Journal of Behavioral and Experimental Economics 53 (2014) 17–23

Contents lists available at ScienceDirect

Journal of Behavioral and Experimental Economics

journal homepage: www.elsevier.com/locate/jbee

Avoiding greedy behavior in situations of uncertainty: The role of magical thinking

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ARTICLE INFO

Article history:
Received 7 October 2013
Received in revised form 19 July 2014
Accepted 29 July 2014
Available online 12 August 2014

Keywords:
Belief in a just world
Greed
Magical thinking
Tempting fate

ABSTRACT

Previous studies have found evidence for the belief that actions which tempt fate increase the likelihood of negative outcomes. These included actions that presuppose a good outcome, that reflect hubris or that involve excessive risk taking. This paper explores a related form of magical thinking whereby individuals believe that asking for too much in situations of uncertainty may be punished by the universe and may decrease the probability of the desired outcome. It was found that many participants irrationally forgo the "greedy" option under uncertainty, even though it dominates other options and their behavior is not observed. It is suggested that some participants fear being magically punished for greediness and it is shown that the avoidance of greedy actions under uncertainty is related to the belief that one should not tempt fate. This phenomenon may have implications for various types of economic decisions such as charity donation, insurance purchase and bargaining.

1. Introduction

A belief that one's actions can affect the outcome of some chance event, when in fact its likelihood is independent of those actions, is often referred to as *magical thinking*. There is considerable evidence in the literature for the existence of such beliefs. Following are several examples: Individuals use more physical force when rolling a die if the desired outcome is one of the higher numbers (Henslin, 1967). Participants tend to place a higher value on lottery tickets when they, rather than the experimenter, pick them out of a box (Langer, 1975, explained this phenomenon as the "illusion of control"). It was found that participants in a medical test selected actions that lead to a favorable diagnosis (such as a strong heart), even though those actions obviously could not affect their state of health (Quattrone and Tversky, 1984). Many superstitious beliefs, such as wearing a lucky charm on the day of an important exam, also reflect this kind of illusion.

This paper explores a novel form of magical thinking whereby individuals believe that asking for too much in situations of uncertainty[1] might be magically punished by the universe and may decrease the likelihood of the desired outcome, which is in fact independent of their behavior. Participants in two experiments were offered the opportunity to choose from a number of positive lotteries that differed only in the value of their prizes. Although the lottery with the highest prize did not involve more risk than the others and was the only rational choice, a significant proportion of participants decided to forgo it. The experimental design allows ruling out the possibility that participants avoided the "greedy" choice mainly in an attempt to impress the experimenter. Furthermore, it was found that the avoidance of greedy choices under uncertainty is related to the participant's belief that one should not tempt fate. A third experiment suggests that the degree to which choosing the highest-prize lottery is perceived to be greedy affects the estimation of the likelihood of winning this lottery. Altogether, the findings support the magical thinking hypothesis described above. Additional explanations for the participants' avoidance of the highest-prize lottery will be discussed later on.

A number of recent studies have found evidence for the belief that actions which tempt fate increase the likelihood of negative outcomes (e.g. Risen and Gilovich, 2008; Swirsky, Fernbach, and Sloman, 2011; Tykocinski, 2008; Van Wolferen, Inbar, and Zeelenberg, 2013). These include actions that presuppose a good outcome, that reflect hubris or that involve excessive risk taking.

For example, participants in a study by Risen and Gilovich (2008) believed that an applicant to the PhD program at Stanford who wears a Stanford T-shirt is less likely to be admitted. The authors suggest that actions which tempt fate bring to mind negative outcomes, which in turn increases their perceived likelihood (since they are more available). Tykocinski (2008) explored the effect of

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[1] Throughout the paper, the term "uncertainty" is used whether probabilities are known or not (i.e. whether objective or subjective). When probabilities are known, it will be stated explicitly.

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http://dx.doi.org/10.1016/j.socec.2014.07.003

being uninsured on the perceived probability of negative events that would have been covered by the insurance. Participants in her study estimated a higher likelihood of such events when it was mentioned that they were not insured against them, perhaps because they felt that being uninsured is tempting fate.

In this paper, it is suggested that a different type of behavior, i.e. choosing the greedy option, may also be viewed as tempting fate. While in previous studies probabilities were unknown and participants were asked to estimate the likelihood of events, the two main experiments reported here involve objective probabilities and it is argued that the participants' choices reflect a perceived likelihood that differs from the objective probability. Additional non-choice data supports the "tempting fate" explanation.

