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Illusion of control and passion mediate the relationship between winning exposure and problem lottery gambling in a multigroup analysis

Yue Hu[1,3] & Xinyu Cai[2]✉

Previous studies have highlighted the key role of winning exposure in problem lottery gambling. However, little is known about the mechanisms underlying this relationship, particularly in mainland China. The current study investigated the structural relationships among winning exposure, illusion of control, harmonious passion, obsessive passion, and problem lottery gambling across three age groups. A total of 3602 Chinese lottery gamblers (3032 males, mean age = 39.72 years) were recruited to participate in this study and completed measures of demographic information, winning exposure, illusion of control, lottery gambling passion, and problem lottery gambling. There were significant correlations between winning exposure, illusion of control, harmonious passion, obsessive passion, and problem lottery gambling. Winning exposure positively predicted problem lottery gambling. Winning exposure related to problem lottery gambling via the illusion of control, via harmonious passion, via obsessive passion, serially via the illusion of control and harmonious passion, and via the illusion of control and obsessive passion. The mediation model varied within three age groups. Illusion of control and gambling passion mediate the relationship between winning exposure and problem lottery gambling. This mechanism of problem lottery gambling varies with ages. These findings expand the understanding of the theoretical mechanism underlying the relationship between winning exposure and problem lottery gambling.

Keywords Problem lottery gambling, Winning exposure, Illusion of control, Harmonious passion, Obsessive passion, Age difference

As one of the largest lottery markets globally, China has more than 300,000 lottery gambling shops and more than 750,000 employees. Since its issuance in 1987, it has accumulated a total sales revenue of 3,443.5 billion yuan[1,2]. However, the continuous expansion of the lottery market in China raises serious concerns, especially regarding problem gambling, which has negative impacts on individuals and related others (family or friends, etc.)[3]. Prevalence survey has revealed that the number of lottery gamblers in China has exceeded 200 million, and approximately 7 million of them are classified as problem lottery gamblers[4]. Extant literature has consistently demonstrated the critical role of environmental determinants in the development of problem lottery gambling, such as winning exposure[5,6], stressful life events[7], parental gambling frequency[8], and accessibility of gambling activities and promotions[9]. Moreover, with the global expansion of gambling activities and the development of sophisticated advertising campaigns, the influence of winning exposure on gambling behaviors across various gambling subtypes, including lottery gambling, has received increasing attention[10]. Previous studies have shown that winning exposure can lead to a decrease in risk perception[11], an increase in gambling intention and behaviors[12–14], and hinder the recovery of individuals with gambling problems[15]. However, most of these studies are conducted among gamblers in Western contexts, gambling studies in Asian populations are limited, particularly in mainland China[7,16]. This study therefore aims to examine the relationship between winning exposure and problem lottery gambling within the Chinese cultural context, while systematically investigating the underlying mechanisms in this association across various age groups.

[1]School of Education and Psychology, Tianjin University of Sport, Tianjin, P.R. China. [2]School of Physical Education and Sports, Central China Normal University, Wuhan, P.R. China. [3]Key Laboratory of Competitive Sport Psychological and Physiological Regulation, Tianjin University of Sport, Tianjin, China. ✉email: caixyccnu@126.com

Winning exposure and problem lottery gambling

Winning exposure refers to exposure to winning advertisements such as easy wins or big jackpots (e.g., "Incredibly lucky! Guangdong Huizhou wins 100 million yuan in the 7-star lottery"), has the potential to trigger the strong craving for gambling[17,18]leading to the irrepressible urge to gamble and ultimately contributing to problem lottery gambling[19]. In addition, frequent exposure to these winning advertisements may lower the gambling risk perception, which in turn elevates the underestimation of the potential harms associated with such activities. Consequently, individuals' self-control over their lottery gambling behavior may gradually decline, which makes them more likely to invest more in buying lottery tickets and suffer problem lottery gambling[20]. Therefore, we proposed the following hypothesis:

Hypothesis 1 Winning exposure is positively correlated with problem lottery gambling.

The mediating role of the illusion of control

Illusion of control refers to a belief that one believes their behavior can increase the chance of winning[21]. According to the control heuristic theory, the intention of winning and perceived connections between individual behavior and winning are crucial in the formation of illusory control[22]. On one hand, frequent exposure to depictions that winning outcomes are predictable, such as trend charts of winning numbers and experts' best sports bets, would make lottery gamblers believe that certain strategies help increase their probability of winning and getting big wins. This makes them pay more attention to the successful episodes with specific lottery gambling behaviors (such as trend analysis) while ignoring the losing episodes related to the same behavior. Consequently, they tend to attribute the winning to their behavior rather than other factors, thus creating an illusion of control[23]. On the other hand, winning exposure can induce rich associations with winning, arouse emotions, and heighten the desire to win, thus making lottery gamblers believe that they can also win big prizes by adopting similar methods, thereby leading to an illusion of control. A qualitative study conducted on sports bettors in the United Kingdom revealed that winning exposure could lead to a strong illusion of controlling the outcomes of betting[24].

