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STABILITY OF THE REPRESENTATIVENESS HEURISTIC: FURTHER EVIDENCE FROM CHOICES BETWEEN LOTTERY TICKETS

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Stability of the Representativeness Heuristic: Further Evidence from Choices Between Lottery Tickets

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Abstract: The representativeness heuristic (RH) proposes that people expect even a small sample to have similar characteristics to its parent population. One domain in which it appears to operate is the preference for combinations of numbers on lottery tickets: most players seem to avoid very characteristic, “unrepresentative” combinations, e.g., only containing very low numbers. Likewise, many players may avoid betting on a recently drawn combination because it would seem particularly improbable to be drawn again. We confirm both of these tendencies in a lab experiment and corroborate their external validity in two field experiments. However, we only find a weak link between these two choices: the same people do not necessarily exhibit the two biases. In this sense, there is little consistent manifestation of the RH across different tasks at the individual level. Nevertheless, there are some links related to rationality across the two choices – people who are willing to forgo a monetary payment to get the preferred ticket in one task are also willing to do it in the other. We find such preferences to be related to the misperception of probabilities and providing intuitive, incorrect answers in the Cognitive Reflection Test.

Keywords: Decision making under risk; Lottery choice; Perception of randomness; Number preferences in lotteries; Representativeness heuristic

JEL codes: C93, D01, D81, D91

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1. Introduction and literature review

The representativeness heuristic (RH; Kahneman & Tversky, 1972) is manifested when people erroneously believe that a sequence of random events, even a short one, should possess the essential characteristics of the process from which it was generated. As a result, people might expect that the new observations in the sequence will quickly correct any deviation. Such a misconception of chance appears to correctly organize several empirical findings. In the context of casino gambling, for example, people may believe that a win is “due” after several losses (“gambler’s fallacy”, Sundali & Croson, 2006). In Lotto, players seem to avoid both recently drawn combinations and very distinctive combinations, such as {1, 2, 3, 4, 5, 6}, apparently (incorrectly) believing that they are less likely to be drawn; see Krawczyk and Rachubik (2019, KR19) for a short review of relevant evidence (which, with very few exceptions, happens to be either indirect or based on hypothetical choices made by small student samples).

In this project, we put these two lotto predictions through an explicit test in our three new experiments. Importantly, we look at the *link* between these two choices: do individuals who prefer random combinations over “distinctive” combinations typically prefer random combinations over combinations that have been recently drawn? As hundreds of millions across the globe play lotteries every week, we believe it is important to understand how they do it and what individual characteristics might drive their behavior. But the importance of the issue goes beyond the case of gambling. When potential insurance clients mistakenly believe that a “hundred-year flood” in an area cannot happen again soon and investors on an efficient market mistakenly believe that a stock that has gone up recently is now more likely to go down, they seem to display the bias analogous to the one that we observe in a much simpler environment of lottery gambling.

The question of correlation of RH-driven behaviors across task is also the question of systematic individual differences in the susceptibility to the heuristic. While it is not necessarily presented as a stable psychological trait, individual differences in susceptibility to heuristics were suggested early on by Kahneman and Tversky (1972) and Nisbett et al. (1982), among others. Subsequent studies linked RH to several individual characteristics, confirming that some people are more prone to employ RH than others. These characteristics included age (Davidson, 1995), statistical sophistication (Tversky & Kahneman, 1983), general intelligence (Stanovich & West,

2000), and authoritarianism (Kimmelmeier, 2010), to name a few examples, although the reported correlations were often weak and sometimes counterintuitive.

There were also some attempts to link the propensity to succumb to RH with individual “thinking styles”; this is particularly true in reference to Epstein et al.’s (1996) distinction of the intuitive-experiential vs. analytical-rational styles. As the experiential system is rapid, automatic, crude, affective, and holistic, it may naturally be associated with the use of heuristics, in contrast to the slower, integrated, intentional, logical, and analytic rational system. Indeed, Epstein et al. (1996) observed that people scoring high on the Faith in Intuition subscale of their Rational-Experiential Inventory (REI) (and, to a lesser extent, people scoring low on the Need for Cognition subscale) tended to display a “heuristic” mode of responding to vignette scenarios, e.g., falling for the near-miss and the sunk-cost bias. However, subsequent research found that the REI did not predict behavior in tasks for which RH was relevant (Shiloh et al., 2002; Sanchez et al., 2012). Moreover, the correlation between (hypothetical) answers to problems aimed at identifying RH was very low (Shaham, 1992) or only observed in certain experimental conditions (Moore et al., 1997), suggesting that the use of RH is not stable within-subject, across tasks. To summarize, the existence of sizable individual differences in the propensity to fall for RH remains unresolved.

It is also of importance, Gigerenzer (1991) argues, that to have a general theory or specific models of underlying cognitive processes, we need to be able to say more about how the mind adapts to the structure of a given environment. When such an adaptation occurs, is it stable, or does it only appear ad-hoc with a problem at hand? Although heuristics are often useful, they lead to systematic errors (Tversky & Kahneman, 1974) and here we want to test whether the use of RH is indeed systematic at the individual level – if it is the same people who are affected by the RH in two different tasks within the same domain.