The patterns of behavior observed in the current study may also be related to the notion of *belief in a just world* introduced by Lerner (1965). He has suggested that people need to believe that the world is just and hence form beliefs in accordance with this idea (for a review of the literature, see Furnham, 2003). This is similar to a belief in *Karma* (the law of moral causation in Hinduism and Buddhism). According to both ideas, good behavior will be rewarded and bad behavior will be punished, either by the universe or possibly by a just god.

Kogut and Ritov (2011) found that individuals estimate their likelihood of suffering from a potential misfortune to be higher after refusing a request to donate to the victims of the same misfortune and this is especially so among individuals who tend to believe in a just world. Thus, if individuals take their future feeling of vulnerability into account, then this belief may increase the amount they donate, which will make them appear to be more generous.[2] This conjecture is in the same spirit as the finding in the current study that individuals who tend to believe that one should not tempt fate avoid greedy choices in situations of uncertainty.

The belief that one should not tempt fate is in some ways similar to the general belief in a just world. Both hold that individuals' actions may affect the likelihood of outcomes that are objectively independent of those actions. Specifically, "bad" behavior on their part might magically lead to negative outcomes for them. One unique aspect of the belief in tempting fate is that the punishment is expected to be ironic. Namely, the negative outcome will be related to the sin. For example, if a person presupposes a good outcome in a particular uncertain situation, the probability that this uncertainty will be resolved in his or her favor decreases. Furthermore, an action does not have to be considered morally bad in order to tempt fate. Well-known examples include the belief that the decision not to take an umbrella increases the chances of getting caught in a heavy rain and that switching lines in the supermarket will result in waiting longer.

"Two-system" explanations of behavior (e.g. Chaiken and Trope, 1999; Evans and St, 2007; Kahneman, 2003; Sloman, 1996) suggest that individuals may be capable of logical reasoning and at the same time be affected by intuitions and feelings. Thus, individuals may rationally understand that their actions cannot affect the probability of an outcome, whether desired or not, while at the same time having a strong gut feeling that they indeed can. This gut feeling may be based on a set of associations that are stored by the intuitive system and individuals may not even be fully aware that these "magical" thoughts are influencing their intuition.[3]

[2] See also Converse, Risen, and Carter (2012) who find that the combination of wanting an outcome and lack of control under uncertainty increases donations to charity and suggest that this is due to a belief that one's donations increase the likelihood of the desirable outcome.

[3] Shafir and Tversky (1992) use the term "quasi-magical thinking" when referring to behavior that is consistent with magical thinking but is not based on explicit magical beliefs or the awareness of such beliefs.

Table 1
The distribution of choices in Study 1.

Amount selected	% of the participants
£23	69
£21	14
£19	6
£18	8
£17	0
£16	2

The conditions in the experiments reported here call for rational behavior. The tasks are simple, the rational choice is obvious (one option is dominant) and real money is at stake. Rozin et al. (2007) found that in judgments involving sympathetic magical feelings, individuals are much more rational when placed into a monetary frame of reference and they suggest that the deliberative processes take over from the intuitive processes in such contexts. The current paper shows that magical beliefs about tempting fate may influence behavior even in circumstances that impose a monetary cost. This may have implications for various types of financial decisions, as elaborated on in Section 5.

2. Study 1

This experiment demonstrates that in uncertain situations a significant proportion of participants avoid choices that may reflect greediness. The decision task was designed such that the "greedy" choice is the only rational one. Thus, it delivers the highest possible prize and does not involve more risk than the other choices.

2.1. Method

The experiment was carried out in the ELSE lab at University College London. A total of 49 participants participated in three sessions of the experiment. Almost all participants were UCL students (mostly undergraduates) in various fields of study. Their ages ranged from 19 to 32 ($M = 21.18$, $SD = 2.7$) and 26 were women. After answering two hypothetical questions as part of an unrelated study, each participant received a form and a small sticker. The form included all the instructions needed for the experiment. Participants were asked to select one of the following amounts of money: £16, £17, £18, £19, £21 or £23 and to write it on their sticker (and on the form as well). After all the participants had made their choices, each was in turn asked up to the experimenter's desk according to his or her lab identity number. The participant put the sticker on one of the six faces of a standard die and rolled it. (The participants were informed in advance that it is a standard die, though the numbers on the die had no meaning in this experiment.) If the die came to rest with the sticker facing up, the participant received *the amount written on the sticker*. Otherwise, he or she received only £5 for showing up. At the end of the experiment, each participant collected the payoff from the experimenter.