Previous research suggests that the illusion of control plays a pivotal role in the development and maintenance of problem gambling[25]. Lottery gamblers with high illusion of control beliefs tended to believe that they are more skilled at predicting the winning outcomes and hold a strong desire to win, allowing for continued participation in irresponsible gambling with excessive time and money spent on gambling, eventually leading to problem lottery gambling[26,27]. For example, Hu et al.[23] and Xu et al.[28] found a positive relationship between the illusion of control and problem lottery gambling among Chinese lottery gamblers. Similar patterns are visible in gamblers with other types of gambling (e.g., poker, horse races), where they reported that the illusion of control exhibited a positive relationship with problem gambling[29,30]. To sum up, we proposed the following hypothesis:

Hypothesis 2 Illusion of control would mediate the link between winning exposure and problem lottery gambling.

Mediating role of lottery gambling passion

Passion for lottery gambling was defined as a strong inclination towards lottery gambling[31]. The Dualistic Model of Passion proposes that the initial development of passion experiences three processes: activity selection (developing a preference for activity over other activities), activity valuation (thinking that activity is especially important), and the internalization of the activity into one's identity. Within these processes, activity selection and activity valuation influence the "quantity" of passion experienced, while internalization influences the "quality" of passion, leading to the development of either harmonious passion or obsessive passion[32,33]. Based on this, passion for lottery gambling can be classified into two distinct forms: obsessive passion and harmonious passion. Obsessive passion arises from a controlled internalization of identity in lottery gambling, showing an uncontrollable urge to engage in lottery gambling[34]. Conversely, harmonious passion emerges from the autonomous internalization of identity in lottery gambling, leading to a harmony between cravings for lottery gambling and their lives[34].

We speculate that the winning exposure can affect the "quantity" of lottery enthusiasm. Exposure to news stories about winning big prizes may attract the attention of non-gamblers[35]thus arousing their interest in lottery gambling[36]. Consequently, this engagement can promote a harmonious passion for gambling, facilitated by experiencing fun and relaxation, making new friends, strengthened concentration, and a sense of responsibility[20,37]. However, it is worth noting that this kind of exposure may also contribute to the obsessive passion for lottery gambling. Lottery gamblers who are repeatedly exposed to messages advertising huge jackpots, easy wins, and top prize winners may also experience more excitement of near-miss wins, anxiety associated with chasing losses, and regret following excessive betting, thus being more likely to have an uncontrollable urge to take part in lottery gambling activities[31,38]which results in obsessive passion.

Individuals who have a strong illusion of control believe that there is a causal relationship between personal behaviors (such as praying and analyzing the trend of lottery numbers) and the winning results, so they are more likely to attribute their winning results to these behaviors, which leads to an overestimation of their ability to predict their gambling wins[21,23]. Those people may then gradually find difficulty in resisting gambling activities and a lack of control over gambling behavior in the process of continuously verifying this predictive connection[39]thus developing strong obsessive passion. Nevertheless, some researchers argue that the illusion of control buffers gamblers from unpleasant thoughts and negative affective states[21,40], thereby fostering the development of harmonious passion. Jointly, we hypothesize that the illusion of control can influence both forms of lottery gambling passion at the same time, although the influence on obsessive passion may be stronger, thus forming a "quality" impact on passion.

In addition, individuals with harmonious passion are more inclined to participate in lottery gambling driven by intrinsic motivations (e.g., enjoyment, joy, and challenge), leading to harmony between lottery gambling and their lives[38]and experience positive gambling consequences such as comfort, pleasant, etc[37,38]. Therefore, the possibility of problem lottery gambling is reduced. In contrast, lottery gamblers with obsessive passion are mainly driven by external pressures, such as winning money or escaping[41]. They have difficulties controlling their lottery gambling thus leading to more severe problems with lottery gambling. Existing research has confirmed the relationships between passions and problem gambling. For example, it has been shown that harmonious passion exhibited a negative relationship with problem gambling[42]. Obsessive passion, conversely, showed a positive association with gambling intentions[38], frequency[43], and problem gambling[42,44].

Taken together, we proposed the following hypothesis:

Hypothesis 3 Lottery gambling passions would mediate the link between winning exposure and problem lottery gambling.

Hypothesis 4 Illusion of control and lottery gambling passions sequentially mediate the effect of winning exposure on problem lottery gambling.

Moderating role of age

The hypothetical model proposed earlier may vary among age groups. Studies have indicated that retirement and widowhood are associated with diminished social networks[45]. For this reason, older adult lottery gamblers may be more vulnerable to external pressures, such as social interactions, self-affirmation, and a desire for control, which in turn foster the development of obsessive passions for lottery gambling. Additionally, older adults who experience gambling problems often hide their problems from family and friends because of the regret and shame associated with gambling[34], which may lead to more serious lottery gambling problems. Furthermore, compared to older adults, young people experience more pressures in their lives and may hope to get rich quickly through winning big. They may be more easily attracted by winning advertisements about huge jackpots, bonuses, or easy wins, and then show stronger external gambling motives, such as winning money and life-change, which lead to obsessive passion and serious gambling problems. In view of the limited theoretical and empirical research, we don't have specific assumptions about age differences.