While this project is a direct follow-up of KR19 (in which we also investigated preference for random-looking combinations of numbers and beliefs concerning sequences of actually independent realizations), we sought to replicate the results in a more controlled environment of an economic laboratory with minimal face-to-face interactions between the subject and the experimenter. In doing so, we were in a position to ask many more questions to the same subject, thus deploying a more systematic manipulation of our core task of choosing a lottery ticket, along with measures of RH used in previous literature; we could also offer more substantial incentives.

We also offer several methodological improvements in the two new field experiments to ensure that the results of KR19 hold after overcoming possible design shortcomings and controlling for additional variables.

In the following section we focus on the laboratory experiment. Subsequently, we present the design and results of field experiments and close with a discussion and concluding remarks.

2. The laboratory experiment

2.1 Design

The experiment was conducted at the Laboratory of Experimental Economics, Faculty of Economic Sciences, University of Warsaw. The subjects were predominantly students, registered in the subject pool managed using ORSEE (Greiner, 2012). We ran four experimental sessions in October 2020 (when the COVID-19 restrictions were briefly lifted, making live sessions possible) during which we collected 165 observations. Females make up 55% of the subjects. Subjects' age varied between 18 and 76 years, with a mean of 35.8 years and a standard deviation of 15.1 years. Their education structure is typical for a lab – with highly educated subjects constituting 77%. The detailed descriptive statistics of our sample are presented in Appendix B, Table B1.

The subjects read instructions and provided responses on printed forms (see Appendix A1). In Part 1, they made a series of choices between lottery tickets.

We used a popular Multi Multi game from Totalizator Sportowy (a state-owned monopolist in the field of number games and lotteries in Poland). Twice a day, 20 numbers between 1-80 are randomly drawn, and players guess up to 10 numbers. The number of matches determines each player's payoff (see Table 1). The prizes are guaranteed, generally meaning that every combination of, for example, ten numbers is as good as any other¹ and yields about 1 PLN in expectation, compared to the ticket price of 2.50 PLN.

¹ This is not true in games with a pari-mutuel format, such as Lotto, in which the jackpot, which is shared among the players who matched all the numbers, corresponds to a significant part of the expected payoff. This means that in expectation, the losses are larger if one bets on popular combinations, so that the jackpot, if won at all, will have to be shared with many other players.

The task involved choices between two lottery sequences, each with ten numbers displayed in ascending order. We used four classes of sequences: Random, Distinctive, Previous and Distant Previous, see Table 2.

Unsurprisingly, the sequences to be on the Random tickets were generated randomly; we used six different sequences, see Table 2. Independently, we also randomized if the Random ticket was displayed on the left- or right-hand side of the form.

Distinctive tickets involved sequences with consecutive numbers or numbers ending in 0 or 5 only, as these can be easily identified as specific when printed out in a row (as they are on Multi Multi tickets).² In the lab experiment, we used two types of these Distinctive sequences: M1 and M5, see Table 2.

Tickets in the “Previous” class contained ten numbers randomly selected from among the 20 that won in the drawing directly preceding the session. Wang et al. (2016) report that frequent players avoid winning numbers from recent draws, while occasional players tend to chase them. We seek to verify this finding.

We used two different Previous sequences during each session. Additionally, to grasp whether the perceived improbability of the same numbers being drawn again reduces over time, we used a “Distant Previous” ticket type, containing numbers that were drawn on March 12, 2019, thus on an arbitrary day approximately a year and seven months before the experiment. Instructions informed the subjects where the numbers in the Previous and Distant Previous types came from.

There were six pairs of sequences, the subjects choosing their preferred one in each pair (see Table 3), with the understanding that one of their six choices would be implemented. The six pairs were fixed, e.g., R1 was always matched with M1. However, the order and thus the A/B labelling within each pair and the order of the six pairs were randomized at the individual level.

The subjects were subsequently asked to rate each combination on a 1-7 scale with “1”, meaning it would be “fully impossible” that this combination is obtained in the next drawing, and “7” meaning it would be “fully possible”. We paid a show-up fee of 10 PLN to reimburse for the

² Of course, multiples of 10 would have been even more prominent given our decimal system, but it would have been impossible to implement as there are only eight numbers ending with a zero in Multi Multi.

time and travel to the campus, and used “6x wager” tickets that sell at 15 PLN and pay up to 1.5 million PLN.

In Part 2, we gave our subjects a number of puzzles previously used to measure susceptibility to the RH, such as the well-known Linda problem. Several minor changes were introduced to the original puzzles to fix features that were obsolete or exotic to the Polish sample, as well as to reduce the probability that subjects recognized the problem. Finally, they collected a number of demographic characteristics.

2.2 Results

Overall, Random was preferred over Distinctive (72%), Previous (69%), and Distant Previous (67%) (for more details, see Table B2 in App. B). The numbers were similar to those in comparable tasks of KR2019.

This pattern of choices was consistent with subjects’ mean responses to the question of which combinations were “possible” or “impossible”. Indeed, on average, the Random combinations were rated at 4.8, compared to 3.5 for Distinctive, 3.7 for Previous, and 4.2 for Distant Previous. The rating of Random combinations was thus much higher than that of any three remaining groups, and due to our within-subject design, we had the statistical power to reject the hypothesis of equality between any two groups, except Distinctive compared to Previous, at a 0.001 significance level (using Wilcoxon signed-rank tests treating each individual as one independent observation). The choices between lottery tickets were also predicted by “possibility” ratings at the individual level; in probit regressions (available upon request due to space constraints), subjects rating R1 sequence as more “possible” and subjects rating M1 sequence as less “possible” were more likely to choose R over M1 and likewise for all the other pairs. In contrast to Wang et al. (2016), the frequent players in our sample, compared to the occasional players, are more likely to choose Previous (correlation significant at $p=0.0550$).

