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ORIGINAL PAPER

# Examining the Gambling Behaviors of Chinese Online Lottery Gamblers: Are They Rational?

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**Abstract** In this research, we explore a unique Chinese peer to peer (P2P) online lottery gambling data (n = 388,123) and examine the rationality of Chinese online lottery gamblers. We show that Chinese online lottery gamblers are irrational in the sense that they are significantly affected by the lottery winning history of others even though this winning history is shown to be merely an exogenous random shock. Specifically, in this Chinese P2P online lottery gambling game, some of the lottery gamblers (named the proposers) propose lottery packages first, and then, other lottery gamblers (named the followers) will follow by choosing among the different packages and deciding on how much to purchase. The past lottery winning return rate of each proposer is provided as public information and calculated as the ratio between her past winning money and wager. It is shown that this past return rate is merely a random shock because winning in the past cannot predict anything about the performance in the future. However, we find that Chinese online P2P lottery gamblers are significantly more likely to join a lottery package if it is proposed by proposers with higher return rates.

**Keywords** Chinese lottery gambling · Chinese online peer to peer gambling · Gambling irrationality · Online gambling · Collective gambling

## Introduction

In this research, we investigate the behavior of Chinese online lottery gamblers by exploiting unique online lottery gambling data (n = 388,123) at the individual level. We are especially interested in examining the rationality of Chinese online lottery gamblers. We show that Chinese online lottery gamblers display irrational beliefs in the sense that their gambling behaviors are significantly affected by the lottery winning history of others, although this winning history is shown to be merely an exogenous random shock.

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There are several motivations for studying the gambling behaviors of Chinese online lottery gamblers and focusing on their rationality. First, the Chinese lottery gambling industry has become one of the largest in the world. In 2012, the lottery gambling revenue in China was 200 billion RMB with over 100 million lottery gamblers. Therefore, it is of great importance for both the academia and policy makers to understand Chinese lottery gambling behavior. In the literature, there is a long line of research that studies the Chinese gambling behaviors of different gambling activities, such as casino gambling, (Wu et al. 2012; Gu et al. 2012; Li et al. 2013;) sports betting (Li et al. 2012) and mahjong gambling (Zheng et al. 2010). This paper attempts to provide some insights into the study of Chinese lottery gambling, especially online lottery gambling.

Second, it is also important and interesting to understand this newly emerging Chinese peer to peer (P2P) online lottery gambling model, which will be described in detail in the following sections. P2P online lottery gambling in China is so popular that every major portal website, such as Sina.com, Baidu.com, Taobao.com, Suhu.com and neteas.com, has set up the P2P online lottery gambling platform. This P2P online gambling feature is rare in other countries, but this model has attracted millions of gamblers in China. To the best of our knowledge, this is the first among the many papers to study this P2P online lottery gambling model in the literature. We aim to provide fresh insights into understanding the behaviors of gamblers in this popular and still rapidly growing P2P online gambling business model.

Third, as pointed out, Chinese gamblers have spent hundreds of billions of RMB in gambling activities. A correct understanding of the rationality issues of Chinese gamblers will have meaningful implications for both policy makers and industrial practitioners. In the literature, there are many papers that have studied the rationality of western gamblers (Ayton and Fischer 2004; Clotfelter and Cook 1993; Terrell 1994; Croson and Sundali 2005; Guryan and Kearney 2008). Meanwhile, there are some papers which investigate this issue for Chinese gamblers by using either survey data or experimental setups (Tang et al. 2007; Tang and Wu 2010, 2012; Zhou et al. 2012; Li et al. 2012). However, there is a lack of research that uses field gambling data which takes place in actual Chinese businesses. We argue that this research which is based on field data may complement previous research which is based on questionnaires or experimental setups. To the best of our knowledge, this research is among the first few to collect and exploit field data to study the rationality issue of Chinese gamblers.

In this research, a popular Chinese P2P online lottery gambling game will be exploited. In this game, people form groups and collectively purchase a set of lottery tickets. Some gamblers (named the proposers) pick the lottery numbers and propose related packages for other lottery gamblers (named the followers) to purchase. The lottery winning return rate of each proposer is provided as public information and calculated as the ratio between her winning money and wager. Based on the past winning history of the proposer as well as the characteristics of the lottery package, other lottery gamblers will make their decisions on which package that they would like to join and if so, how much to purchase.