Methods

Participants and procedure

As online lottery gambling was prohibited in mainland China, the recruitment of study participants was displayed in land-based retail outlets for lottery gambling. The first author and a total of 13 research assistants recruited by the second author participated in the recruitment. Training including procedure and notes for this cross-sectional survey was conducted for them before the formal survey. In total, about 162 retail stores were randomly selected from 27 cities in 9 provinces. Participants recorded their responses directly onto the questionnaire forms and were instructed not to write their names on the forms (5–8 min). The first author and the research assistants distributed and gathered the questionnaires. Participants received a lottery ticket after completing the study. Formal ethics approval for this study was granted by Tianjin University of Sport's Human Research Ethics Committee (2023-014). All participants informed consent for study participation and publication of results. A total of 3602 lottery gamblers participated in the current study. The age range of the participants was 18–83 years (3032 males, *M*age = 39.72 years, *SD* = 12.56). A detailed description of the participant sample is provided in Table 1.

Measures

Winning exposure

Winning exposure was measured with the Lottery Advertisements Questionnaire[46]. It consists of 4 items. Participants were asked to report the frequency of exposure to the following advertisements during the last 12 months [e.g., "Advertisements featuring predictive strategies for lottery wagering outcomes (e.g., trend pattern of the winning numbers) "]. Each item was scored from 1 (never) to 5 (always), with higher scores indicating higher levels of exposure to winning advertisements. The Cronbach's α coefficient was 0.86 in this study.

Illusion of control

Illusion of control was measured with a subscale in the Gambling Cognition Questionnaire[29]. A translated Chinese version of the Gambling Cognition Questionnaire has been validated[47]. The illusion of control subscale contained four items (e.g., "I have specific rituals and behaviors that increase my chances of winning"). Each item was rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating a stronger illusion of control. The Cronbach's α coefficient was 0.85 in this study.

Lottery gambling passion

Lottery gambling passion was measured with a ten-item Gambling Passion Scale[48]. A translated Chinese version of the Gambling Passion Scale has been validated[49]. The scale consisted of two sub-scales: harmonious passion (e.g., "lottery Gambling is in harmony with the other activities in my life") and obsessive passion (e.g., "I cannot live without this lottery gambling"). Each sub-scale contained 5 items and was rated on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree), with higher scores indicating stronger gambling passion. The Cronbach's α coefficient for harmonious passion and obsessive passion was 0.88 and 0.92, respectively.

Variable	*n* (%)	M(SD)
Socio-demographic characteristics		
Age		9.72(12.56)
Gender		
Male	3032 (84.18)	
Female	570 (15.82)	
Residential area		
Metropolitan	2184 (60.63)	
Rural/regional	1418 (39.37)	
Education		
Junior high school or below	649(19.66)	
High school	1133(34.32)	
Associate degree	908(27.51)	
Bachelor's degree	559(16.93)	
Graduate degree or higher	52(1.58)	
Gambling-related characteristics		
Type of game		
Sport betting	1405 (39.01)	
Number games (e.g., Super Lotto and the Seven Star Lottery)	2871 (79.71)	
Scratch card	1160 (32.20)	
Years of gambling		
0–1 years	420 (11.66)	
2–5 years	1224 (33.98)	
6–10 years	1244 (34.54)	
11–25 years	684 (18.99)	
26–50 years	30 (0.83)	

Table 1. Socio-demographic and gambling-related characteristics of the study sample ($n = 3602$).

Problem lottery gambling
Problem lottery gambling was measured by the Problem Gambling Questionnaire developed by Ferris and Wynne[3]. A translated Chinese version of the problem lottery gambling scale has been validated[23]. It included 9 items, such as "bet more than you could afford to lose". Each item is scored from 1 (strongly disagree) to 7 (strongly agree). The Cronbach's α coefficient was 0.90 in this study.

Socio-demographic and gambling-related variables
Age, gender, residential area, and education were collected as socio-demographic variables. Participants were all 18 years of age or older. They were divided into three groups according to their age: 1542 young adults (18–35 years old), 1747 middle-aged adults (36–59 years old), and 313 elderly (above 60 years old). The type of game and years of gambling were collected as gambling-related variables. In terms of the years of gambling, participants were asked to report their gambling experience in years. Those with less than one year of experience were asked to specify the number of months. Years of gambling was ultimately condensed into the following categories: 0–1 years, 2–5 years, 6–10 years, 11–25 years, 26–50 years.

Data analysis
SPSS 22.0 and MPLUS 8.3 were used to conduct data analysis. To examine the serial indirect effect of winning exposure on problem lottery gambling via the illusion of control and lottery gambling passion, descriptive and correlational analyses, and structural equation modeling were conducted. The model fit was evaluated using multiple well-established indices, including RMSEA, SRMR, CFI, and TLI. Following widely accepted guidelines in structural equation modeling[50], we adopted the following benchmark values for assessing global model fit: CFI values approaching 0.95 or higher, RMSEA values below 0.06, and SRMR values less than 0.08. Two phases were conducted to examine the differences among the three age groups in these relationships, as recommended by previous researchers[51,52]. The first phase was the measurement phase which was conducted to test measurement invariance. The second phase was the structural phase which was undertaken following the 3-step procedure recommended by Aguirre and Hu[53]. The first step was to establish the baseline model for the three age groups, respectively. The second step was to test the invariance of structural path coefficients across groups, where estimating a configural SEM model using the three samples simultaneously. The last step was to test the invariance of indirect effect across groups.

