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Illusion of Control or Passive Superstition? A Comparison of Two Explanations for Irrational Gambling Beliefs

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Objective: The "illusion of control" is a dominant cognitive illusion in disordered gambling, but its role in shaping irrational gambling beliefs has been questioned by recent null experimental findings. Here, we aimed to test this recent work, in a preregistered Bayesian framework, by additionally correlating the dependent variable (nonuniform probabilistic beliefs) with self-reported gambling behavior and by exploring "passive superstition" as an alternative driver of these irrational gambling beliefs. ***Method:*** A between-participants online experiment involving three boxes, one of which a $1 prize was randomly assigned to ($N = 3{,}064$; 49.1% males, 49.5% females, 1.4% other; $M_{age} = 42.5$ years). Participants estimated the likelihood of each box winning, with any estimates outside the 33%–34% interval categorized as irrational "nonuniform" probabilistic beliefs. "Preselection" participants gave estimates prior to box selection, "post-no-choice" participants had their box randomly selected, and participants in the treatment "postchoice" condition selected their own box. Whether participants gambled within the past 12 months (gambling status), Problem Gambling Severity Index (PGSI) score, and passive superstition scores were used as additional predictors. ***Results:*** Comparing postchoice participants with post-no-choice participants (95% CI [0.80, 1.22]) and comparing postchoice with preselection participants (95% CI [0.88, 1.34]) yielded substantial support for a null effect. Gambling status supported substantial evidence for a null effect (95% CI [0.92, 1.30]), whereas higher PGSI (95% CI [1.08, 1.13]) and higher passive superstition scores (95% CI [1.08, 1.10]) overwhelmingly predicted our outcome. ***Conclusions:*** Active choice elements in illusions of control may have been overemphasized in irrational gambling beliefs compared to passive superstitions.

Public Health Significance Statement

Gambling can be a harmless pastime for many, but it can also harm so many others that a wide range of stakeholders are increasingly considering gambling as a public health issue. The psychological side of this public health issue often centers around the various irrational beliefs that gamblers can have, with much attention focusing on active choice elements, such as gamblers' ability to choose their own lottery numbers, which we contrast here against aspects of passive superstition (e.g., "horoscopes are right too often for it to be a coincidence"). Our findings suggest that superstitions should be given greater consideration as a significant driver of irrational gambling beliefs, at least with respect to chance-based gambling formats such as lotteries.

Keywords: irrational cognitions, disordered gambling, Problem Gambling Severity Index

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All hypotheses were preregistered. The materials, data, and analysis code are publicly available on the Open Science Framework at https://osf.io/n7crd (Monson et al., 2024), and the preregistration is available at https://osf.io/ghfau (Monson et al., 2023). The authors confirm that their article or any other study derived from their data set is not in press, published, or under review anywhere else.

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The "illusion of control" is an influential psychological theory stating that people overestimate their ability to control the outcomes of objectively chance-based events (Langer & Roth, 1975), with the original article having over 7,000 Google Scholar citations at the time of writing (Langer, 1975). The illusion of control has been especially influential in gambling psychology, where it is considered one of the core cognitive illusions underpinning gambling disorder (Clark & Wohl, 2022; Ejova & Ohtsuka, 2020)—a *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.) psychiatric condition with sufficient negative impacts on health and well-being that it is considered a public health issue by many stakeholders (Browne et al., 2023; Wardle et al., 2019). This influence on gambling psychology is fitting given that early illusion of control demonstrations used gambling scenarios (Henslin, 1967). For example, Langer's (1975) influential Experiment 2 demonstrated the potential role of choice in inducing illusions of control, showing that participants were more willing to give up lottery tickets with randomly allocated numbers than lottery tickets with numbers that they had picked themselves—despite all tickets having equal chances of winning, as in real lotteries (Langer, 1975). When participants chose their ticket in Langer's study, they were twice as likely to refuse to sell their ticket back to the experimenter and required significantly more money to be prepared to do so ($8.67 vs. $1.96). This research has potential relevance to gambling outside of the laboratory, as lotteries are enduringly popular (Welte et al., 2015), with U.S. gamblers spending $191 billion on lotteries in 2021 (U.S. Census Bureau, 2021).

