations between self-report measures will be examined for construct validity. Criterion validity will be assessed by comparing participants' scores on self-report measures with observed betting behaviors during the task. Specifically, correlations between all the self-report measures will be analyzed with behavioral outcomes, including (i) whether or not the participants place a bet, (ii) the bet amount. and (iii) the odds ratio of the bets placed. Significant correlations would support the criterion validity of these self-report measures.

Sampling

Participants will be recruited via the mailing list of the Hungarian online gambling service provider, Vegas.hu. Individuals who meet the criteria of being at least 18 years old, residing in Hungary, and having prior experience in sports betting will be eligible to participate in the study. Vegas.hu will send out recruitment emails in chunks to the potential participants.

The target sample size and power analysis

The minimum target sample size was determined in consultation with our recruiting partner, Vegas.hu. Based on their prior experience with the availability of eligible participants, they estimated that at least 500 valid responses could be obtained with high certainty after applying exclusions. We therefore treated this number as the minimum guaranteed recruitment. A power analysis using the *pwr* package in R determined that 500 participants would provide evidence for an effect size of 0.23 (Pearson *r*) in a regression model with 43 predictors (Team R, 2013) at a 0.05 significance level with 0.80 power for testing H_1. Based on a randomized online experiment (see Study 3 of Newall et al. [2022], utilizing a similar strategy), we estimate that approximately 61% of these participants will place bets, resulting in a subset of 305 participants for testing H_2 and H_3. A power analysis suggested that this subset would provide statistical evidence for an effect size of 0.29 (Pearson *r*) under the same statistical conditions. While this represents a worst-case scenario, such an effect size estimate is consistent with the upper bound of effect sizes found in recent meta-analyses on related phenomena. For instance, a meta-analysis of pop-up interventions during gambling (Bjørseth et al., 2021) found an

overall effect size of $g = 0.507$ (approximately $r = .25$). Similarly, a meta-analysis on gambling advertisements and their impact on gambling behavior (Bouguettaya et al., 2020) reported effect sizes ranging from $r = –.08$ to $r = .68$. However, as no prior research has used experimental methods to directly estimate the present effect, we lack studies that could be directly used to estimate the expected magnitude of the effect.

It is also likely that a substantially larger sample than 500 participants can be recruited by our partner (Vegas.hu). Therefore, to avoid unnecessarily wasting participants' time, we also identified the smallest effect sizes of interest. We consider that an effect of $r = 0.1$ would still be of theoretical and practical interest. The sample size required to detect such an effect (at $\alpha = .05$ with 80% power) was calculated. This resulted in a sample size of 2840 participants. For that reason, if possible, we will continue data collection up to 2840 participants for H_2 and H_3. Data collection will cease if either (1) we reach this upper recruitment limit or (2) Vegas.hu exhausts its pool of potential gamblers to contact.

Hypothesis and data analysis strategy

Overview

In the present study, the impact of the availability of the cash-out option on three dimensions of gambling behavior will be investigated. Accordingly, in the primary confirmatory analyses, three confirmatory hypotheses (H_s) will be tested:

- Participants will be more likely to place a bet in the cash-out condition compared to the no cash-out condition (H_1).
- Among participants who place a bet, individuals will place higher cash amounts in the cash-out condition compared to the no cash-out condition (H_2).
- Among participants who place a bet, individuals will select bets with higher odds (riskier bets) in the cash-out condition compared to the no cash-out condition (H_3).

To test the robustness of the primary analyses and to test their sensitivity to different analytical choices, a multiverse analysis will be conducted. Moreover, exploratory analyses will aim to identify which factors moderate the effect of cash-out options on gambling behavior. To do this, random forest models concerning each of the hypotheses defined above will be conducted.

Statistical framework for inferences

To make inferences, an alpha level of .05 will be used. In case a *p*-value is significant, and the direction of the interaction aligns with the hypotheses, it will be treated as evidence for the hypothesis. If a *p*-value is nonsignificant or significant but the direction of the interaction is misaligned with the hypotheses, it will be concluded that there is no evidence for the existence of the effect, and if the effect exists, the effect size (*r*) is likely smaller than 0.23 (or 0.1 depending on our final sample size), as determined by the power analysis.

Primary analyses

Exclusion criteria

To ensure data quality and validity in the primary analyses, participants will be excluded if they (i) are under the age of 18 years, (ii) did not solve at least 7 of the 10 Captchas correctly, (iii) were self-reportedly under the influence of any drugs or alcohol during the experiment, (iv) did not understand cash-out features, (v) missed the attentional check, (vi) completed the survey in less than three minutes, and (vii) provided the same answer on ten consecutive survey items.