	M	SD	1	2	3	4	5	6
1. Winning exposure	2.67	1.01	1.00					
2. Illusion of control	2.99	0.88	0.31**	1.00				
3. Obsessive passion	3.37	1.43	0.23**	0.36**	1.00			
4. Harmonious passion	4.23	1.32	0.28**	0.25**	0.45**	1.00		
5. Problem lottery gambling	1.89	0.78	0.41**	0.36**	0.45**	0.10**	1.00	
6. Age group	1.66	0.63	0.05**	0.07**	0.10**	0.19**	-0.10**	1.00

Table 2. Descriptive statistics and correlation analysis of variables. $^{**}p < 0.01$.

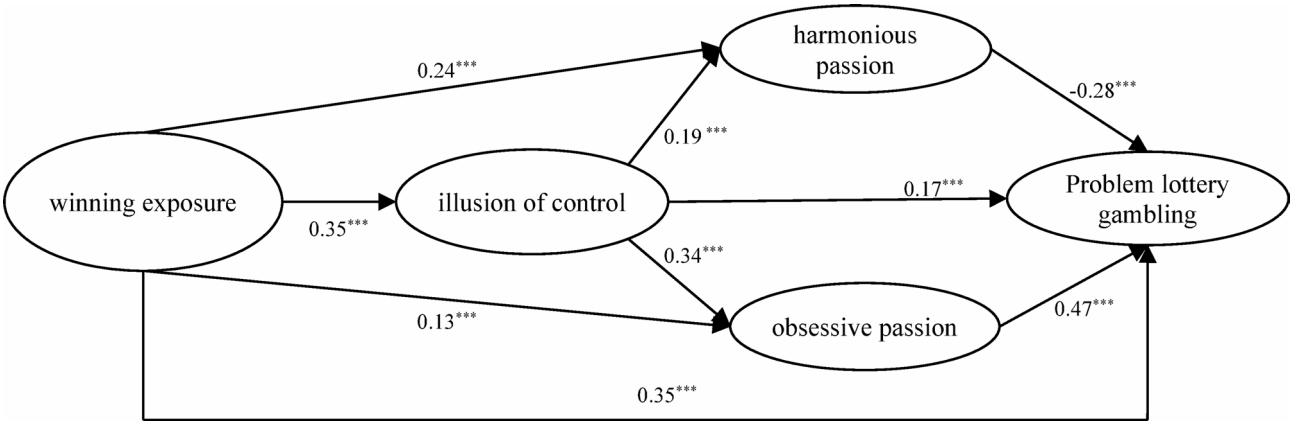

Fig. 1. Serial mediating model of the illusion of control and lottery gambling passion between winning exposure and problem lottery gambling. *Notes*: $^{***}p < 0.001$, $^{**}p < 0.01$.

Results

Descriptive statistics and correlation analysis

The correlation analysis showed that problem lottery gambling was significantly positively associated with winning exposure ($r = 0.41$, $p < 0.01$), illusion of control ($r = 0.36$, $p < 0.01$), obsessive passion ($r = 0.45$, $p < 0.01$), harmonious passion ($r = 0.19$, $p < 0.01$) (Table 2). Additionally, Harman's single factor was applied to assess the common method bias[51]. The results showed that the variation explained by the first factor was 29.3%, less than 40%. It indicated that there was no significant common method bias in this study.

Structural model

To examine the association between winning exposure and problem lottery gambling, as well as the mediating effects of the illusion of control and lottery gambling passion, structural equation model analysis was conducted on the full sample without imposing additional constraints. To scale the metric of each latent factor, one loading for each factor was set to 1. The model fit indices were within the acceptable range: $\chi^2 = 1479.21$, $p < 0.001$; RMSEA = 0.03; SRMR = 0.04; TLI = 0.98; CFI = 0.97. Figure 1 summarizes the standardized path coefficients of the serial mediated structural model. The result showed that winning exposure was positively associated with problem lottery gambling ($\beta = 0.35$, $p < 0.001$), supporting research hypothesis H1. To estimate the indirect effects, we adopted the bootstrapping technique with 1,000 resamples. The significance of the estimates was assessed using the 95% confidence interval (CI). The estimates were considered statistically significant at the $p < 0.05$ level when their 95% CI did not include zero. Results reported that the significantly simple indirect effect of illusion of control ($\beta = 0.062$; 95%CI: 0.04, 0.07), obsessive passion ($\beta = 0.063$; 95%CI: 0.04, 0.08), and harmonious passion (β=-0.072; 95%CI: -0.09, -0.06) in the relationship between winning exposure and problem lottery gambling. H2 and H3 have thus been supported by these results. The indirect role of the illusion of control and obsessive passion ($\beta = 0.063$; 95%CI: 0.04, 0.08) and the indirect role of the illusion of control and harmonious passion (β=-0.019; 95%CI: -0.03, -0.02) was also significant, supporting research hypotheses H4.