It is easy to see that the past return rate of lottery purchases is a random shock because winning in the past cannot predict anything about performance in the future. If lottery gamblers are rational, they should not use this illusionary luck to guide their future lottery purchases. However, instead, we find that Chinese P2P online lottery gamblers are significantly more likely to join a lottery package if it was proposed by proposers with higher past return rates of lottery betting although they are merely random shocks.

## Methods

### Background of P2P Online Lottery Gambling

Taobao, also called China's Amazon, is the biggest online shopping service provider in China, or perhaps even in Asia. In 2010, Taobao had over 370 million registered customers and generated over 400 billion RMB in sales (over 60 billion US dollars) with an annual growth rate of over 100 %. Besides general e-business, Taobao also provides a platform called the "Taobao Lottery" for online lottery gambling in China.

Any registered Taobao customer can buy tickets for any of the lotteries listed on the Taobao Lottery. However, the Taobao Lottery is more than just an online lottery store. The Taobao Lottery also provides a platform for group or collective lottery purchases. Figure 1 illustrates how the Taobao collective lottery purchase system works.

Anyone with a Taobao account can propose a "lottery package". A lottery package is a collection of lottery numbers chosen by a Taobao user that are sold for a price set by that same user. The user announces the number of shares in a package and the corresponding price per share (=Total Cost/Total Shares). For example, the user can propose a package, which only consists of two lottery tickets, and the total cost is 2 RMB; 1 RMB for each ticket. Meanwhile, if this same user divides this package into 100 shares, she will entice more people into joining. Therefore, there will be 100 shares for this lottery package and each share will be worth 0.02 RMB. Thus, at most, 100 lottery gamblers can take part and purchase shares in this lottery package.

Besides the lottery number selection, total cost, total shares and price per share, the user also has to reveal the number of shares that she had purchased before the package became available for sale. In other words, she must reveal her own investment in this lottery package. The last parameter that the creator of the lottery package must reveal is her commission fee: the percentage of the total winning prize that she will collect before the prize is divided among the investors according to their shares in this package. For example, suppose that a lottery package wins 100 RMB and the commission fee of the package proposer is 3 %. Before the others share the prize, the proposer will get 3 RMB first, thus leaving 97 RMB to be shared among the rest of the individuals.

If the open shares are not sold out, the lottery package is regarded as a failure and everyone gets her investment back. If the package is successfully sold out, the lotteries will be automatically purchased. If the package wins a prize, the Taobao Lottery will automatically calculate the return for each investor based on her share in this package and the money will be credited to the account of each investor. Most importantly, it is free and very easy for any registered Taobao user to initiate a lottery package. Any registered Taobao user can either initiate a lottery package or simply participate in the lottery package of another person.

### Data

The data are from a collection of web pages that contain all of the collective lottery gambling activities on the Taobao Lottery web site. We design and implement an algorithm to directly extract the lottery gambling information from the web page html code and compile them into a usable data format. The algorithm enables us to trace all of the collective gambling behavior of individual lottery gamblers that is related to the Bicolor Ball Lotto on the Taobao Lottery web site for 2 months. We collect all of the variables of interest, including the information of each proposer, number combinations of each lottery

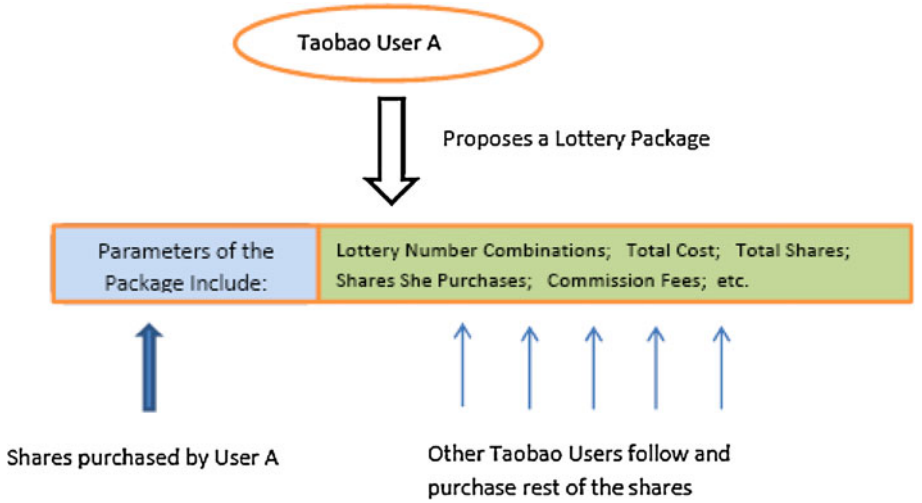


**Fig. 1** How collective lottery purchase system works

package, total cost, total shares, share prices, number of shares bought by each proposer, number of participants, whether the lottery package sold out, winning prize, and so on.