Looking across the tasks, we find significant positive correlations between choices involving Distinctive; see Table 4. By contrast, there are few correlations across other types of choices. It is only when we look at the number of times that Random was preferred over Distinctive (0-3) and likewise the number of times that Random was preferred over (Distant) Previous (0-3) that a weak but significant correlation arises (Spearman’s $\rho = 0.20$, $p < .01$).

As for the hypothetical RH puzzles of Part 2, they were indeed puzzling, in accordance with the existing literature: incorrect answers (typically consistent with the RH) prevailed; see Table 5. To analyze the responses, we constructed dummy variables (with a suffix “_RH” in the code), taking a value of 1 if the response is consistent with the representativeness heuristics. In line with Shaham et al. (1992), they clearly do not represent the same latent factor; for example, when these six _RH variables are mutually correlated, as many as seven out of 15 ($=6*5/2$) coefficients come out negative.

However, the responses to the RH puzzles were hardly predictive of the lottery ticket choices. Specifically, only for the high school puzzle did those who solved it correctly tend to choose random less often, whereas the correlation was insignificant and often reversed for the remaining puzzles; see Table B3 in Appendix B.

We also investigated if demographics were correlated to ticket choices or responses in RH puzzles (also because in such a case, some of the previously reported correlations or lack thereof could be spurious) (Table B4 and B5 in App. B). Overall, these effects were few; better-educated respondents seem to prefer Random over Distinctive tickets more often, and those who gambled more had a weaker preference for Random over P1 (but not P2). Given the multiple comparisons, these effects, albeit significant at the 1% level, should be considered with caution. Unsurprisingly, given the weak impact of demographic variables, controlling for them in regressions (available upon request) generally confirmed the previously reported correlations (or lack thereof) between ticket choice tasks and HR puzzles.

3. Field experiments

In the two field experiments, we sought to corroborate the external validity of the lab experiment. We thus addressed a much more diverse sample, in a more natural setting of the streets of Warsaw. We also wanted to replicate the field experiment of KR19, with substantial methodological improvements. First, in KR19 we had our subjects choose between a Random ticket and a Distinctive ticket and to be then asked whether they wanted to switch if we added a small monetary bonus to the initially unwanted ticket (replicating Bar-Hillel and Neter, 1996). Thus, the fact that the majority of our sample stayed with the initial choice (did not switch) could reflect a clear preference but was also consistent with a (near) indifference coupled with a status-quo bias.

In the improved design, we want to unambiguously identify the effect of the RH. We thus employ other elicitation procedures, rendering status-quo bias irrelevant, thereby allowing us to establish a preference for Random (as postulated by the RH) cleanly. Compared to the lab experiment which involved no bonuses, we offer a more stringent test for the preference for Random: we verify if it prevails over monetary incentives.

Second, in KR19, we examined correlation between RH predictions for two different (but similar) tasks and failed to find any, perhaps because one of the tasks involved hypothetical choices (coin tosses). In the present experiments, we study subjects' behavior under even more closely related, incentivized tasks – both are choices between tickets.

Third, we modify the question concerning subjects' justifications of choice, explicitly identifying if they believe that the random-looking tickets are more likely to win. Finally, in the new experiments, we add other dimensions characterizing subjects (education, religiosity, belief in superstition). We also include a question from the Cognitive Reflection Test (CRT) (Frederick, 2005), which, as suggested by Toplak et al. (2011), may be predictive of the use of heuristics in decision-making.

We now describe the elements that are common to both field experiments. The subjects were random passers-by approached in several locations in the city of Warsaw. They were greeted and asked whether they would agree to participate in a very brief study coordinated by the University of Warsaw, which would allow them to earn several pre-paid lottery tickets. The exact wording used in both experiments can be found in Appendix A2.

In both experiments, the main tasks involved choices between two lottery tickets. We used all six Random sequences (Table 2). Independently, we also randomized in all tasks in both experiments if the Random ticket was displayed on the left- or right-hand side of the other ticket. Also for Distinctive tickets, one of six particular combinations was always used; see Table 2.

Tickets in the “Previous” class, just as in the lab experiment, contained ten numbers randomly drawn from among the 20 that won in the drawing directly preceding a specific subject's choice. Subjects were explicitly told where the numbers came from. Because the experiment took place on different days, as many as 80 distinct combinations were used in the “Previous” class; they are therefore not shown here. We did not use “Distant Previous” tickets.

In both experiments, after the two main tasks, we asked our subjects a question adapted from the CRT:

A pencil and a pen together cost 1.10zł. The pen costs 1zł more than a pencil. How much does the pencil cost?

We then asked about subjects' age, education, gambling habits, superstitious behaviors, and religiosity. The experimenter also coded subjects' gender. Both experiments lasted five minutes per subject on average, and they involved a fully randomized between-subject design.

Both experiments have very similar demographic distributions. Roughly 52% of the subjects are female. Subjects' age varied between 18 and 81 years, with a mean of 39.1 years and a standard deviation of 15.3 years. These statistics are closer than those of the Lab Experiment to the national population³.