Moreover, we found that the difference in the indirect effect between obsessive passion (path a: Winning exposure → Obsessive Passion → Problem Lottery Gambling) and harmonious passion (path b: Winning exposure → Harmonious Passion → Problem Lottery Gambling) was non-significant (path a–path b = 0.01, $p = 0.429$). The difference of the indirect effect between illusion of control and obsessive passion (path c: Winning exposure → Illusion of Control →Obsessive Passion → Problem Lottery Gambling) and illusion of control and harmonious passion (path d: Winning exposure → Illusion of Control →Harmonious Passion → Problem Lottery Gambling) was significant (path c–path d = 0.04, $p < 0.001$).

Measurement model	χ^2	df	RMSEA	SRMR	TLI	CFI
Model 1: Baseline model (no equality constraints imposed)	2322.065***	918	0.036	0.036	0.968	0.972
Model 2: Factor loadings modeled invariant	2373.792***	962	0.035	0.037	0.969	0.972
Model 3: Factor loadings and error variance modeled invariant	2763.424***	1016	0.038	0.047	0.964	0.965
Model 4: Factor loadings, error variance and factor variance/covariance modeled invariant	2889.613***	1046	0.038	0.058	0.963	0.963

Table 3. Testing for measurement invariance across three age groups.

	χ^2	df	RMSEA	SRMR	TLI	CFI
Model: Young Adult	797.217***	306	0.032	0.030	0.975	0.978
Model: Middle-Aged Adult	967.557***	306	0.035	0.036	0.967	0.971
Model: Elderly	557.291***	306	0.051	0.055	0.932	0.941
unconstrained model	1716.299***	1006	0.024	0.037	0.972	0.973
constrained model	1766.198***	1024	0.025	0.056	0.971	0.972

Table 4. Model fitting index. ***$p < 0.001$.

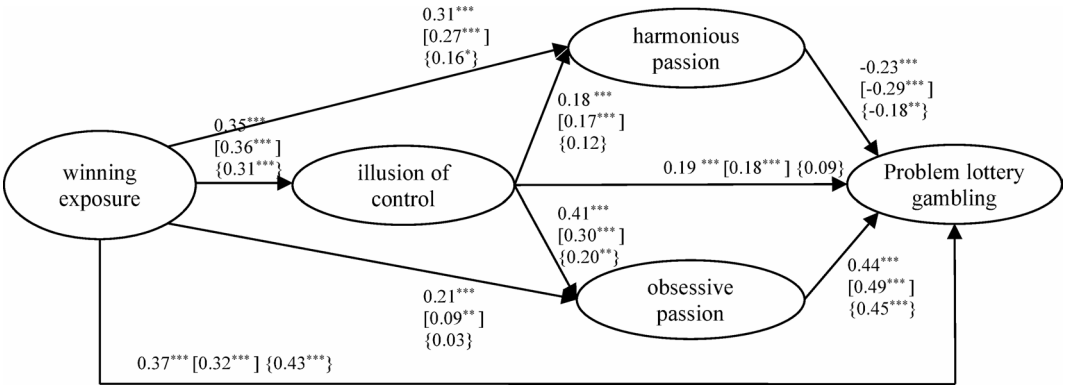

Fig. 2. Serial mediating model in three age groups. *Notes*: ***$p < 0.001$, **$p < 0.01$; [] middle-aged Adult, {} elderly.

Multigroup analysis of measurement invariance

Multigroup analysis of measurement invariance was conducted following the procedure recommended by Byrne (2006)[54]. The first step was to test the configural invariance, which involves assessing whether the same latent factors and the pattern of free and fixed factors are present in the same group in the three groups. Later, metric invariance was performed, where the factor loadings were constrained to be equal across groups. Finally, the most restrictive model with an additional constraint of factor variance-covariance was performed. Table 3 summarizes the results of these steps. The full sequence invariance tests showed good data fit for all the increasingly restrictive models, with CFI > 0.90 and RMSEA < 0.06. ΔCFI and ΔRMSEA were all not exceed 0.01 and 0.0015, respectively, indicating scalar invariance[55,48].

Multigroup analysis of structural models

After confirming the measurement invariance, we estimated separate structural models for each group. The model fit indices for three age groups were within the acceptable range (see Table 4). Figure 2 summarizes the standardized path coefficients of the serial mediated structural model for three age groups. Results showed that the association between winning exposure and obsessive passion, between the illusion of control and harmonious passion, and between the illusion of control and problem lottery gambling was non-significant for older adults. All other paths are significant.

The second step was to test the invariance of structural path coefficients across groups. Results showed that the model fit indices for the unconstrained model ($\chi^2 = 1716.299$, $p < 0.001$; RMSEA = 0.02; SRMR = 0.04; TLI = 0.97; CFI = 0.97) and constrained model ($\chi^2 = 1766.198$, $p < 0.001$; RMSEA = 0.03; SRMR = 0.06; TLI = 0.97; CFI = 0.97) were within the acceptable range (see Table 4). Moreover, the constrained model differed from the unconstrained model ($\Delta\chi^2 = 70.842$, $\Delta df = 18$, $p < 0.001$), which suggested that our hypothesized structural path model showed significant differences across the three groups.