2.2. Results and discussion

The distribution of choices in the experiment appears in Table 1. Only 69% of the participants chose the highest possible amount (the 95% confidence interval extends from 55 to 81%). The rest chose one of the other amounts, with about half of them choosing the second highest amount. Although the situation is endowed with objective probability, one could argue that participants perhaps did not perceive all the outcomes of the die's roll as equally likely. If the probabilities of the different faces of the die are not perceived as equal, it might be possible to explain the results using theories of behavior under ambiguity (see Camerer and Weber, 1992, for a

survey of the topic). Note, however, that even according to these theories, the perceived probability of winning the amount of money written on the sticker cannot depend on the specific amount chosen by the participant (but rather only on the selected face).

What may explain this intriguing phenomenon? Below I suggest a possible explanation for the irrational choices based on magical thinking.

It might be that some participants who did not choose the highest amount intuitively believed that the realization of the die's roll depends on the choice they make and feared being punished for greediness by some higher power. In other words, they had a gut feeling that the likelihood of winning would be lower if they selected £23, which was liable to be considered greedy. The specific design of the experiment may have triggered the illusion of dependence between a participant's action and the outcome of the die's roll by creating a physical connection between the two (i.e. writing the selected amount on the sticker and placing it on the die).

In real life, small prizes are often objectively associated with a higher probability of winning than large prizes and it is more common to observe someone who has won a small prize than someone who has won a large prize. This may lead people to feel that going for smaller prizes generally brings luck. In other words, it is possible that we develop an intuitive association between "greedy" choices and a low likelihood of winning.

A participant's intuitive belief may have affected his choice despite his awareness of the rational argument for choosing £23. This is in line with two-system theories, according to which System 1 and System 2, which are responsible for intuitive and deliberative reasoning, respectively, may be active simultaneously and both can guide decisions. This is also consistent with the claim made by Loewenstein et al. (2001) that feelings play a prominent role in decision-making under risk and uncertainty.

As in many other contexts (in both real life and experiments) in which an individual's behavior is affected by superstitious beliefs, participants in the die experiment apparently allowed themselves to be influenced by magical beliefs in order to be "on the safe side". While some magical beliefs may not result in a material cost, the participants in this experiment were willing to sacrifice an amount of money (at least £2) for that purpose.

2.3. Support for the interpretation of the findings

While the intuitive system is allegedly responsible for magical thinking, the deliberative system encourages the use of reason and does not allow for such beliefs. Thus, participants may feel uncomfortable admitting that they actually hold magical beliefs. This is particularly true in situations where the probabilities are objective and there is a clear rational choice, as in this experiment.

In order to shed light on the arguments that might lead to choosing less than £23, a different group was asked to explain the behavior of the 31% of participants who chose the smaller prizes in the die experiment. To this end, the die experiment and its results were briefly described to 35 students majoring in Social Work at Tel Aviv University. They were asked to write down the most likely explanation in their opinion for not choosing the largest possible prize.

Among this group, 46% interpreted the choice of a prize smaller than £23 as an outcome of magical thinking. They conjectured that participants in the die experiment believed that their chances of winning would increase if they did not choose the largest prize. Most of the answers explicitly mentioned that the greediness associated with selecting the highest prize is the reason for the lower perceived probability of winning while a few suggested that some number other than 23 felt luckier. Thus, the magical thinking interpretation was the most popular by far. Other explanations suggested that the participants did not understand some aspect of the experiment, that they did not believe they would win and hence did not care which amount they chose, that they did not want to appear greedy in the experimenter's eyes or that they wanted to lower their expectations in order to minimize their potential disappointment if they did not win.

Overall, the findings suggest that magical thinking considerations are indeed relevant in the context of the die experiment. It is likely that many of those who were asked to explain the observed irrational behavior would themselves have chosen the largest possible prize if they had participated in the die experiment; nonetheless, they offered magical thinking as the most likely explanation for the behavior of 31% of the participants in the die experiment.

3. Study 2

It might be argued that the results of Study 1 are partly due to the fact that the experimenter observes the participant's choice. Thus, a participant may avoid the greedy action for the purpose of making a good impression on the experimenter. That is, the participant is not necessarily worried about being punished for a greedy choice by some higher power, but rather tries not to appear greedy in the experimenter's eyes. Conversely, it is also plausible that the desire to impress the experimenter in such a context works in the opposite direction and motivates some participants to reject their magical thoughts and to choose rationally. After all, not choosing the highest amount may be considered a silly choice.

The following experiment was designed to test this experimenter effect. Two conditions are compared, one in which the participant's choice is observed by the experimenter and one in which it is not. It was hypothesized that being observed by the experimenter does not encourage the participants' avoidance of the greedy choice. In addition, the experiment relates the participants' decision to forgo the greedy option to their belief in the concept of tempting fate. This association supports the hypothesis that magical thinking plays a role in the underlying mechanism.