Our sample's education structure (66% of our subjects having a higher education) resembles that of the city as a whole but is starkly different from that of the nation⁴.

In Table 6 see the summary of the possible choices in all four tasks.

3. 1 Field Experiment 1

3.1.1 Design

In Task 1.1, we offered the subjects a choice between a Random and a Distinctive ticket, the latter being offered with a bonus of 1PLN (a distinctive amount close to the ticket's expected value). Thus, unlike in the KR19, choosing the ticket without a bonus could unambiguously be identified as a manifestation of a sufficiently strong preference (in favor of the Random ticket) rather than as a status-quo bias.

In Task 1.2, we asked the subjects to choose between a Random ticket and a Previous one. Since we had predicted that there would be a general preference towards Random, we offered no

³ In Poland: 52% female; population mean age 42, standard deviation 22 years.

⁴ That fraction for Warsaw is 55% and 26% for Poland. The validity of this comparison is slightly limited by the fact that these official statistics are calculated for the population aged 15-64, whereas our subjects' ages ranged between 18 and 76.

bonuses to half of the subjects and a bonus of 1PLN for choosing Previous to the other half (no condition involving a bonus for choosing Random, which is typically preferred anyway). We then asked for a justification of their choice; in particular, we asked whether any of the tickets had a greater chance of being drawn.

3.1.2 Results

In Task 1.1, Random vs. Distinctive, 60% of the 260 subjects chose the Random ticket, thus forgoing the bonus (Table 7, Panel A), a replication of KR19 and the lab experiment. This pattern of outcomes suggests that it is primarily *not* due to a status quo bias that the subjects reject the offer to switch, rather due to a strong preference for the random-looking sequences.

As for the preferences for each of the distinctive patterns, M5 was chosen relatively more often than other types (48% of the time), while L1 relatively less (33% of the time), as in KR19.

Similarly, in Task 1.2, in a choice between a Random and a Previous sequence, the vast majority of the 260 subjects, namely 77%, preferred the Random ticket (Table 7, Panel A), as in the lab experiment. Naturally, this tendency is weaker when the alternative (Previous) was offered with a bonus, but compared to the no-bonus benchmark, the difference is small and insignificant (74% vs. 80% choosing Random $p = 0.24, z = 1.18$). In this task, we also explicitly asked the subjects whether any of the tickets had a greater chance of being drawn. From Table 8, Panel A we can see that Random (consistent with the gambler's fallacy) was indicated to be more likely by 74% of the subjects. Only 5% believed, conversely, that Previous was more likely to be drawn (consistent with the hot-hand fallacy). Nineteen percent said that they both had the same probability, and the answer was ambiguous for the remaining 3% of subjects. Panel A of Table 8 also illustrates that the choices were entirely consistent with probability judgments; essentially, all the subjects picked the ticket they said was more likely to win, and the choices were split 43/57 when they said the chances were identical. One reason for this preference for Previous with bonus not being more prevalent than without the bonus could be that some participants misrepresent their true beliefs. If someone knows that the "correct" answer is that the chances are identical but it does not feel this way at all, she may report the chances are identical and yet choose R even if P comes with cash.

Across the two tasks, we find no correlation suggested by the RH; when no bonuses were offered in the R vs. P task, behavior in this task was unrelated to behavior in the R vs. D choice

(see Table 7, Panel B1). However, among subjects who had the chance to get the bonus in both tasks, we find the tendency to be rational (take the bonus) in either both or neither; see Panel B2. Since the bonus was associated with avoiding Random, we cannot be sure if this tendency is driven by either some people consistently going for the bonus (and others not doing it) or by some people consistently avoiding Random (while others consistently taking it). If the latter effect were true, we should see the same tendency in Panel B1 of Table 7; yet we do not. In other words, we identified a consistent willingness to take cash across the two tasks, but no consistent willingness to go for the Random ticket.

CRT results are presented in Table 9, Panel A. Overall, only 15% gave the correct answer of 0.05, and among those who gave an incorrect answer, 93% gave the intuitive answer of 0.1. Relating the choices in CRT to the choices of lottery tickets, we see that those choosing Random (rather than Distinctive with a bonus) was associated with giving an incorrect answer in the CRT; see Table 9, Panel A. These findings are confirmed in a probit regression (see Table B6 in Appendix B).⁵

Choosing Random rather than Previous with a bonus is also associated with answering the CRT question incorrectly, but there is no link with the choice not involving a bonus, see Table 9, Panels B1 and B2. Thus, correct CRT answers appear to be predictive of a willingness to take cash, not of the preference for or against Random per se. Again, these findings are confirmed when one controls for other variables (which by themselves have little systematic effect); see Table B7 in Appendix B.

The results are generally consistent with the findings reported in KR19 and the lab experiment. We confirm that people have a strong preference for random-looking tickets and that the status quo bias does not cause this preference. Despite the tendency to choose Random, we see no consistent use of the RH in both tasks; however, we did determine that subjects tend to be rational (go for the bonus) either in both tasks or neither. We also find that going for the bonus is predicted by answering the CRT question correctly.

⁵ This analysis also suggests that more religious individuals are more likely to choose the Random ticket, foregoing the bonus.