Treatment of missing values

To compensate for differential attrition, missing values in incomplete survey responses will be imputed. The analysis will use the k nearest neighbor imputation method, with $k = 3$, following the recommendations of Beretta and Santaniello (2016). This method identifies the *k* closest observations with similar characteristics to those containing missing data. The analysis will only use the survey data, but not the betting behavior or the Captcha performance, to determine the imputed values.

Specification of the statistical models

To test the primary hypotheses, three sets of analyses will be conducted, one for each hypothesis. In each of these sets, the analysis will fit two separate models, one containing the experimental condition dummy (cash-out vs. no cash-out) and one not. Both models will include the following variables that have been theorized to affect gambling-related behavior: impulsiveness, problem gambling, gaming patterns, numeracy, age, employment, gender, household income divided by the square root of the number of household members, highest educational attainment, and experience with the cash-out feature.

To test whether participants are more likely to place bets in the cash-out condition (H_1), the analysis will fit intention-to-treat binomial logistic regression models on whether the participant chose to make a bet or not. To test whether participants who place bets wagered

higher amounts in the cash-out condition (H_2), the analysis will fit regression models on the amount of money wagered. The histogram of the wagered amounts will be used to determine whether the dependent variable has an appropriate amount of variance to fit linear models or whether ordered logistic regression models should be used. If the amount of variance in the dependent variable allows for the use of a linear model, but the model diagnostics indicate that the assumptions are violated based on visual inspection, data transformations on the included variables will be conducted. If the ordered logistic regression model is used, the dependent variable will be divided into five equal segments. To test whether participants who place bets select bets with higher odds (riskier bets) in the cash-out condition (H_3), the decimal odds will be transformed into probabilities by taking the reciprocal of the odds before the analysis. This transformation will linearize the relationship and improve model fit. The analysis will then involve fitting linear regression models to the probabilities associated with the chosen bets of the individuals.

Robustness tests of the primary analyses

To assess the robustness of the results and their sensitivity against the methodological choices, a multiverse analysis will be conducted. Multiverse analysis involves "performing all analyses across the whole set of alternatively processed data sets corresponding to a large set of reasonable scenarios" (Steegen et al., 2016 p. 702). The addition of a multiverse analysis is useful given that there are several choices that can influence the results. The multiverse analysis was exploratory as there were no specific hypotheses for each analysis. Accordingly, multiple versions of the analyses specified in the primary analysis will be conducted with 24 (2 x 12) alternatively processed datasets. First, all analyses will be repeated with the exclusion criteria listed above and also including all the individuals without excluding any participant. Second, all the analyses will be repeated with 11 different imputation methods: with the imputation listed in the primary analyses, with only the inclusion of complete cases, and with the use of different k values (1-10). Only the summary of the results of the multiverse analysis will be reported in the main text, discussing which analytical choices and variables lead to which inferences as compared to the main analyses.

In addition to the analysis of bet risk (H_3), a robustness analysis will be conducted using the untransformed decimal odds. This could help contextualize the participants' interpretation of the decimal odds, which could yield more realistic insights into perceived risks and betting behaviors.

Exploratory analyses

Finally, the study aims to explore the variables moderating the impact of the availability of cash-outs on the key dependent behaviors (betting vs. no betting, amount of money wagered, odds associated with the bets). To do this, three random forest models will be conducted separately for each of these outcome variables, examining how various demographic and self-report variables influence these betting behaviors.

Data will be split into training and test sets in an 80-20 ratio, and the training set will be used to find the number of variables sampled at each split of a decision tree for the random forest models. The number of variables is set between 1 and the number of included interaction variables and tuned via repeated 10-fold cross-validation. In case the number of observations in the categories of the outcome variable is unequal, the training data will be up-sampled. This means that the analysis will sample with replacement from the original, minority class data until a sample size is reached equal to the majority class. The training set will be tuned to get the greatest area under the precision-recall curve.

To evaluate the importance of the investigated variables in moderating the effect of cash-out availability, the relative importance scores of these variables will be calculated. The analysis will include all the following variables: psychological traits and gambling behaviors will be assessed through self-report measures of impulsiveness, problem gambling severity, gambling patterns, and numeracy. Behavioral outcomes will consist of: (i) whether or not participants place a bet, (ii) the amount wagered, and (iii) the odds ratio of the bets placed.