Many psychological effects have failed to replicate in recent years (Open Science Collaboration, 2015), causing a field-wide reexamination of influential findings. Klusowski et al. (2021) conducted 17 conceptual replications (total N = 10,825) of Langer's (1975) Experiment 2. They failed to find illusion-of-control effects through manipulating participants' choice using a variety of dependent variables and paradigms (Klusowski et al., 2021). Their final and most conclusive experiment asked participants to estimate the chances of winning a $1 bonus from one of three boxes. Since the $1 bonus was randomly assigned to the boxes, participants should have given uniform estimated probabilities = 1/3 for each box. Participants were randomly assigned to either give these estimates after choosing a box ("postchoice" condition), a condition that should promote illusion-of-control effects, or in a control condition, where a box was randomly assigned to them ("post-no-choice" condition). A second control condition was also used where estimated chances of winning were elicited prior to any allocation of boxes ("preselection" condition), to also assess preexisting (and therefore not involving active control) probabilistic beliefs. Overall, 26% of their participants gave at least one estimated chance of winning outside of the 33%–34% interval, demonstrating clearly irrational nonuniform probabilistic beliefs. Importantly, this rate was no higher in the postchoice condition (19%) than in the post-no-choice condition (36%) or preselection condition (24%). This means that this experiment (and earlier experiments in this article) was inconsistent with the illusion of control via choice. Although Langer (1975) also described illusions of control under other situations such as through greater competition, familiarity, or active involvement, these are unlikely explanations for these irrational beliefs as this paradigm was a single-shot task with no competitors and low task engagement required. Consequently, alternative accounts are warranted.

However, Klusowski et al. (2021) did not demonstrate which participants tended to have irrational gambling beliefs. If this task does indeed mimic actual gambling situations, then two plausible predictors are gambling participation and rates of disordered gambling severity among gamblers. This is because the dominant cognitive perspective on gambling has implicated cognitive illusions in causing disordered gambling (Walker, 1992), of which the illusion of control is key (Clark & Wohl, 2022), but which includes other illusions such as the "gambler's fallacy" belief that wins and losses will revert over time (Leonard & Williams, 2016). On average, around 50% of adults might gamble in a given year, with a smaller proportion of around 0.5%–3% of the adult population meeting the diagnostic criteria for disordered gambling, alongside a somewhat larger at-risk group (Calado & Griffiths, 2016). Showing a link between irrational gambling beliefs in this task and gambling outside of the laboratory would help to reinforce this finding's external validity to gambling.

Klusowski et al. (2021) also did not demonstrate which thinking styles are associated with their irrational gambling beliefs. Because

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The data are available at https://osf.io/n7crd

The experimental materials are available at https://osf.io/n7crd

The preregistered design is available at https://osf.io/ghfau

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participants were explicitly told the boxes had equal chances of winning and overall probabilities had to add to 100%, common mathematical errors were less likely to be made. Therefore, simple explanations like mathematical illiteracy are limited in fully accounting for these irrational beliefs. Furthermore, as active mechanisms such as choice provide an uncompelling account, passive elements may alternatively explain these beliefs. "Passive superstition," the belief that supernatural factors such as fate or astrological signs can cause outcomes (Hernandez et al., 2008), is one plausible thinking style beyond choice-induced illusions of control. Passive superstitions are separate from proactive superstitions, which require personal agency and are therefore more related to active choice, such as undertaking rituals or using lucky charms to enact outcomes via supernatural forces (Chinchanachokchai et al., 2017). Indeed, passive superstitions may be interpreted as softer illusions of control through "secondary control," whereby decision making based on irrational superstitious beliefs increases perceived control over outcomes similarly to a skill (Rothbaum et al., 1982). Numerology and other passive superstitions appear as plausible alternative explanations both for irrational gambling beliefs in Klusowski et al.'s (2021) experiments and for patterns in lottery players' naturalistic number preferences, where numbers that could correspond to dates or occasions of personal significance such as birthdays or anniversaries are chosen at above-chance levels (Goodman & Irwin, 2006; Wang et al., 2016). Such a finding would provide support for the relatively overlooked role of superstitions among gamblers' cognitive illusions (Joukhador et al., 2004; Leonard & Williams, 2019; Moritz et al., 2021).