In the end, we obtain a panel of data with 388,132 collective lottery packages or observations. This panel of data contains 52,489 registered Taobao users and traces their histories of collective lottery proposals for 2 months, from 2011-04-12 to 2011-06-05, which represent 24 rounds of lottery draws. Table 1 presents the simple statistics of the data.

Each package clearly specifies the information, including the total cost of the package, number of shares that the package was divided into, number of shares purchased by the proposer him/herself, number of followers who bought into the package, commission fee for the proposer, sales progress of the package, amount of money won by the package, time when the package was proposed, and most importantly, lottery investment return rate of the lottery package proposer in the past 3 months.

The first row of Table 1 shows an important variable in the data: the average return rate of the lottery investment. The mean value of the return is 70 %, which means that for each lottery purchase of 1 RMB, the lottery gambler is losing 30 cents on average. The SD is 11,800 %, which suggests a huge variation among the return rates. The median return rate is 15.6 %, and the 90th percentile return rate is 43 %. This suggests that the distribution of the return rate is skewed to the left. In other words, most of the lottery package proposers have a mediocre return rate except for a few of them. The highest rate of return in the data is 4,098,400 %, which suggests that this particular proposer may have won a jackpot in the past 3 months.

## Regression Analysis

The purpose of the paper is to examine the rationality of Chinese lottery gamblers. We mainly investigate the following question: does a higher past rate of return of a proposer attract other lottery gamblers so that her package is more likely to succeed?

Here, the past rate of return of a proposer is defined as follows:

**Table 1** Simple statistics

| | Mean | SD | Min | Median | 90th percentile | Max |
|---|---|---|---|---|---|---|
| RATE | 0.71 | 118.8 | 0 | 0.156 | 0.43 | 40,984 |
| Cost of each package | 412.2 | 5,364 | 8 | 16 | 140 | 10,000 |
| Winning money | 39 | 16,076 | 0 | 0 | 20 | 10,000,000 |
| Shares in each package | 495 | 6,965 | 1 | 50 | 240 | 2,079,700 |
| Price of each share | 1.71 | 45.04 | 0.2 | 0.4 | 1 | 10,000 |
| No. of followers | 11.23 | 57.5 | 1 | 6 | 19 | 8,322 |
| Shares purchased by self | 76 | 442 | 1 | 25 | 100 | 75,000 |
| Portion of self purchase | 76 % | 442 % | 1 | 25 % | 100 % | 100 % |
| Commission | 5.60 % | 4.30 % | 0 | 6 % | 10 % | 10 % |
| Progress of lottery package | 86.2 % | 30 % | 1 % | 100 % | 100 % | 100 % |
| Package success rate (total) | 81 % | | | | | |
| Number of draws | 24 | | | | | |
| Number of proposers | 52,489 | | | | | |
| Number of observations | 388,132 | | | | | |

The money is in RMB. The data records start on 12th April 2011 and end on 5th June 2011

$$RATE = \frac{Total\ Winning\ in\ Previous\ Round}{Total\ Spending\ Previous\ Round}$$

It is easy to see that this past return rate is a random shock because winning the lottery in a previous draw cannot predict future performance as the winning is purely due to luck. If lottery gamblers are rational, they should not use this illusionary luck to guide their future lottery purchase decisions. We will run regressions to examine this claim.