Drawing from the findings of Bennett et al. (2024), problem gambling severity (PGSI-HU) scores are expected to moderate the effect of cash-out availability on bet amount. Specifically, in the no cash-out condition, participants with high PGSI-HU scores are anticipated to place larger wagers. While this association is expected to weaken or disappear in the cash-out condition. Such results would highlight the potential role of cash-out availability on gamblers' risk behaviors. Demographic information such as age, employment status, gender, household income, household size, and educational attainment will also be analyzed to contextualize how broader social and economic factors interact with gambling behavior. Together, the analysis of these variables would provide a comprehensive overview of the key moderating effects in betting behaviors under the context of cash-out availability.

Design table

Research Question	**Hypothesis**	**Sampling plan**	**Analysis Plan**	**Rationale for deciding the sensitivity of the test**	**Interpretation given different outcomes**
Does the perceived availability of a cash-out option in online sports betting influence the likelihood, amount, and riskiness of bets placed by bettors?	H1: Participants will be more likely to place a bet in the cash-out condition compared to the no cash-out condition.	Participants (Hungarian residents with prior sports betting experience, ≥18 years old) will be recruited via Vegas.hu's mailing list. Minimum target sample size is 500 valid responses (80% power for $r = 0.23$, 43 predictors, $\alpha = 0.05$). We will stop data collection when reaching 2840 responses.	Binomial logistic regression on whether the participant chose to place a bet, adjusting for 43 covariates.	Effect sizes of interest were determined via prior literature on gambling interventions and gambling ads.	To make inferences, an alpha level of .05 will be used. In case a *p*-value is significant, and the direction of the interaction aligns with the hypotheses, it will be treated as evidence for the hypothesis. If a *p*-value is nonsignificant or significant but the direction of the interaction is misaligned with the hypotheses, it will be concluded that there is no evidence for the existence of the effect, and if the effect exists, the effect size (r) is likely smaller than smallest detectable effect size , as determined by the power analysis.
	H2: Among participants who place a bet, individuals will place higher cash amounts in the cash-out condition compared to the no cash-out condition.	Based on prior research (Newall et al., 2022), it was estimated that approximately 61% of these participants will place bets. Based on the 500 minimum target sample size mentioned above, we expect 305 participants to place a bet. Power analysis determined that this would provide evidence for an effect size of $r = 0.29$.	The regression model used (linear or ordered logistic) will be determined based on the variance of the bet amounts.	As above	
	H3: Among participants who place a bet, individuals will select bets with higher odds (riskier bets) in the cash-out condition compared to the no cash-out condition.		Fit adjusted linear regression on the reciprocal-transformed odds (bet risk) of the chosen bets of the participants.	As above	

Data sharing

The analysis code for the power analysis and all the study materials are available on the Open Science Framework Page of the project: https://osf.io/yf4rn/. After data collection, the anonymized data will be shared here.

Competing interest statement

SB was funded by the Supervisory Authority for Regulatory Affairs (SARA), which is the regulatory body of gambling in Hungary. The compensation of the participants is covered by Vegas.hu. Vegas.hu had no role in study design, analysis, decision to on the conclusions, and the preparation of the manuscript, while the authors discussed the design plan with the representatives of SARA to maximize the chance that the findings would provide useful insights to the regulator.

MDG has received research funding from Norsk Tipping (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling, and gambling treatment from Gamble Aware (formerly the Responsibility in Gambling Trust), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling and his clients have included *Allwyn, Entain, Camelot, bet365, SkyCity, Premier Lotteries Ireland, Bet City, West Lotto, Postcode Lottery, Kindred, Hong Kong Jockey Club, China Sports Lottery, Singapore Football Pools, Rikstoto, OPAP, Casumo, Veikkaus, At The Races, Multilot, Norsk Tipping, Svenska Spel, RAY, Atlantic Lottery Corporation, Nova Scotia Provincial Lotteries and Casino Corporation, GalaCoral, Loterie Romande, GTECH/Lottomatica, Association of British Bookmakers, Austrian Lottery, Uruguay Lottery, 888.com,* and *Paddy Power*).

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Author contributions

BS developed the first version of the hypotheses, the study design, and wrote the first version of the manuscript. HWY refined the manuscript, addressed reviewer comments, and contributed to the finalization of the Registered Report. PK, AY, and MK contributed to the improvement of the study design and implementation and created the Qualtrics survey. PS and BS created together the first version of the analysis plan, and PS wrote the analysis script. MB coded the gambling interface. PS and PK created the figures. ZD and MDG supervised the project. All authors provided suggestions for the manuscript of the Registered Report.

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