Finally, the model constraint was used to test the invariance of indirect effect across groups. Table 5 summarizes the results of invariance analyses of indirect effect across three age groups. The results showed that path a ($\Delta\chi^2$young-middle-aged = 31.19, $p < 0.001$; $\Delta\chi^2$young-elderly = 30.28, $p < 0.001$) and path c ($\Delta\chi^2$ young-

Path	Young adult		Middle-aged adult		Elderly		χ^2 (df = 1)
	β	95% CI	β	95% CI	β	95% CI	
winning exposure → illusion of control → problem lottery gambling	0.06***	0.05, 0.09	0.07***	0.05, 0.08	0.03	-0.02, 0.07	Young Adult-Middle-Aged Adult: 2.79 Young Adult-Elderly: 3.54 Middle-Aged Adult-Elderly: 0.55
winning exposure → obsessive passion → problem lottery gambling	0.10***	0.06, 0.12	0.05**	0.01, 0.07	0.01	-0.07, 0.07	Young Adult-Middle-Aged Adult: 31.19*** Young Adult-Elderly: 30.28*** Middle-Aged Adult-Elderly: 3.22
winning exposure →harmonious passion → problem lottery gambling	-0.06***	-0.09, -0.04	-0.08***	-0.01, -0.06	-0.03	-0.11, -0.01	Young Adult-Middle-Aged Adult: 4.70* Young Adult-Elderly: 14.18** Middle-Aged Adult-Elderly: 5.63*
winning exposure → illusion of control →obsessive passion →problem lottery gambling	0.07***	0.05, 0.08	0.06***	0.04, 0.07	0.03*	0.004, 0.06	Young Adult-Middle-Aged Adult: 15.22*** Young Adult-Elderly: 26.99*** Middle-Aged Adult-Elderly: 5.00*
winning exposure→ illusion of control → harmonious passion →problem lottery gambling	-0.02***	-0.03, -0.01	-0.02***	-0.03, -0.01	-0.01	-0.03, -0.002	Young Adult-Middle-Aged Adult: 3.01 Young Adult-Elderly: 15.47*** Middle-Aged Adult-Elderly: 7.47**

Table 5. Multi-group analysis test of indirect effects. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

middle-aged = 15.22, $p < 0.001$; $\Delta\chi^2$young-elderly = 26.99, $p < 0.001$) were both significantly higher and the path c ($\Delta\chi^2$ young-middle-aged = 4.70, $p < 0.05$; $\Delta\chi^2$young-elderly = 14.18, $p < 0.01$) was significantly lower in the young adults than in middle-aged adults and elderly. Path b ($\Delta\chi^2 = 5.63$, $p < 0.05$), path c ($\Delta\chi^2 = 5.00$, $p < 0.05$), and path d ($\Delta\chi^2 = 7.47$, $p < 0.05$) also existed significant difference between middle-aged adults and elderly.

Discussion

While gambling problems have received significant scholarly attention in Western contexts, gambling studies in Asian populations are limited, particularly in mainland China[7,16,54,55]. Moreover, with the diversification and increased frequency of gambling-related advertising exposure, a growing body of research has called for heightened attention to its potential impact on problem gambling[56]. This study focuses on examining the association between winning exposure and problem lottery gambling in mainland China and investigating whether the illusion of control and lottery gambling passion mediates this association. This study further investigates whether the mediating mechanisms are the same across different age groups.

The relationship between winning exposure and problem lottery gambling

It has been shown that gambling advertisements are positively related to attitudes toward gambling, behavioral intentions, gambling urges, excessive betting on sports, and problem gambling[10,14,15,57]. Among these advertisements, the role of winning advertisements is very prominent[6,15]. Supporting our first hypothesis, winning exposure was positively associated with problem lottery gambling, and this association remained when the illusion of control and lottery gambling passion were controlled across three age groups. These results suggest that winning exposure was responsible for problem lottery gambling, and this effect held after accounting for (above and beyond) any mediating effects of changes in the illusion of control and passion.

Mediating roles of illusion of control and lottery gambling passion

Firstly, the present study found that the relationship between winning exposure and problem lottery gambling was partially mediated by the illusion of control, operating alongside the direct relationship. Consistent with the pathways model of problem gambling, environmental factors relating to availability and legality lead to the cognitive process resulting in the illusion of control, the development of habitual patterns of gambling, and increasing pressure to chase losses, which ultimately cause gambling problems[58]. This suggests that lottery gamblers who are repeatedly exposed to winning advertisements are more likely to shape beliefs surrounding erroneous perceptions of the control over the outcome, believing that they can influence the chance outcomes of winning (i.e., illusion of control), ultimately resulting in problem lottery gambling. In addition, in the later part of the mediation process (illusion of control → problem lottery gambling), the illusion of control was positively and significantly related to problem lottery gambling, which was in line with the conclusions of previous studies[23,28].