If a lottery package does not successfully sell out, there will be a zero assigned to this package. Otherwise, the value will be 1. Therefore, we first employ a standard Logit model to investigate the factors that influence the success rate of a lottery package. The estimation function is shown as follows:

$$\begin{aligned}\Pr(y = 1) = F(&\beta_0 + \beta_1 * RATE + \beta_2 * Size + \beta_3 * Price \\ &+ \beta_4 * SELF\_BUY\ \beta_5 * \text{TIME\_SPAN} + \beta_6 * COMMISSION)\end{aligned}$$

The above is a standard logit model. $y$ is an indicator variable that shows whether the lottery package successfully sells out. *RATE* represents the lottery winning return ratio. $\beta_1$ is the coefficient that the research is interested in. If lottery gamblers are rational, they should not be affected by *RATE*. Therefore, $\beta_1$ should not be significant, which is the claim that we aim to examine. Other variables of interest are also controlled. *Size* is the total cost of the lottery package; *Price* is the share price of the lottery package; SELF_BUY is the portion of the package purchased by the lottery package proposer herself; TIME_SPAN is controlling for the time factor or how early the lottery package is put online for sale; and *COMMISSION* represents the commission rate set by the package.

## Results

Table 2 presents the regression results for the Tobit model, which examines whether the rate of return affects the success rate of the lottery packages. To examine the robustness of

the regression results, we try a number of regression setups. The first column shows the logit regression result when the regression only includes RATE as the regressor. As discussed above, the return rate is completely a random shock across individuals. Therefore, if lottery gamblers are fully rational, they should know that this past luck cannot bring them any meaningful result in the future, and thus they should ignore it. That is, $\beta_{RATE}$ should not be significant. However, the estimated result shows the contrary: $\beta_{RATE}$ is significantly positive, 0.011. In other words, if the past return rate is higher, lottery gamblers are more likely to chase this illusionary luck which makes the lottery package more readily to succeed.

To check the robustness of the regression result, we add more control variables into the regression. Column 2 shows the results when *Size* is added into the regression. In Column 3, we add the *Price* is added. In Columns 4, 5 and 6, we further add variables of *Self_Buy*, *Time_Span* and *Commission* one by one.

With regards to the estimation of $\beta_{RATE}$, Columns 2–6 show similar regression results: the return rate of the lottery package proposer has a positive impact on the purchasing decision of the lottery gamblers. Moreover, there is no significant difference in the estimation results, which suggests that the results are robust.

It is also worthwhile to look at the coefficients of the other variables. First, it should be noted that the coefficients of each variable are very stable regardless of the form of the regression functions. Therefore, we just look at the regression results when all of the variables are included, which are shown in Table 2, Column 6. $\beta_{SIZE}$ is negative, which is consistent with our intuition: packages with more lottery tickets are harder to sell out.

Positive $\beta_{Self\text{-}Purchase}$ suggests that lottery gamblers are more likely to join a package if the proposer herself purchases more shares of her own package. $\beta_{Time\text{-}Span}$ is also significantly positive, which suggests that packages placed online earlier will help to sell them out. Lastly, a negative $\beta_{Commission}$ suggests that lottery gamblers do not like the package that charges higher commission rates, which is also consistent with our intuition.

To summarize, Table 2 shows that lottery gamblers are affected by many factors when they make their lottery purchase decision. They like the proposer to purchase more shares in her own package; meanwhile, lottery gamblers do not like commission fees. However, the real focus of this research is on whether lottery gamblers show full rationality in the sense that they can ignore the impact of the random shocks of the return rate of the proposers. However, the results show that the past lottery investment return rate does have a significant impact on lottery gambling behavior although it should not if lottery gamblers are rational. Moreover, this result is very robust when a variety of regression functions are attempted.

## Discussion

In this section, we try a broad variety of model setups to check the robustness of the above results against different possible factors which may potentially affect the above regression.

### Fringe Package Proposers

We first check whether the results in Table 2 are robust against the behaviors of fringe lottery package proposers. The possible influence comes from the fact that some lottery package proposers may not be serious gamblers. The data show that some of the gamblers propose multiple packages, sometimes more than 40 packages in a single draw. If a