3.1. Method

The participants consisted of 84 undergraduate students at Tel Aviv University. Their ages ranged from 20 to 51 ($M = 25.24$, $SD = 3.62$) and 37 were women. The experiment was carried out in a computer lab at Tel Aviv University. At the end of the experiment, each participant collected a payoff of at least 20 shekels (about $5) at a different location in the building. Some participants received a higher payoff depending on their choice of lottery and its outcome.

At the beginning of the experiment, an urn was introduced containing five balls marked with the numbers 30, 40, 50, 60 and 70. (The participants could see that each of the five numbers was written on one of the balls.) In the main task of the experiment, each participant was asked to select one of the following amounts of money: NIS 30, NIS 40, NIS 50, NIS 60 or NIS 70 (equal to approximately $7.50, $10, $12.50, $15 and $17.50, respectively). Once the participants had selected an amount, they called the experimenter over in order to draw a ball out of the urn. They then input the number on the ball into the computer and the experimenter made sure that they had done so correctly. Following the experiment, the participants were given the amount of money they had selected if the specific amount that they had chosen was written on the ball they had drawn; otherwise, they did not receive any payment. After each draw, the ball was returned to the urn and the balls were remixed.

Thus, a participant's choice and draw could not affect those of any other participant.

There were two conditions in the above task: "hidden" ($n = 47$) and "observed" ($n = 37$). In the hidden condition, a participant was asked to choose an amount of money and then proceed to the next screen in the experiment and only then to call the experimenter over in order to draw a ball out of the urn. In this way, the experimenter could not observe the participant's choice, but only the outcome of the draw. This was emphasized in the instructions given to the participants. In the observed condition, participants entered the outcome of the draw on the same screen where they had previously entered the amount of money they had chosen. The instructions given to the participants emphasized the fact that the experimenter is the only one who will observe the participant's choice. Note that in both conditions, the experimenter could not manipulate the balls in the urn such that the chances of winning the lottery would depend on which amount of money the participant had chosen.

The probability of winning the lottery was 0.2 regardless of the participant's choice and therefore selecting the lottery with a prize of NIS 70 was the only rational choice (since it dominated all the others). It was hypothesized that some participants would avoid choosing the highest amount in order not to be "greedy", which might tempt fate and decrease their chances of winning. The two conditions were designed to test whether the frequency of irrational choices depends on whether or not the experimenter observes the participant's choice. It was hypothesized that the experimenter's observation of the participant's choice would not cause participants to choose smaller amounts of money in an attempt to appear less greedy by the experimenter.

In order to further explore the mechanism generating irrational behavior, and in particular the role of magical and intuitive thinking, the participants were given two additional tasks after completing the urn task. In the first, the participants were asked to answer two variations of Kahneman and Tversky's (1972) question involving the gender sequence of 6 births on a particular day.[4] The purpose of this task was to determine whether participants tend to think intuitively when analyzing a probabilistic problem.

The second task was to fill in a questionnaire that measures the participant's belief in the concept of tempting fate. The questionnaire, introduced in Risen (2013), includes 10 statements such as "I believe that I'm more likely to have a drink spilled on me at a party if I borrow a shirt without permission than if I borrow a shirt with permission" and "I don't believe my behavior can prompt the universe to make bad things happen to me." Participants were asked to state the degree to which they agree with the statements on a scale of 1–7.

Prior to the urn task, participants filled in an additional questionnaire that measures the belief in a just world (they also answered an unrelated hypothetical question between the two tasks that created a separation between them). The questionnaire is based on the "belief in a just world for self" scale used in Lipkus, Dalbert, and Siegler (1996) and includes 8 statements such as "I feel that I deserve the punishments and prizes that I get". For each statement, the participants were asked to state to what degree they agree with the statement on a scale of 1–6. The participants also filled in a demographic questionnaire.

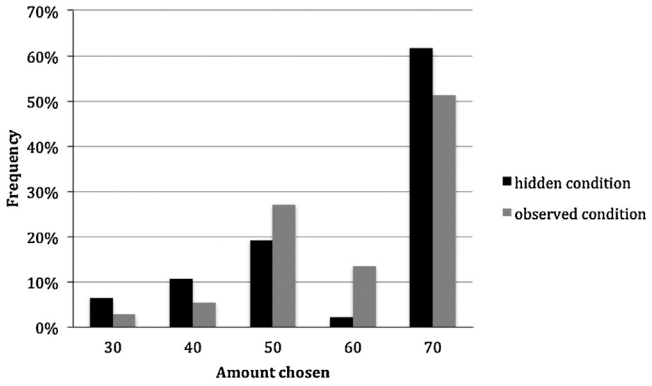

Fig. 1. The frequencies of the amounts chosen in the hidden and observed conditions.