Replication is an important cornerstone of modern psychological science, and conceptual replications, which change some relevant feature(s) of an original study, such as its analysis plan or participant pool, can demonstrate a finding's robustness (Nosek et al., 2022). Klusowski et al. (2021) used frequentist statistics, which can only reject or fail to reject a null, rather than quantify the degree of evidence for the null compared to an alternative hypothesis, which requires Bayesian statistics (Wagenmakers et al., 2008). Most of Klusowski et al.'s (2021) studies were performed via the crowdsourcing platform Amazon Mechanical Turk (MTurk), whereas the rival crowdsourcing platform Prolific has been shown to produce higher quality data than both MTurk (Peer et al., 2022) and undergraduate student samples (Douglas et al., 2023). Furthermore, 4.5% of Experiment 17's participants failed a set of three simple comprehension checks (explained in the Participants section) and yet were retained in the sample, suggesting that inattention or carelessness might affect these findings.

Therefore, we aimed to compare the illusion of control versus gambling engagement, disordered gambling symptomology, and passive superstition as other potential drivers of nonuniform probabilistic beliefs in a conceptual replication of Klusowski et al.'s (2021) Experiment 17. Given that effect sizes typically decrease in replications compared to original studies (Open Science Collaboration, 2015), we increased their sample size from 598 to over 3,000 and implemented preregistered data quality checks. We hypothesized that a Bayesian analysis would show support for the null over the alternative hypothesis regarding the experimental control manipulation (Bayes factor [BF] < 1). We additionally hypothesized positive relationships between nonuniform probabilistic beliefs and gambling participation and disordered gambling symptomology (BFs > 1) and also with passive superstition (BFs > 1). We finally planned an exploratory multivariate analysis.

Method

Participants

We recruited an initial 3,151 U.S.-based participants through Prolific, but two participants were excluded for failing the self-reported carelessness check, and 85%—2.7% compared to 4.5% in the Klusowski et al. (2021) sample—for failing the comprehension check (completely correct responses asking how many boxes were present [3], how many boxes would win [1], and how many boxes would be selected as theirs [1]), giving $N = 3{,}064$ (49.1% males, 49.5% females, 1.4% other). Participants were paid £0.60 each and took on average 5 min and 43 s for completion, at a mean pro rata hourly pay of £6.30 (£9.30 average including the bonus winnings). The mean age was 42.5 years ($SD = 13.6$). Other demographics are in Table 1. Ethnicity or race demographics were not collected as in the study that we replicated as they were deemed unrelated to our research questions. Ethical approval was received by the University of Bristol School of Psychological Science Research Ethics Committee Code No. 15815.

Task

Klusowski et al.'s (2021) materials for their final experiment (Experiment 17) were imported into Qualtrics. Participants in all conditions were presented with three boxes and told that one of them would randomly contain a $1 bonus. They were also told that each box had "equal chances" of winning. As the main dependent variable, participants had to give the probability estimates that each of the three boxes contained the random bonus, with the sum of their estimates being forced to add up to 100%. Since the winning box was in all conditions randomly determined, the correct response was

Table 1
Frequencies of Demographics

Variable	*N*	%
Nonuniform probabilistic beliefs per condition		
Preselection	211	20.7
Post-no-choice	226	22.2
Postchoice	226	22.0
Having gambled within the past 12 months (gambling status)		
No	1,379	45.0
Yes	1,685	55.0
PGSI categorization		
Nongambler	1,379	45.0
Recreational gambler	924	30.2
At-risk gambler	517	16.9
High-risk gambler	244	8.0
Educational level		
No high school degree	27	0.90
High school degree	856	27.9
Associate's degree	369	12.0
Bachelor's degree	1,234	40.3
Graduate degree	578	18.9

Note. Categorizations for PGSI scores are based on Williams and Volberg (2014) and coded into nongamblers, recreational gamblers (PGSI Score 0), at-risk gamblers (PGSI Scores 1–4), and high-risk gamblers (PGSI Score 5+). PGSI = Problem Gambling Severity Index.