**Table 2** Logit regression: the impact of rate of return on gambler decision

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $\beta_{RATE}$ | 0.00964*** (0.000233) | 0.0105*** (0.000238) | 0.0105*** (0.000238) | 0.00974*** (0.000244) | 0.00962*** (0.000242) | 0.0101*** (0.000243) |
| $\beta_{SIZE}$ | | −0.00453*** (0.0000416) | −0.00459*** (0.0000423) | −0.00360*** (0.0000542) | −0.00362*** (0.0000543) | −0.00340*** (0.0000543) |
| $\beta_{Price}$ | | | 0.0219*** (0.00250) | 0.0371*** (0.00336) | 0.0424*** (0.00350) | 0.0316*** (0.00334) |
| $\beta_{Self\text{-}Purchase}$ | | | | 7.151*** (0.0274) | 7.248*** (0.0277) | 7.784*** (0.0295) |
| $\beta_{Time\text{-}Span}$ | | | | | 0.00862*** (0.000295) | 0.00849*** (0.000299) |
| $\beta_{Commission}$ | | | | | | −0.0907*** (0.00142) |
| Constant | 1.405*** (0.00599) | 1.646*** (0.00649) | 1.633*** (0.00665) | −1.499*** (0.0127) | −1.784*** (0.0162) | −1.545*** (0.0166) |
| $N$ | 360,126 | 360,126 | 360,126 | 360,126 | 360,126 | 360,126 |

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

proposer submits more than 20 packages, it is reasonable to question her seriousness towards the game and reasonable to speculate that this non-serious proposer may be more likely to encounter failure in her lottery package proposals. Therefore, we revise the regression to include a control for fringe proposers to examine the robustness of the previous result.

Table 3 shows the estimation results when fringe proposers are eliminated. We run the same regressions as we do as per Table 3 with all six columns. The results show that the estimated coefficients are very similar to the results in Table 2. This is especially the case for $\beta_{RATE}$, which are all significantly positive and stable. All these suggest that the regression results are robust against the possible impact from non-serious package proposers.

### Tobit Regression

In the previous analysis, we adopt Logit model to analyze the impact of the rate of return of the proposers on lottery gamblers. Here, we adopt a different regression model and the aim is to check whether our claim still stands.

Here, we adopt the following standard Tobit model with a lower limit of 0 % and an upper limit of 100 %:

$$\begin{aligned}\text{Progress} = {} & \beta_0 + \beta_1 * RATE + \beta_2 * Size + \beta_3 * Price + \beta_4 * SELF\_BUY\ \beta_5 * \text{TIME}_{\text{SPAN}} \\ & + \beta_6 * COMMISSION + \varepsilon \\ & \text{with a lower limit of } 0\% \text{ and an upper limit of } 100\%\end{aligned}$$

Here, Progress represents the percentage of the shares sold for each lottery package when the game is over. The rest of the variables are the same as those in the above logit regression.

Table 4 gives the Tobit model regression. We also follow the regressions in Tables 2 and 3 and add variables one by one to check the robustness of the regression results. First, Table 4 shows that the regression results are very stable. When different variables are added into the Tobit regression, the estimations results do not change much, which suggests that the regression results are robust. Second, the signs of the estimated coefficients are the same as those in Tables 2 and 3. Therefore, the previous discussions and conclusions still hold in these Tobit regressions. This is especially the case for the coefficient of $\beta_{RATE}$ which is significantly positive with a value around 0.25–0.42. This shows that the Tobit regression still suggests that Chinese lottery gamblers are affected by the rate of return of the proposers although it is merely a random shock.

## Conclusion

The examining of the misconception of randomness is empirically important as it hinges on the fundamental issue of the gambling decision in the face of uncertainties. The current P2P online lottery gambling business in China provides a good social experiment to examine lottery gambling behaviors and further touches on the conception of randomness in reality. As opposed to most of the past research, which is mainly based on questionnaires or experiment setups, we investigate this issue using a panel data at the individual level on

**Table 3** Robustness check: the impact of rate of return on gambler decision, excluding fringe gamblers who propose more than 5 packages in a single draw

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $\beta_{RATE}$ | 0.0111*** (0.000261) | 0.0110*** (0.000262) | 0.0111*** (0.000262) | 0.00948*** (0.000254) | 0.00933*** (0.000252) | 0.00981*** (0.000253) |
| $\beta_{SIZE}$ | | −0.00441*** (0.0000452) | −0.00447*** (0.0000458) | −0.00346*** (0.0000574) | −0.00349*** (0.0000575) | −0.00326*** (0.0000577) |
| $\beta_{Price}$ | | | 0.0176*** (0.00236) | 0.0399*** (0.00362) | 0.0455*** (0.00377) | 0.0336*** (0.00359) |
| $\beta_{Self\text{-}Purchase}$ | | | | 7.021*** (0.0290) | 7.110*** (0.0293) | 7.611*** (0.0310) |
| $\beta_{Time\text{-}Span}$ | | | | | 0.00849*** (0.000309) | 0.00829*** (0.000312) |
| $\beta_{Commission}$ | | | | | | −0.0888*** (0.00147) |
| Constant | 1.479*** (0.00645) | 1.716*** (0.00699) | 1.706*** (0.00713) | −1.419*** (0.0136) | −1.696*** (0.0171) | −1.454*** (0.0175) |
| $N$ | 334,248 | 334,248 | 334,248 | 334,248 | 334,248 | 334,248 |