3.2 Field Experiment 2

3.2.1 Design

One possible shortcoming of the design of Field Exp. 1 is that some subjects could treat the bonus immediately added to the Distinctive ticket as a signal of its inferiority. The possibility that a price is a signal of quality is often discussed in the marketing literature (Gerstner, 1985). An analogous signal of the inferiority of Previous could be perceived by (half) the subjects in Task 1.2 of Experiment 1. Hence, in Exp. 2, we wanted to remove the possibility of such an effect.

In Task 2.1, we applied the two-stage procedure of KR19 to the choice between a Random ticket and a Previous ticket. Once a subject indicated which one she liked better with no mention of the bonus, we added a bonus of 1PLN to the unwanted ticket, and the subject could *stay* with the initial decision or *switch* and cash the bonus. This procedure was thus not susceptible to the “price as a signal of quality” effect previously described because the bonus was determined by the subject’s choice, not by the experimenter. However, it was susceptible to the status quo effect, as explored before; thus, running this condition gives a natural closure to the study’s design, also allowing for the investigation of the status quo effect in the Random vs. Previous choice. Again, we would then ask how they made their decision, and if any of the tickets had a greater chance of being drawn.

The choice between Random and Distinctive (Task 2.2) was structured as follows. Before a subject could see the tickets, the experimenter tossed a coin, telling the subject that the outcome would determine to which ticket the bonus of 1 PLN would be added (we call it a toss-the-coin-to-determine-the-bonus or TCDB procedure). As a result, it was clear that the bonus was *not* a valuable signal of quality. Once this was determined, the subject was asked to choose. Again, we asked how they made their choice and if either of the two tickets had a greater chance of being drawn.

The order of the tasks was reversed compared to the Field Experiment 1. The main reason for this is that subjects first exposed to the TCDB procedure could be inclined to ask about the bonus at the beginning of the subsequent two-stage procedure.

3.2.2 Results

In both tasks, we once again see a clear preference for Random among our 199 subjects. From the results of the two-stage Random vs. Previous choice, it is evident that subjects preferred the Random ticket (87%), and the offer to switch with the bonus almost did not impact their decisions—only 12% of these subjects decided to *switch* from their initial choice; see Table 10, Panel A, suggesting a strong preference for R once again. We do see, however, that among those initially choosing Previous (13%), as much as 42% decided to *switch* when the bonus was introduced, suggesting that this preference is often relatively weak.

The subjects were subsequently asked whether they thought that any of the tickets had a greater chance of being drawn. As shown in Table 8, Panel B, the willingness to switch correlated very highly with the belief that both tickets had equal probability. We can stipulate that consistent with our other results, the willingness to stay or switch does not come from a status quo or other biases but from a strong belief that the chosen ticket has a greater probability of winning.

In the TCDB procedure applied to the choice between Random and Distinctive, we see that 77% chose Random if it came with a bonus, see Table 10, Panel B. Even if the bonus was, conversely, added to the Distinctive ticket, a slight majority – 58 of 104 (56%) – still chose Random. While the latter figure is not significantly different from the equal split, it also does not differ from the 60% choosing Random against Distinctive (with a bonus) in Experiment 1 ($z = 0.7, p = 0.48$), suggesting that the bonus added directly, without explicit randomization, did not cause the effect of perceived inferiority we had hypothesized. Further, the TCDB procedure does not allow for the status quo bias; despite this, more than half of the subjects still rejected the bonus, which again suggests a very strong preference towards Random.

When inspecting the two tasks (Table 10, Panel C), we observe, again, that those choosing Random against Previous were not necessarily the same subjects as those choosing Random against Distinctive. Choosing Random in one task but not in the other is so common that the choices in the two tasks appear unrelated. This is in accordance with all our previous findings that the RH does not show up consistently across different tasks.

In the CRT only 21% (of N=199) were able to find the correct answer of 0.05 (additional 10% admitting they have seen the problem before), while 69% gave an incorrect answer, among whom 92% chose the intuitive option of 0.1.

Once again, we see rationality across the tasks. Those giving a correct answer to CRT, initially chose Previous more often (21% vs. 9%) and regardless of the initial choice *switched* to the bonus more often (31% vs. 9%); see Table 11, Panel A.

In the choice between the Random and Distinctive, if the bonus was associated with R, CRT-correct subjects chose Random particularly often (94%), while if the bonus was with Distinctive, we see no dependence (52% chose Random); see Table 11, Panels B1 and B2. Again, the fact that correct answers to the CRT were only associated with hunger for the bonus is confirmed by probit regression; see Table B8 in Appendix B.

4. Discussion

Tasks that predictably trigger non-normative performance do not necessarily have profound consequences of the underlying theoretical model. As proposed by Stanovich & West (2002), “irrational” behaviors need not follow from inherent irrationality of the human being; inspecting correlations across tasks can give us some hint as to which alternative explanation is the most plausible. Most importantly for our purposes, some deviations from the normative performance can simply be understood as performance errors, i.e. the “failure to apply a rule, strategy, or algorithm that is part of a person’s competence because of a momentary and fairly random lapse in ancillary processes necessary to execute the strategy (lack of attention, temporary memory deactivation, distraction, etc.).” [emphasis added]. If that is the case, we expect a low correlation across tasks: all or vast majority of the population is capable of applying the norm but they occasionally fail to do it. Our results seem to be largely consistent with this perspective – representativeness heuristic is sometimes used but does not altogether replace correct judgment. We believe it is a valuable contribution to the wider discussion on individual differences in susceptibility to cognitive biases (Bruine de Bruin et al., 2007; Shiloh, Salton & Sharabi, 2002; Stanovich & West, 2008; Teovanović et al., 2015; Vartanian et al., 2018).