The questionnaires described above were used to test whether irrational behavior in the urn task is correlated with the belief that one should not tempt fate, with the belief in a just world and with responding intuitively to probabilistic problems.

3.2. Results and discussion

The highest amount (i.e. NIS 70) in the urn task was chosen by only 55% of the participants.[5] The distribution of the chosen amounts did not differ significantly between the observed and hidden conditions according to a Mann–Whitney test ($W = 1545.5$, $p = .81$; the means were 60.21 and 60.54 with Mdn = 70 in both conditions; see Fig. 1 for the frequencies of the different amounts). Furthermore, the proportions of participants choosing the highest amount, 62% in the observed condition and 51% in the hidden condition, did not differ significantly ($\chi^2(1) = 0.532$, $p = .466$). Thus, the substantial frequency of choices of smaller amounts cannot be explained by the participants' attempt to avoid appearing greedy to the experimenter. Nevertheless, it is possible that a small fraction of the participants in the observed condition forgo the highest amount in order to avoid being perceived as greedy by the experimenter.

The responses on the "tempting fate" questionnaire ranged from 10 to 56 ($M = 31.44$, $SD = 10.95$; Cronbach's Alpha was .76). The mean score ($M = 35.67$, $SD = 10.17$) of participants who did not choose 70 was significantly higher than the mean score ($M = 28.27$, $SD = 10.52$) of those who did ($t(82) = 3.24$, $p = .002$). Pearson's correlation coefficient between the score and whether or not 70 was chosen is $r = .336$ ($p = .002$, $n = 84$).[6] Fig. 2 compares the empirical cumulative distribution of scores for these two groups.

In the gender sequence of births problems, 30% of the participants gave an intuitive and incorrect answer to both problems, 52% answered only one of the problems correctly and 18% answered both correctly. There was no significant linear correlation between the choices in the urn task (70/lower amounts) and the number of intuitive/correct answers in the two problems (Pearson's $r = .069$,

[4] They were asked to state which of two gender sequences of births is more likely or that they are equally likely: BBBGGG vs BGBBGB and GGGGGG vs BGBBGB. They were reminded that the probabilities of a boy or a girl are approximately the same for any particular birth.

[5] Similar results were obtained in a 'pen and paper' experiment of the urn task, in which the experimenter paid the participants right after the draw and thus observed the participant's choice. In this experiment, participants did not fill in any additional questionnaire.

[6] Pearson's correlation coefficient between the score in the "tempting fate" questionnaire and the choice of 70, 60, 50, 40 or 30 was $r = -.294$ ($p = .007$, $n = 84$), suggesting that given that participants forgo the choice of 70, their belief in tempting fate does not significantly affect the sum that they end up choosing. In other words, the main issue is whether to avoid the greediest choice while the choice between 60, 50, 40 and 30 is not related to the degree of belief in tempting fate.

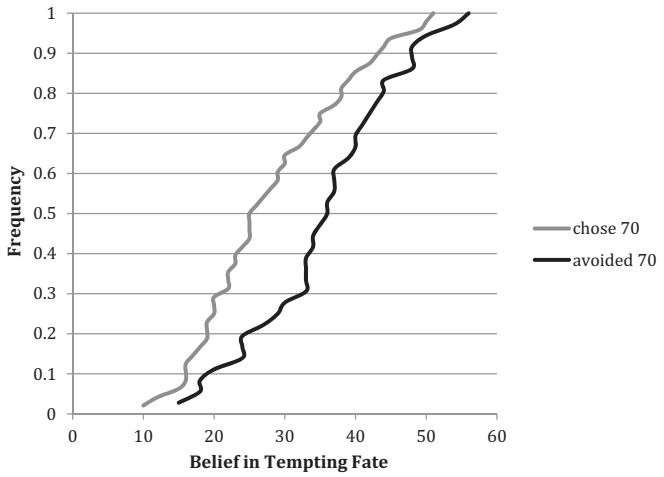

Fig. 2. The empirical cumulative distribution of scores in the tempting fate questionnaire, for participants who chose 70 and those who avoided 70.

$p = .532$, $n = 84$). Although these two problems do not represent all types of intuitive thinking in situations with objective probabilities, this finding suggests that irrational choices in the urn task are not necessarily due to a general tendency toward intuitive thinking in the case of probabilities, but rather reflect a particular type of intuitive thinking that involves a belief in tempting fate. Risen (2013) found that the explicit belief in tempting fate is correlated with the tendency to engage in intuitive rather than rational thinking as measured by the Rational–Experiential Inventory questionnaire (Epstein et al., 1996).