to give uniform probabilistic beliefs ($p = 1/3$ for each box). As in the original study, this was followed by three Likert scales and a text response field, but we follow that original study by not analyzing those measures here. Although these Likert measures were analyzed in other studies by Klusowski et al. (2021), we include them without analysis for the following reasons. First, our preregistered analysis focused on using the outcomes (albeit dichotomized as described in the Statistical Analysis section) of Study 17. Second, we wished to maintain conceptual and computational continuity with Klusowski et al. (2021) by including all potential illusions of control measures. Third, despite not analyzing these measures, we report their existence for transparency, with such data available for use on the Open Science Framework at https://osf.io/n7crd (Monson et al., 2024).

Participants' level of control was manipulated between participants. The treatment condition was called the "postchoice" condition, which involved participants first choosing the box that they thought contained the $1 bonus and then giving probability estimates afterward. In the "post-no-choice" control condition, this active choice was removed from participants, with a box being randomly allocated to them before they then gave the same probability estimates. Contrastingly, in the "preselection" control condition, participants gave their probability estimates first, before then either being randomly allocated to either choosing a box or having a box being randomly chosen for them.

Participants then completed the original demographics block and two novel blocks, with block order randomized. Participants were asked if they had paid money to gamble in the past 12 months; those saying "yes" (55.0%) then completed the nine-item Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001), the gold-standard screener for disordered gambling symptomology in community samples (Holtgraves, 2008). This mirrors the methodology of gambling prevalence surveys, which only give these nine questions about gambling behavior and its consequences to those who have gambled in the past 12 months (Sturgis & Kuha, 2022). In the second block, all participants completed an 11-item Passive Superstition Scale (PSSC)—see Table 2—containing nine items from the "Superstition Items" survey from Hernandez et al. (2008), Item 11 ("The number '13' is unlucky") was taken from the "Surface Traits" items from Mowen and Carlson (2003) and Item 7 ("When asked to choose a number, I tend to go with a lucky one") was taken from the "Beliefs in Superstitions Scale" from Fluke et al. (2014). These two added items are likely more relevant to Western participants than the two unused items from Hernandez et al. (2008), which assess more Eastern-oriented numerological superstitions (Item 11: "number 8 attracts good luck" and Item 22: "number 4 attracts bad luck"). Participants rated their level of agreement with each item on a 5-point Likert scale. The PSSC had a Cronbach's α of .89, which alongside a factor analysis indicates scale reliability (see Table 2, which also provides each items' text).

Participants then provided optional feedback and were told of their bonus outcome, before completing the study. Klusowski et al.'s (2021) experiment contained three initial comprehension questions (explained in the Participants section), with 4.5% giving at least one incorrect answer in the original study, and 2.7% doing so here. The present experiment was preregistered to exclude these participants, as well as participants who self-reported "No, I was not paying attention, discard my data" to a self-reported carelessness check shown immediately before the bonus outcome was revealed. This check has been recommended as a way to remove inattentive responses without resorting to "trick" questions as is common in attention checks (Brühlmann et al., 2020). All participants were paid regardless of whether the data were used.

Statistical Analysis

The original study used the highest probability estimate out of the three boxes as the dependent variable, which was analyzed via *t* tests. However, analysis of their data and of a preliminary student-led study suggested that the highest probability estimate was likely to be heavily skewed (skewness = 4.3 in the present sample). Therefore, a logistic regression model was preregistered here which categorized the dependent variable as whether it was "uniform," with probability estimates for all three boxes in the 33%–34% interval, or "nonuniform," with at least one probability estimate being less than 33% or greater than 34%. As the total estimates had to add to 100%, participants stating equal winning probabilities across the three boxes could not give consistent integers for all boxes, hence why estimates to the bounds of 33%–34% were computed as uniform beliefs. Klusowski et al. (2021) reported that 26% of their Study 17 participants had nonuniform probabilistic

Table 2
Pattern Matrix of PSSC Using Principal Axis Factoring and Oblique Rotation of 11–Item Passive Superstition Scale