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

**Table 4** Togit regression: the impact of rate of return on gambler decision

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $\beta_{RATE}$ | 0.428*** (0.0105) | 0.445*** (0.0102) | 0.445*** (0.0102) | 0.270*** (0.00642) | 0.268*** (0.00639) | 0.272*** (0.00624) |
| $\beta_{SIZE}$ | | −0.243*** (0.00204) | −0.245*** (0.00205) | −0.0807*** (0.00131) | −0.0803*** (0.00131) | −0.0747*** (0.00129) |
| $\beta_{Price}$ | | | 1.134*** (0.117) | 0.839*** (0.0776) | 0.927*** (0.0782) | 0.704*** (0.0763) |
| $\beta_{Self\text{-}Purchase}$ | | | | 286.3*** (1.048) | 288.8*** (1.055) | 302.9*** (1.091) |
| $\beta_{Time\text{-}Span}$ | | | | | 0.295*** (0.00933) | 0.287*** (0.00918) |
| $\beta_{Commission}$ | | | | | | −3.068*** (0.0437) |
| Constant | 197.1*** (0.553) | 204.4*** (0.566) | 203.7*** (0.569) | 27.99*** (0.394) | 18.37*** (0.499) | 27.20*** (0.501) |
| *N* | 360,126 | 360,126 | 360,126 | 360,126 | 360,126 | 360,126 |

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

actual lottery gambling obtained by directly extracting and tracing data from individual lottery gamblers with the help of an auto algorithm.

We mainly focus on examining the lottery gambling reactions of gamblers to the lottery gambling history of other people. As argued above, the past return rate of proposers is a complete random shock governed by chance. The estimation result is interesting. People are influenced by this random shock. By further examining a broad variety of model setups, the result proves to be very robust. That is, Chinese online lottery gamblers are erroneously affected to purchase lottery package shares if the package proposer has a higher past lottery investment return rate.

The result suggests that the traditional rationality assumption in the literature is violated in Chinese lottery gambling activities. As stated in the literature review section, there is a lack of research that uses field gambling data which takes place in actual Chinese businesses. The current research and the findings further complement the gambling literature regarding the rationality issue of Chinese lottery gamblers.

Meanwhile, the irrationality displayed by Chinese lottery gamblers also has important policy implications. Right now, the focus of Chinese lottery authority is mainly on the sales of different lottery games and how the transfers are allocated. However, rare attention is paid to the lottery gambler side. Current result implies that Chinese lottery gamblers may not gamble rationally. And this irrationality may be further related to other potential social issues such as problem gambling. Therefore, the future lottery policy design should also take this into consideration, instead of just focusing on the revenues brought by the lottery games. Possible policies may include educating the lottery gamblers or increasing advertising to publicize the irrationality issues displayed in the lottery gambling.

Our current research also has some limitations. First, the above findings lead to an immediate question: what explains this phenomenon? Another interesting question will be: is there any monetary consequence for these irrational behaviors for the gamblers? However, these questions are outside the scope of the current paper as we only want to show solid evidence that lottery gambling behavior is sometimes irrational. Even so, the questions are worth investigating, as they are related to a fundamental understanding of the gambling decision making process of individuals under uncertainty. Our speculation would be that the misconception or misinterpretation of probability of lottery gamblers may the reasons behind it, and there will be monetary loss for the irrational gamblers. These are left for future study.

In addition, the current research contains rich longitudinal data, not all of which are explored in this research. The current research only exploits the variation across lottery gamblers to examine their gambling fallacy behaviors. Yet it could be very interesting to explore the dynamics of lottery gambling behavior. However, this is also outside the scope of the current research and also left for future research.

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