The participants' behavior in the urn task was not correlated with age, gender, number of siblings, economic status or degree of religiosity. The belief in tempting fate, however, was found to be associated with the reported degree of religiosity (Pearson's $r = .326$, $p = .003$, $n = 84$) even though there was little variation in the reported degree, and it was very low for the vast majority of participants.

The scores on the "belief in a just world" questionnaire ranged from 18 to 48, with $M = 35.32$, $SD = 6.84$ (Cronbach's Alpha was 0.88). Interestingly, no correlation was found between a participant's belief in a just world and his or her behavior in the urn experiment (Pearson's $r = -.034$, $p = .760$, $n = 84$). Furthermore, the scores on this questionnaire were not correlated with those on the "tempting fate" questionnaire (Pearson's $r = -.144$, $p = .191$, $n = 84$), as in Risen (2013). A major difference between the belief in a just world and the more specific belief in tempting fate is that according to the latter "the punishment should fit the crime" (i.e. the negative outcome should match the action that tempted fate). It appears that those who believe in tempting fate feel that "the universe seems interested not only in punishing certain behaviors but in punishing them in a certain, ironic way" (Risen and Gilovich, 2008). Thus, irrational behavior in the urn task may be a reflection of the belief that being greedy in a particular context will be punished by a negative outcome in that same context.

Finally, the belief in tempting fate, the belief in a just world and the number of correct answers to the sequence of birth problems were simultaneously entered into a binary logistic regression predicting whether or not participants chose the highest-prize lottery. The estimated coefficient of the belief in tempting fate was significant ($\text{Exp}(\beta) = 1.07$, $p = .004$), whereas the coefficients of the other two variables were not ($p = .857$ and $p = .741$, respectively) and Nagelkerke $R^2 = .151$. There was no significant interaction between these three variables.

4. Study 3

As discussed above, it is possible that individuals intuitively associate between large prizes and low probability of winning since this is usually what is observed in real-life lotteries. Study 3 is designed to show that the degree to which choosing the highest-prize lottery is perceived to be greedy, which is context-dependent, affects the estimation of the likelihood of winning. Namely, the perception that this is a greedy choice plays an important role in the formation of the intuitive belief that the likelihood of winning will decrease if it is chosen.

The degree of greed expressed in the choice of the highest possible prize is manipulated in the experiment by changing the background context (while keeping the lottery prizes constant).

4.1. Method

The participants in the experiment consisted of 244 undergraduate students in various fields of study at Tel Aviv University. The students were invited by e-mail to participate in a short online experiment and were randomly assigned among the experiment's four conditions.

In all of the conditions, the participants read a story about a woman named Sara who had spent a few hours in a Las Vegas casino, first playing card games and later participating in a bingo-style lottery. In the lottery, Sara was asked to select one of five amounts of money: \$200, \$300, \$400, \$500 or \$600. Once her choice had been made, a bingo machine would select one ball at random from among many, each marked with one of the following numbers: 200, 300, 400, 500 or 600; the proportion of each ball is unknown.[7] She will win the lottery and receive the amount she has selected only if that amount is written on the drawn ball.

The participants were then told that Sara had chosen the number X and they were asked to estimate how likely it is that Sara would win the lottery on a scale of 0–10 (where 0 is not at all likely and 10 is extremely likely).

The conditions varied as to whether Sara had chosen 600 (the highest prize) or 400 and whether she was participating in the lottery after already winning \$350 in the card games or after exhausting her budget for card games. Thus, the design is 2×2: Context (win, not) $\times$ choice (600, 400). The number of participants in the four conditions (win, 600), (win, 400), (not, 600) and (not, 400) was 61, 63, 61 and 59, respectively. It was hypothesized that after already having won a few hundred dollars, choosing the highest-prize lottery would be perceived as greedy and thus the difference between the estimated likelihood of winning \$600 and that of winning \$400 will be larger than in the case that she had lost money in the card games.

Note that moving to a casino environment, where the probabilities of the various outcomes are not specified, makes the likelihood estimation task more natural than in environments endowed with objective probabilities. However, in such an environment it is plausible that participants initially believe lower numbers to be more likely (because of the casino's strategic design of the lottery). The interpretation of the experimental results will rely on the assumption that the participants' beliefs about the proportions of different balls in the bingo machine are the same in the two contexts (after winning in the card games and after losing).

[7] In order to elicit the participants' estimated likelihood, objective probabilities were not used in this study (as they were in Study 1 and 2).