	Factor	
Item	Fate	Astrology, numerology, and fantasy
Your palm lines impact your future.		.965
Your birthday affects your destiny.		.836
Horoscopes are right too often for it to be a coincidence.		.835
Your personality is determined by astrological alignments.		.785
Black magic exists.		.613
Big Foot exists.		.528
The number "13" is unlucky		.500
When asked to choose a number, I tend to go with a lucky one		.379
In many situations what happens to people is determined by fate.	.688	
Getting a good job or promotion in the future will depend on my getting the right turn of events.	.603	
Due to the mystical powers of fate, many times I feel that I have little influence over the things that happen to me.	.451	.380

Note. $N = 3,064$. Factor loadings <0.3 are removed. PSSC = Passive Superstition Scale.

beliefs by this measure, compared to 21.6% here. A Bayesian logistic regression analysis suggested there was substantial evidence for a lower rate of nonuniform probabilistic beliefs in the present sample compared to Klusowski et al.'s (2021) Study 17 (BF_{10} = 8.45), 95% CI [0.67, 1.00].

As we predict a null effect from the experimental control manipulation, Bayes factors (BFs) are needed to see if collected evidence supports the null hypothesis over the alternative hypothesis. The "BFpack" package (Mulder et al., 2021) was used in R Version 4.30 (R Core Team, 2021). BFs (denoted as BF_{10}) below 1 indicate evidence favoring the null, and if greater than 1 indicate evidence favoring the alternative hypothesis, with a BF_{10} of 3 or more considered to indicate substantial evidence (Jarosz & Wiley, 2014). A BF_{10}—over 500—provides "overwhelming" evidence for an alternative hypothesis (van Doorn et al., 2021). If a BF_{10} is below 1, then we report their reciprocal (BF_{01}) for easier interpretation, indicating the degree of evidence favoring the null hypothesis.

The experimental manipulation, PSSC, and gambling responses were then put in a planned multivariate analysis. The PGSI scores in the multivariate model only were totaled and categorized, participants were grouped as being nongamblers, recreational gamblers (PGSI Score 0), at-risk gamblers (PGSI Scores 1–4), or high-risk gamblers (PGSI Score 5+), as follows the Williams and Volberg (2014) suggested categories.

We also conducted an exploratory analysis to incorporate passive superstition in an analytic context closer to that of Study 17 by Klusowski et al. (2021). We performed Bayesian linear regressions with the predictor of PSSC scores on the probability estimates for one's chosen box, within each experimental condition (see Supplemental Material 1). This approach is similar to the pairwise comparisons of probability estimations for one's chosen box across the experimental conditions assessed in Study 17 by Klusowski et al. (2021).

Transparency and Openness

We report how our sample size was determined, all data exclusions, experimental manipulations, and measures in our report and follow the journal article reporting standards for quantitative psychology research (Appelbaum et al., 2018). Our hypotheses were preregistered. The materials, data, and analysis code are publicly available on the Open Science Framework at https://osf.io/n7crd (Monson et al., 2024), and the preregistration is available at https://osf.io/ghfau (Monson et al., 2023). We determined our sample size heuristically. As we were replicating a null effect, we increased our sample size to what is considered a large *n* per cell size (Serdar et al., 2021) ensuring sufficient power with a sample size of over 3,000. Data were prepared using SPSS Version 29.0 and analyzed using R Version 4.30 (R Core Team, 2021) using the R package "BFpack" (Mulder et al., 2021).

Results

Overall, 22.0% of participants in the postchoice condition had nonuniform beliefs, compared to 22.2% of participants in the control post-no-choice condition and 20.7% in the other control preselection condition. The preregistered Bayesian model indicated substantial support for the null hypothesis. As in the original study, we compare the two control conditions separately to the treatment condition. Comparing postchoice participants (95% CI [0.80, 1.22]) with post-no-choice participants only yielded substantial evidence for the null (BF_{01} = 50.0). Comparing postchoice participants (95% CI [0.88, 1.34]) with preselection participants only also found substantial evidence for the null (BF_{01} = 22.3).