Secondly, results reported that the relationship between winning exposure and problem lottery gambling was also partially accounted for by the type of passion held for lottery gambling. In particular, the association between winning exposure and problem lottery gambling was positively mediated by obsessive passion, but negatively mediated by harmonious passion. This result was partially supported by previous research, showing that obsessive passion was positively related to problem mobile gambling, while harmonious passion was unrelated to problem gambling[59]. A surprising finding was that the difference in the simple mediating effect between obsessive passion and harmonious passion was nonsignificant. A possible explanation for this result is that while individuals repeatedly engaged in playing lottery games induced by winning exposure, they may alternately experience controlled and free states (such as relaxation and entertainment) or uncontrolled and inflexible states (such as anxiety with chasing losses, regret after over-betting, or uncontrollable gambling desire). Thus both types of passion for lottery gambling can be strengthened[60]. Harmonious passion can help gamblers effectively balance their lottery activities with other aspects of their lives and experience positive consequences, thus reducing lottery gambling-related problems. In contrast, obsessive passion can make it difficult for gamblers

to control their lottery gambling behaviors, leading to excessive engagement and an increased risk of problem gambling.

Furthermore, this study found that the illusion of control and passion jointly mediate the association between winning exposure and problem lottery gambling. Lottery gamblers who were frequently exposed to lottery advertisements revealing huge jackpots, easy wins, and showcasing top prize winners are more likely to develop an illusion of control. They believe that there are some skills available to improve their odds of winning a jackpot and deem gambling to be a means of settling their financial problems[21]. This may result in a controlled internalization of lottery activities and the development of obsessive passion, thereby leading to problem lottery gambling. On the other hand, lottery gamblers with strong control illusions can also experience more sense of control, less unpleasant feelings, and negative feedback from losing experiences, and meet the demand for enjoyment and joy, thus promoting the development of harmonious passion and preventing gambling harms. Since the role of the illusion of control in promoting physical and mental health has been widely discussed as an adaptive misbelief[61,62], it is not surprising that there is a positive correlation between control illusion and harmonious passion. More importantly, the serial mediation role of the illusion of control and obsessive passion was stronger than the serial mediation role of the illusion of control and harmonious passion in the relationship between winning exposure and problem lottery gambling. This indicates that although winning exposure can reduce gambling problems by promoting the illusion of control and harmonious passion, it is more likely to amplify problem gambling behaviors by exacerbating the illusion of control and obsessive passion.

To sum up, it is important to highlight the special role of passion for lottery gambling. First, consistent with the Dualistic Model of Passion[32] and previous studies[38,42], our results suggest that passion for lottery gambling activities doesn't always lead to adaptive outcomes, and sometimes it can evolve into inflexible, uncontrollable, and pressure-driven pursuits (e.g., problem lottery gambling). Second, in the correlation analysis, we found that there is a positive correlation between harmonious passion and problem lottery gambling, while in the structural equation model analysis, there is a negative correlation between them. The explanation for this result might be that both types of passion for lottery gambling involve a strong inclination toward gambling activity and usually show a moderate positive correlation, thus affecting the 'pure' correlations between harmonious passion and problem lottery gambling[33]. These findings corroborate previous empirical evidence that harmonious passion has non-significant or small significant positive correlations with problem gambling and negative consequences of gambling, and the protective roles of harmonious passion become evident when controlling for obsessive passion[31,37,48,59]. Additionally, although these two types of passion have opposite effects on problem gambling, they are both influenced by the illusion of control and winning exposure, which indicates that they may have common sources.

Age differences in the mediating model

The results of the multigroup structural equation model analysis showed that the mediating path involving passion varied within three age groups. In particular, the simple mediating effect of obsessive passion and the serial mediating effect of illusion of control and obsessive passion between winning exposure and problem lottery gambling decreased with age, and the former was non-significant in elderly people. Similarly, the simple mediating effect of harmonious passion and the serial mediating effect of illusion of control and harmonious passion also decreased with age, and the latter was non-significant in elderly people. These results indicate that the obsessive passion of young gamblers seems to be more influenced by winning exposure and the illusion of control, which leads to lottery gambling problems. A possible explanation for this is that young people experience more economic pressures than the elderly[63] and are more susceptible to bonuses. They become attracted to various forms of winning advertisements and are more prone to erroneous beliefs about gambling[64]which results in stronger obsessive passion and problem gambling behavior. These findings were in line with the previous studies, which considered young people a vulnerable population for gambling problems[65–67] because of cognitive immaturities (e.g., illusions of control[68]), susceptibility to environmental factors, including messages that distort the financial rewards and exposure to advertising[69]. In contrast, most elderly individuals have been found to exhibit favorable attitudes toward gambling, viewing it as an ordinary and secure mode of amusement[70]. They also focus more on maintaining the enjoyment of gambling[71] and show less illusion of control[72]. These findings may explain the age differences in the indirect effects of passions.