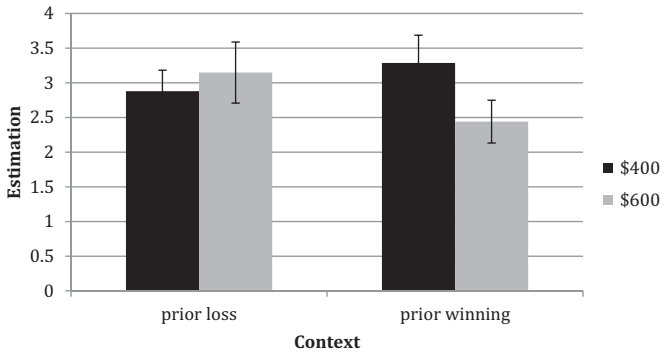

Fig. 3. The average estimation of the likelihood of winning given Sara's choice of the $400 or $600 lottery and depending on whether she had previously won or lost money in the card games.

4.2. Results and discussion

The participants' average estimations of Sara's likelihood of winning are presented in Fig. 3. In the case that Sara had lost money in the card games, the average estimated likelihood of winning $600 was $M = 3.15$ ($SD = 2.01$) and the average estimated likelihood of winning $400 was $M = 2.88$ ($SD = 1.42$). These estimations did not differ significantly ($t(117) = .839$, $p = .403$). I suspect that due to the prior loss of money, the highest amount is perceived as more legitimate and not as greedy as in the "neutral context" described in Study 2. In contrast, in the case that Sara had won $350 prior to the lottery, her estimated likelihood of winning $600 was significantly lower than that of winning $400 ($M = 2.44$, $SD = 1.47$ vs. $M = 3.29$, $SD = 1.84$) as hypothesized ($t(120) = 2.79$, $p = .006$). Furthermore, it was found that the likelihood of winning after choosing the highest prize ($600) was estimated as significantly lower in the case that Sara had already won some money in gambling prior to making this choice ($t(118) = 2.2$, $p = .029$), whereas the probability of winning $400 did not depend on prior winnings ($t(119) = -1.35$, $p = .179$).

A 2×2 analysis of variance with context (win, not) and choice (600, 400) as between-subject factors indicated that there is no main effect of context or choice on the estimation. However, the analysis did reveal an interaction between context and choice ($F(1, 237) = 18.65$, $p = .012$, $\eta_p^2 = .026$).[8]

Having previously won money in the card games could increase the estimation of the likelihood of winning future lotteries if it makes one feel that it is Sara's lucky day or could decrease it if one feels that she has already had her share of luck for that day. These two possible effects are essentially different from the hypothesized effect, i.e. that the degree of greediness perceived in the choice of $600 affects the estimation of the likelihood of winning. One difference is that these two effects will be relevant even if a computer (rather than Sara) selects the lottery prize. Another difference is that these effects are not likely to depend on whether the lottery prize is $400 or $600. According to the findings in this experiment, the estimation of the likelihood of winning the $600 lottery depends on whether Sara had won or lost money prior to her participation in the lottery, whereas the estimation of the likelihood of winning $400 does not depend on the context. This supports the hypothesized effect of the perceived greediness of choosing $600. However, participants might also believe that luck is limited and hence winning $600 is less likely than winning $400 after winning $350, but winning $600 and $400 is as likely after losing money, which is also consistent with the experimental results.

5. General discussion

This paper reports an intriguing phenomenon: when participants have an opportunity to choose between a number of positive lotteries that differ only in the value of the prizes, a large proportion of them forgo the rational choice (the lottery with the largest prize). Magical thinking is offered as a possible explanation for this behavior. In particular, it is suggested that choosing the lottery with the largest prize is considered greedy (i.e. asking for too much) and that some participants are afraid of tempting fate and being magically punished for such a choice through the outcome of the lottery.

Study 1 and 2 consisted of two different behavioral tasks. In both, many of the participants avoided the greedy choice even though it was the dominant option. In Study 2 they did so both when their behavior was observed and when it was not. In other words, the avoidance occurred even when there was no obvious channel for impressing the experimenter. Study 3 hints that the degree of greed associated with each lottery affects the estimation of the likelihood of winning. Additional non-choice data from Study 1 (i.e. the participants' interpretation of others' behavior) and from Study 2 (i.e. a measure of the individuals' belief in tempting fate) suggest that magical thinking plays a role in the underlying mechanism.

However, there may be additional explanations for the avoidance of the highest-prize lottery. For example, it is possible that some participants think there is no normatively correct choice in these situations and hence they choose randomly or pick a number that feels lucky. The avoidance of the highest-prize lottery may also be related to the general tendency to prefer middle options to options located at the extremes (e.g. Christenfeld, 1995; Falk, Falk, and Ayton, 2009). It is likely that various considerations cross the mind in such situations, as reflected in the interpretation of this avoidance by participants (Study 1).