Next, we explored potential individual difference predictors of nonuniform beliefs. Gambling status (whether participants had gambled at all in the past 12 months) did not predict nonuniform beliefs as the model provided substantial support for the null (BF_{01} = 19.8), 95% CI [0.92, 1.30]. However, higher continuous PGSI scores, which reflect levels of disordered gambling symptomology, overwhelmingly predicted higher rates of nonuniform probabilistic beliefs among gamblers ($BF_{10} = 1.71 \times 10^{10}$), 95% CI [1.08, 1.13]. Higher PSSC scores also overwhelmingly predicted higher rates of nonuniform beliefs ($BF_{10} = 7.02 \times 10^{45}$), 95% CI [1.08, 1.10]. Additionally, an exploratory analysis suggested that higher PSSC scores were associated with higher PGSI scores among gamblers ($BF_{10} = 9.50 \times 10^{15}$), 95% CI [0.081, 0.13].

Effect sizes and credible intervals from the planned multivariate analysis using the combined predictors of condition allocation, PGSI categorization, gambling status, and passive superstition are shown in Table 3. Overall, our multivariate model corroborates the findings of our univariate models and indicates our model parameters independently predict nonuniform probabilistic beliefs. The multivariate model as a whole overwhelmingly predicts nonuniform probabilistic beliefs ($BF_{10} = 6.45 \times 10^{40}$). However, categorized PGSI scores indicate, relative to nongamblers, that recreational gamblers are less likely to have nonuniform beliefs, with a null effect for at-risk gamblers and a positive effect for high-risk gamblers.

Results from our exploratory analysis (outlined in the Statistical Analysis section) found that higher PSSC scores predicted higher probability estimates for one's chosen box, with stronger evidence in the postchoice condition (BF_{10} = 28,616) compared to post-no-choice (BF_{10} = 200) or preselection (BF_{10} = 64). See Supplemental Material 1 for details.

Table 3
Results of Multivariate Analysis

Predictor	Median odds ratio	95% credible interval *LL*	95% credible interval *UL*
Condition			
Preselection	0.92	0.74	1.15
Post-no-choice	1.03	0.83	1.28
PGSI categories			
Recreational gambler	0.66	0.53	0.83
At-risk gambler	1.13	0.88	1.44
High-risk gambler	1.78	1.31	2.42
Other predictors			
PSSC scores	1.09	1.07	1.10

Note. Effects for preselection and post-no-choice predictors are both compared in reference to the postchoice condition. Low-risk, at-risk, and high-risk gambler predictors are all in reference to the nongambler category. PGSI = Problem Gambling Severity Index; PSSC = Passive Superstition Scale; *LL* = lower limit; *UL* = upper limit. Gambling categories are based on PGSI score categories from Williams and Volberg (2014).

Discussion

Psychology's replication crisis has caused a field-wide reexamination of influential findings (Open Science Collaboration, 2015), such as the illusion of control. The present study attempted to conceptually replicate a recent null finding on the illusion of control (Klusowski et al., 2021) subject to various design changes to explore the finding's robustness (Nosek et al., 2022). The present study found strong evidence in support of the null hypothesis for the choice manipulation via Bayesian statistics, which adds support to this recent claim. We also looked at individual difference factors to explore the external validity of, and alternative explanations for, nonuniform beliefs. Although merely participating in gambling did not predict nonuniform beliefs, higher PGSI scores among gamblers did. The multivariate analysis revealed an interesting pattern here where recreational gamblers were less likely to have nonuniform probabilistic beliefs than nongamblers, but high-risk gamblers had the highest rates of nonuniform probabilistic beliefs. This reflects similar findings where recreational gamblers have higher subjective well-being than nongamblers, but high-risk gamblers have the lowest rates of subjective well-being (Blackman et al., 2019). Overall, these associations with gambling behavior outside of the experiment suggest that this simple online task can capture the irrational thinking styles that disordered gamblers exhibit in actual gambling environments (Clark & Wohl, 2022). While superstitions have been investigated in gambling research (Joukhador et al., 2004; Leonard & Williams, 2019), they have been subject to less investigation than the illusion of control. Our findings suggest that passive superstitions—which do not require any personal agency and hence no active control to be enacted—could overwhelmingly predict nonuniform beliefs. These findings have various implications for future illusion-of-control research.