Even more directly, our study contributes to the literature on lottery ticket preference. Previous experiments (Bar-Hillel & Neter 1996; Risen & Gilovich, 2007; KR19) established that

people are reluctant to *exchange* the ticket they received first. This kind of endowment effect could be explained in terms of loss aversion or regret aversion.⁶ Risen and Gilovich (2007) further linked this reluctance to (regret-related) dwelling on the possibility that the ticket being given up actually wins, which leads people to overestimate the probability of such an occurrence. Our data can hardly be organized along these lines.

First, in the Field Experiment 1, the fraction of people willing to forgo a monetary payment to obtain the preferred ticket was just as high (60%) in the one-stage procedure as in the two-stage procedure in KR19 (59%), although only the latter involved tickets being relinquished, thus giving more scope for regret and (especially) the Risen-Gilovich effect. We thereby confirm that subjects choose Random due to their strong preference (and not due to a bias possibly partly driven by regret). Second, if anything, we would expect that people mostly regret turning down a Distinctive ticket because it is easy to remember its combination of numbers (and experience the pain of having discarded a winning ticket). Despite this, preference for Distinctive is very rare. Third, among the people choosing Random over Previous when no bonus was offered in a one-stage procedure (Task 1.2 of the Field Experiment 1), 90.5% say that Random was more likely to win. Among those who chose Random over Previous *in the first stage* (Task 2.1, Field Experiment 2) and were subsequently offered the chance to switch (which some of them did), only 70.7% said that Random was more likely to win. Thus, offering an incentive to switch, if anything, shifted the belief against the ticket that could be given up, rather than in favor of it – a *reversed* Risen-Gilovich effect.

One crucial difference between our set-up and those of previous studies, which could partly explain the lesser role of regret-related mechanisms that we observe, is that they had small lotteries run by the experimenter, with fellow students as participants. It could thus be natural to wonder who received the discarded ticket, etc. Strong regret/dwelling on the possibility that the relinquished ticket will win eventually in someone else's hands could thus be somewhat specific to these designs, with less bearing on the natural real-world stimuli that we are using.

⁶ That said, in KR19 and in the two-stage choice between Random and Previous reported here, we tried to minimize such a possibility, in particular the subjects did not physically receive the ticket after their initial choice.

While regret does not seem to play a role in our findings, we do find the RH to be quite relevant. Since tickets with Random sequences are generally preferred and held onto regardless of the task or the alternative ticket, RH prevails in our subjects' decisions. However, consistent with KR19, we find little correlation across tasks in this regard, which provides more evidence towards our previous finding that being affected by RH in one task does not predict its significance in a subsequent decision. This effect is also confirmed by the missing correlation with the answers to the classic puzzles used to illustrate RH that we have administered in the Lab Experiment. In this sense, RH is not systematically observed across tasks. In other words, our findings suggest that there are few individual differences in the propensity to fall prey to RH – instead, such occurrences are determined by circumstances and pure chance. What does seem to differ between individuals is the willingness and ability to undertake cognitive reflection: correct answers to the CRT predict choosing tickets which come with a bonus, predict switching, and stating that the two tickets have the same probability of being drawn.

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6. Tables

Table 1

Distribution of prizes in Multi Multi (when ten numbers are selected)

# of matches	10	9	8	7	6	5	4
Prize in PLN	250,000	10,000	520	140	12	4	2
Probability	1/8,911,711	1/163,381	1/7,384	1/621	1/87	1/19	1/8

Table 2

Types of Random and Distinctive sequences used

“Random” sequences		
R1: {01,10,15,27,37,54,56,63,64,69}	R4: {01,11,12,38,41,44,50,59,60,77}	
R2: {02,11,31,34,40,42,62,65,66,68}	R5: {12,19,27,29,37,39,42,59,74,75}	
R3: {08,21,30,44,47,54,56,59,63,77}	R6: {03,08,11,15,23,24,44,52,57,71}	
“Distinctive” sequences		
Numbers	Distance 1	Distance 5
Low*	L1: {01,02,03,04,05,06,07,08,09,10}	L5: {05,10,15,20,25,30,35,40,45,50}
Medium	M1: {01,02,03,04,05,76,77,78,79,80}	M5: {05,10,15,20,25,60,65,70,75,80}
High*	H1: {71,72,73,74,75,76,77,78,79,80}	H5: {35,40,45,50,55,60,65,70,75,80}
* used in the field experiments only		
“Previous”		
Ten numbers randomly selected from among the 20 that won in the drawing directly preceding a specific subject’s choice. For example, if numbers (02, 07, 11, 15, 18, 20, 21, 23, 25, 31, 32, 38, 46, 48, 51, 55, 71, 77, 79, 80) showed up in the 2pm drawing, subjects making a choice later that day could see (11, 25, 31, 32, 38, 48, 51, 55, 77, 79) on their “Previous” ticket.		
“Distant Previous” (used in the lab experiment only)		
Numbers that were drawn on March 12, 2019, thus on an arbitrary day approximately a year and seven months before the experiment.		