Note that the tendency to forgo the dominant but greedy choice was found in straightforward circumstances that should induce rational behavior. In particular, real money was at stake in Studies 1 and 2 and the objective probabilities of the various outcomes were known (i.e. there was no room for the miscalculation of their likelihoods). Hence, it is plausible that magical thinking becomes even more pervasive in uncertain circumstances, in which the probability of the independent event is unknown.

It would be interesting to investigate in which circumstances this type of magical thinking prevails and whether it is more common for particular types of population (e.g. religious individuals) or in particular cultures.

5.1. Comment on the connection to the Newcomb paradox

The finding that individuals choose a dominated lottery, presumably in order to avoid being magically punished for greediness, relates to Nozick (1969) Newcomb paradox. In this thought experiment, participants are presented with a description of two boxes: A and B. Box A contains $1000 and Box B contains an uncertain amount of money: either one million dollars or nothing. The participant is to choose between the following two options: (1) open Box B and keep whatever is in it; or (2) open both A and B and keep the contents of both. Participants are asked to assume the existence of a "predictor" who is capable of predicting the choices people will make and punishes them for greedy behavior. In particular, if the predictor predicts that the participant is going to open both boxes, he will punish the participant for greediness and the uncertainty

[8] The analysis was performed after eliminating outliers (3 extreme observations), using the median absolute deviation method (MAD) with a threshold of 5. The results are robust to lower thresholds.

will not be resolved in his or her favor (i.e. Box B will contain nothing in this case). If, on the other hand, the predictor predicts that the participant is going to open only Box B, then it will contain one million dollars.

Two conflicting motivations come into play here: on the one hand, if the choice is predictable, then it is better for the participant to open Box B only. On the other hand, whatever the content of the boxes is at the moment, the dominant choice is to open both boxes. Many participants choose the dominated option of opening only Box B, which means that within this imaginary scenario they believe that their action can affect how the uncertainty will be resolved.

The similarity of Newcomb's paradox to the current experiments lies in the choice between a dominant and a dominated lottery and the role of magical thinking in this decision. The crucial difference is that participants in the current experiments were not explicitly presented with the possibility of being punished for greedy behavior by some higher power. Nevertheless, behavior consistent with this magical belief was common among the participants.

5.2. Implications of the phenomenon

The findings suggest that the presence of uncertainty may trigger less-greedy behavior due to magical thinking. This may have implications for various types of financial decisions. For instance, an individual's willingness to donate to charity may increase when some financial uncertainty is yet to be resolved.

This form of magical thinking is particularly relevant in uncertain situations where risky behavior can be seen as reflecting greediness. For example, an individual who considers canceling his or her insurance for a valuable object (in an attempt to avoid a very small cost) may fear being magically punished for choosing this risky and "greedy" action. Thus, it is suggested that in such situations people will buy insurance more frequently than their estimated risk aversion would imply in contexts where risky choices are not associated with greediness. This is in line with the finding in Tykocinski (2008) that the estimation of the likelihood of bad events is higher when one is not insured against them.

The phenomenon observed here may also affect the outcome of strategic interactions. Consider, for example, a bargaining situation in which two individuals negotiate the allocation of a piece of land between them. Suppose that regardless of the individuals' behavior during the negotiating process and the agreement they reach, there is a small probability that eventually the land will be taken away by a third party. If magical thinking plays a role in this context, then individuals who would claim a large portion of the land in situations without exogenous uncertainty are likely to make more generous offers in the presence of uncertainty (believing that tough bargaining may magically increase the probability of the undesirable outcome in which the land is taken away).[9] Thus, models of economic behavior may benefit from incorporating this type of magical thinking.

Acknowledgements

This paper is based on a chapter of my PhD dissertation written at Tel Aviv University. I wish to thank Gabi Gayer, Ariel Rubinstein, Eldar Shafir and Ran Spiegler for their useful comments and Efrat Barkai, Hadar Binsky, Michael Vardi, Hadar Weisman and Eli Zvuluni for technical assistance. I also acknowledge financial support from the European Research Council: grant no. 269143 and 230251.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.socec.2014.07.003.

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[9] Even without exogenous uncertainty, in a two-person strategic interaction the other person's actions are often uncertain. Therefore, a person may behave agreeably in an attempt to magically affect the other person's behavior. Such behavioral patterns have been reported by Shafir and Tversky (1992) and Croson (1999) in the context of the prisoner's dilemma game.