Theoretical and practical implications

The present study has several theoretical and practical implications. First, by demonstrating the strong effect of winning exposure on problem lottery gambling, this study adds to the scant empirical evidence on this issue. Second, although previous researchers have pointed out the vital role of advertisements in problem gambling, the mechanism under this link remains unclear. This study included the illusion of control in the model, a special belief that has been shown to be stronger in Chinese collectivistic culture relative to Western individualistic culture[73–75]. The mediating role of the illusion of control provide a new and important insight into how repeated exposure to big jackpots, bonuses, or easy wins leads to problem lottery gambling among lottery gamblers in China. Moreover, in response to positive psychology, passion has been discussed to understand human behaviors in various fields such as work, sport, education, and gambling[33,76,77]. The findings of this study do align with the Dualistic Model of Passion and suggest that passion is not always adaptive, that is, individuals with obsessive passion are more likely to experience maladaptive outcomes, and individuals with harmonious passion are more likely to experience adaptive outcomes. Furthermore, and importantly, this study clarifies the differences in the underlying mechanism of the relationship between winning exposure and problem lottery gambling. The results show that, compared with the elderly, the illusion of control and passion of young people are more easily influenced by winning exposure, which leads to problem lottery gambling.

From a practical perspective, this study shows some implications for promoting responsible lottery gambling. Lottery managers should pay more attention to winning advertisements due to their associations with erroneous beliefs, obsessive passion, and lottery gambling problems. Chinese Lottery Administration Center is striving to promote rational lottery gambling by using warning messages about the probabilities of winning, such as "There is no so-called 'winning pattern' in the lottery. Take the Super Lotto as an example, the probability of winning a big jackpot is about 1 in 21.42 million." However, empirical research has confirmed that these warning messages are often ignored by gamblers[26]and they can't consistently modify irrational beliefs or erroneous estimations about the probability of winning[78]. A possible reason for this phenomenon is that lottery gamblers, especially sports bettors, are more susceptible to winning advertisements[15]. As such, lottery managers should moderately reduce the advertisements of winning and customized messages targeting various segments of lottery gamblers. Regarding the protective role of harmonious passion in reducing lottery gambling problems, the second recommendation is to promote harmonious passion by focusing more on entertainment functions and intrinsic motivations of lottery gambling. Furthermore, the findings of this study suggest that lottery managers should take into account the age of lottery gamblers when designing responsible gambling strategies, as this may help to reduce gambling-related harms. For example, it would be beneficial to enforce time and monetary betting limits among young adults, especially college students, as it has been suggested that those limit-setting tools may be effective in reducing irrational beliefs and regular use for young people[79,80].

Limitations and future research

There are several limitations in this study. First, the cross-sectional design can only obtain simultaneous relationships. Therefore, problem gambling may also affect winning exposure. Lottery gamblers with higher problem gambling severity may self-select in environments with more lottery winning advertisements. Research indicates that problem gamblers often display stronger attentional biases toward gambling-related visual cues[81–83]leading to increased focus on winning advertisements. Experiment research from analogous areas of Tobacco and alcohol found that smokers display an attentional bias toward cigarette-related stimuli[84]and individuals with alcohol dependence show similar biases toward alcohol-related cues[85]. Future research may consider the experiment studies combining the Eye-tracking method to infer causal conclusions, and conduct the longitudinal studies to examine the long-term effects of winning exposure. Additionally, it is important to note that the scale of winning exposure only has four items and may not accurately gauge all kinds of winning advertising. Future work could conduct other measures such as the Negative Influence of Gambling Advertising Questionnaire[86] and Effects of Gambling Advertising[17].

A further suggestion is that future research can consider the diary design, which permits tests of within-person fluctuation in intrapersonal outcomes, thus helping explore how gambling passions vary and affect gambling behavior. Second, data in this study are collected by self-reported measures that can be affected by response bias[15]. Future research may consider ecological momentary assessment technology, which allows real-time collection of current behavioral data to minimize recall bias[87]. Third, although this study has identified several key risk factors for problem lottery gambling, other factors, such as lottery gambling motivation[41]socioeconomic status[88]or present hedonistic time perspective[89] could also be considered. Additionally, recent studies have discussed the underlying mechanisms of gambling preferences in explaining why some people become problem gamblers[15,90]. Further research should thus consider the characteristics of lottery gamblers with different preference types (e.g., skill-based games and chance-based games).

Conclusions

Problem lottery gambling is a growing public health problem in China. Winning exposure is a potential trigger of problem lottery gambling. However, little is known about the underlying mechanisms between winning exposure and problem lottery gambling. This study investigated the structural relationships among winning exposure, illusion of control, lottery passions, and problem lottery gambling. Importantly, the present study revealed the key role of winning exposure in problem lottery gambling and the serial mediation roles of the illusion of control and passion. Furthermore, this study revealed that mediating roles of passions were stronger for young adults. These results expand our understanding of the mechanisms underlying problem lottery gambling and guide directions for promoting responsible lottery gambling.

Data availability

Data and material are available on request from the corresponding author.

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Author contributions
YH Design of the study, conducted statistical analyses, major contributor in the manuscript preparation. XYC Design of the study, provided statistical support, manuscript preparation. All authors read and approved the final manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

Ethics approval and consent to participate
All methods involving human participants were performed in accordance with the relevant guidelines and regulations as stipulated in the Helsinki Declaration. Informed consent was obtained from all participants. All procedures followed approved by Tianjin University of Sport's institutional research board (2023-014).

Additional information
Correspondence and requests for materials should be addressed to X.C.