Table 3

Lab exp.: Table with lottery sequences (6 choices) as presented to the subjects [here: 1B = Distinctive M1; 2B = Distinctive M5; 3A = Distinctive M5; 4A (previous drawing) = Previous; 5A (drawing from 12.03.2019) = Distant Previous; 6B (previous drawing) = Previous]

	Available sequences:		Your choice:
1.	1A: 01, 10, 15, 27, 37, 54, 56, 63, 64, 69	1B: 01, 02, 03, 04, 05, 76, 77, 78, 79, 80	A / B
2.	2A: 08, 21, 30, 44, 47, 54, 56, 59, 63, 77	2B: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	A / B
3.	3A: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	3B: 02, 11, 31, 34, 40, 42, 62, 65, 66, 68	A / B
4.	4A (previous drawing): 05, 12, 14, 15, 19, 22, 32, 33, 38, 45	4B: 12, 19, 27, 29, 37, 39, 42, 59, 74, 75	A / B
5.	5A (drawing from 12.03.2019): 11, 17, 20, 21, 29, 45, 58, 68, 72, 79	5B: 03, 08, 11, 15, 23, 24, 44, 52, 57, 71	A / B
6.	6A: 01, 11, 12, 38, 41, 44, 50, 59, 60, 77	6B (previous drawing): 21, 24, 25, 30, 32, 34, 38, 43, 46, 52	A / B

Table 4

Lab experiment: Correlation between lottery choices

	R D(M1)	overR D(M5)	overR D(M5)	over R over P1	R P2	overR DP	over
R over D(M1)	1.00						
R over D(M5)	0.17	1.00					
	0.03*						
R over D(M5)	0.25	0.24	1.00				
	0.001*	0.002*					
R over P1	0.10	-0.11	0.15	1.00			
	0.19	0.16	0.06				
R over P2	0.18	0.08	0.13	0.19	1.00		
	0.02*	0.32	0.11	0.02*			
R over DP	0.14	0.05	0.04	0.12	0.00	1.00	
	0.07	0.54	0.61	0.13	1.00		

Table 5

Lab experiment: Percent of correct (normative) answers to the puzzles (N=165)

	% % correct consistent % other with RH		
Linda problem	55%	45%	0%
Taxi problem*	30%	42%	28%
Hospitals	22%	62%	16%
Families	24%	65%	10%
High school	21%	78%	2%
Marbles	51%	48%	1%
*Unlike in the other puzzles, providing a precise answer in the Taxi problem requires the application of the Bayes theorem and some calculations. One thus has to decide as to the maximum error allowed. We took the most lenient approach and considered any guess larger than 20% and smaller than 85% (thus taking some account for both the prior and the evidence) as normatively correct.			

Table 6

Summary of the possible choices in all four tasks of the Field Experiments

Field Experiment 1	
Task 1.1	Random vs. Distinctive+bonus
Task 1.2	Random vs. Previous (50%+bonus; 50% no bonus)
Field Experiment 2	
	initial choice: Random vs. Previous
Task 2.1	bonus offered to the not chosen one final choice: stay or switch
	toss the coin to determine to which one goes the bonus (TCDB)
Task 2.2	Random vs. Distinctive (either one might be with a bonus)

Table 7

Field Exp. 1: Choices across the two tasks: joint and marginal proportions

Panel A: Decisions across the two tasks (in %)

Task 1.1 \ Task 1.2	Random	Previous	Total
Random	49	11	60
Distinctive +bonus	28	12	40
Total	77	23	100 (N=260)

Panel B1: R vs. D + bonus and R vs. P; subjects who *were not offered a bonus to P* (in %)

Task 1.1 \ Task 1.2	Random	Previous	Total
Random	45	12	57
Distinctive +bonus	35	9	43
Total	80	20	100 (N=130)

Pearson $\chi^2(1) = 0.0078$ Pr = 0.929**Panel B2:** R vs. D + bonus and R vs. P; subjects who *were offered a bonus to P* (in %)

Task 1.1 \ Task 1.2	Random	Previous	Total
Random	52	10	62
Distinctive +bonus	22	16	38
Total	74	26	100 (N=130)

Pearson $\chi^2(1) = 11.3604$ Pr = 0.001

Table 8

Field Exp.1 and 2: Choices and beliefs about probability

Panel A: Field exp. 1: Choices in Random vs. Previous and beliefs about their probability

Which has a greater chance?

R vs. P	Random	Previous	Equal	Other	Total
Random	98	0	43	33	81
Previous	2	100	57	67	19
Total	74	5	19	3	100 (N=198*)

Note: *the first 62 subjects were not asked this question, hence the smaller sample size

Panel B: Field exp. 2: Stay or switch choice in Random vs. Previous and beliefs about the probability

Which has a greater chance?