Lotteries provided an original context for illusion-of-control research, which in turn provided an explanation for why lottery players put an effort into picking between numbers, which offer identical chances of winning (Langer, 1975). The passive superstition finding suggests a more nuanced explanation, however. It appears that the choice aspect of picking lottery numbers may have been overemphasized by previous research (Chodzyńska & Polak, 2020; Langer, 1975). Instead, it may be that superstitions are a more distal driver of lottery engagement and that the ability to actively choose numbers merely reveals these superstitions, rather than itself driving lottery engagement. This account is consistent with the present findings and the naturalistic research on patterns in lottery players' number preferences (Goodman & Irwin, 2006; Wang et al., 2016). Note that this account cannot itself explain the causal pathways between irrational thinking and disordered gambling, with the collection of previous evidence suggesting some aspects of bidirectionality (Bersabé & Arias, 2000; Philander & Gainsbury, 2023; Yakovenko et al., 2016). However, this account does imply that gambling research should focus more on passive superstitions than active choice elements in disordered gambling. This is relevant to both underlying theory (Clark & Wohl, 2022; Ejova & Ohtsuka, 2020) and to harm prevention, where the correction of irrational thinking styles such as the illusion of control underlies current gold standard cognitive behavioral therapy treatment for gambling disorder (Petry et al., 2017).

Limitations

This alternative theoretical account is subject to various limitations inherent to the present research, which future research should address. A more ecologically valid task could better reflect actual lotteries or scratch tickets, or utilize another gambling game, which provides options over statistically identical options, such as roulette (Dixon et al., 1998) or slot machines (Moritz et al., 2021). Other gambling formats which do allow gamblers to select between statistically distinct options, such as sports betting (Newall et al., 2021), may yield different findings. Additionally, manipulating situational cues like lighting or music may moderate gambling cognitions and could be tested in future studies (Spenwyn et al., 2010). Importantly, the present research used a single-shot task with a minimal level of actual involvement—it may be that more time or greater engagement with the task is needed for a choice manipulation to meaningfully affect perceived chances of winning. Behavioral economics research suggests that increasing stakes can sometimes have little effect on behavioral biases (Enke et al., 2023) but this factor should still be considered. Furthermore, our study did not test other aspects of illusions of control such as familiarity or competition (Langer, 1975), and therefore, our findings cannot reject illusions of control through mechanisms beyond active choice. We also do not test other explanations for nonuniform beliefs such as mathematical illiteracy (Williams & Connolly, 2006), which could be incorporated into future predictor models.

Our findings extend the previous research which mostly focused on the crowdsourcing platform MTurk to a new platform Prolific, which arguably yields better quality data (Douglas et al., 2023; Peer et al., 2022), supported by lower rates of nonuniform probabilistic beliefs and comprehension check failures in our sample compared to Klusowski et al. (2021). Nonetheless, other recruitment approaches should also be considered. In addition, PGSI categorizations demonstrated a high proportion of participants as "at-risk" or "high-risk" gamblers (24%). This considerably large percentage could be explained by poorer data quality from online crowdsourcing platforms or via potential sampling bias wherein experienced gamblers (exhibiting higher rates of disordered gambling symptomology) may disproportionately select gambling-related studies. We also did not collect ethnicity or race demographics preventing conclusions on the generalizability of our findings to various populations.

Following the original study, using the requirement that probability estimates had to add to 100% may have also affected participants' responses. First, this may have revealed researcher's expectations about rational thinking to the participants and prevented more optimistic estimates. Imposing this upper bound also prevented participants from giving possible answers that could indicate mathematical errors about probability. Therefore, future studies should test the impact of this constraint, which could potentially elicit greater irrational responses. Second, as participants could not respond with the same integer across all options (because of the constraint and the use of a nondivisible number of boxes), this led to various responses for uniform beliefs being given, for example, whether to use a decimal or an integer. As estimates could not be exactly equal, it is possible we encoded some responses as uniform when in fact respondents believed one option had slightly different likelihoods of winning (between 33% and 34%) than others. However, this is only likely to apply to a small minority of respondents. Future work may elicit estimates only for one's selected box or to use a number of boxes divisible by 100.

Conclusion

In conclusion, this research casts additional doubt on whether active choice can explain irrational gambling beliefs like the illusion of control while suggesting an alternative and relatively overlooked explanation involving passive superstitions.

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