Final choice	Random	Previous	Equal	Other	Total
Stay	71	4	22	3	100 (N=167)
Switch	16	0	84	0	100 (N=32)
	62	3.5	32	2.5	100 (N=199)

Table 9

Field Experiment 1: Choices in Random vs. Distinctive with direct bonus and Random vs. Previous and CRT results

Panel A: Choice in R vs. D (D always with a bonus)

CRT	Random	Distinctive bonus	+ Total
Correct (15%)	38	62	100
Intuitive (79%)	62	38	100
Other (6%)	75	25	100

Panel B1: Choice in R vs. P **without** bonus

CRT	Random	Previous	Total
Correct (13%)	76	24	100
Intuitive (79%)	80	20	100
Other (8%)	90	10	100

Panel B2: Choice in R vs. P **with** bonus

CRT	Random	Previous bonus	+ Total
Correct (17%)	55	45	100
Intuitive (78%)	77	23	100
Other (5%)	83	17	100

Table 10

Field Experiment 2: Choices in Random vs. Previous, Random vs. Distinctive and across tasks

Panel A: Choices in Random vs. Previous

Initial preference	Final Choice		
	Stay	Switch	Total
Random (87%)	88	12	100
Previous (13%)	58	42	100
Total	84	16	100 (N=199)

Panel B: Choices in Random vs. Distinctive, depending on the bonus

Bonus added to	Choice		
	Random	Distinctive	Total
Random	77	23	100 (N=95)
Distinctive	56	44	100 (N=104)
Total	66	34	100 (N=199)

Panel C: Choices across the initial choice in R vs. P and R vs. D

Choice in R vs. D	Initial choice in R vs. P	
	Random	Previous
Random	66	62
Distinctive	34	38
Total (N=199)	100	100
Pearson $\chi^2(1) = 0.2448$; Pr = 0.621		

Table 11

Field Experiment 2: Choices in Random vs. Distinctive and Random vs. Previous and CRT results

Panel A: Choices in R vs. P and CRT responses (N=199)

	CRT	
Initial choice	Correct	Incorrect
Random	79	91
Previous	21	9
	100	100

Pearson $\chi^2(1) = 4.9827$; Pr = 0.026

Final Choice	Correct	Incorrect
Switch	31	9
Stay	69	91
	100	100

Pearson $\chi^2(1) = 13.1766$; Pr = 0.000**Panel B1:** Choice in R+bonus vs. D and CRT responses

CRT	Correct (25%)	Incorrect (75%)	
Random + bonus	94	70	75
Distinctive	6	30	25
Total (N=84)	100	100	100

Pearson $\chi^2(1) = 4.1545$; Pr = 0.042**Panel B2:** Choice in R vs. D+bonus and CRT responses

CRT	Correct (26%)	Incorrect (74%)	
Random	52	59	57
Distinctive + bonus	48	41	43
Total (N=95)	100	100	100

Pearson $\chi^2(1) = 0.3243$; $Pr = 0.569$

7. Appendix A

Wording of the Lab experiment (A1), and Field experiments 1 (A2), 2 (A3)

A1. The wording of the Lab experiment

Instructions

Welcome to the experiment. We ask you to turn off your mobile phones and not communicate with other participants in any way. If you have a question, raise your hand.

The experiment consists of two parts (and a questionnaire). You will receive 10 zł for participating in this study and a lottery ticket worth 15 zł for the Multi Multi lottery. When you answer all the questions that this form contains, approach the payout desk outside the room. The entire study is anonymous.

Part 1

Multi Multi is a game offered by Totalizator Sportowy (which also offers, among others, the Lotto game). During this game (which happens twice daily at 14:00 and 21:50), **out of numbers from 1 to 80, 20 numbers are drawn**. In Multi Multi, one can bet on up to 10 numbers, and the prize depends on the quantity of drawn matching numbers. When betting on **ten numbers** (you will be choosing from such sequences here), a guaranteed prize (when all ten numbers are drawn) is one million five hundred thousand zlotys (1 500 000 zł). The lowest price (12 zł) is paid out for 4 matching drawn numbers.

In each row in the table below, choose the sequence you prefer to receive on your lottery ticket. At the end of the experiment, you will find out which of rows 1-6, as seen in the table below, we have drawn for you. You will receive a single ticket with the sequence of numbers that you have chosen as your preferred one in this row. This ticket will be for the next drawing, that is, today at 9.50 PM. Since you do not know which row will be drawn, it is in your best interest to consider them and in each pair (in each row), choose the sequence you prefer to receive on your ticket.

The following sequences differ only in their selected numbers. Each of them contains 10 numbers.

Sequences labelled as "previous drawing" contain only the numbers that won (i.e., were drawn) in the last draw, that is, today at 2 PM.

The sequence labelled as "drawing from 12.03.2019" contains only the numbers drawn in the draw of 12.03.2019 at 2 PM.

In each of the rows, choose one of the sequences A or B. Mark your choice in the rightmost column.

	Available sequences:		Your choice:
1.	1A: 01, 10, 15, 27, 37, 54, 56, 63, 64, 69	1B: 01, 02, 03, 04, 05, 76, 77, 78, 79, 80	A / B
2.	2A: 08, 21, 30, 44, 47, 54, 56, 59, 63, 77	2B: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	A / B
3.	3A: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	3B: 02, 11, 31, 34, 40, 42, 62, 65, 66, 68	A / B
4.	4A (previous drawing): 05, 12, 14, 15, 19, 22, 32, 33, 38, 45	4B: 12, 19, 27, 29, 37, 39, 42, 59, 74, 75	A / B
5.	5A (drawing from 12.03.2019): 11, 17, 20, 21, 29, 45, 58, 68, 72, 79	5B: 03, 08, 11, 15, 23, 24, 44, 52, 57, 71	A / B
6.	6A: 01, 11, 12, 38, 41, 44, 50, 59, 60, 77	6B (previous drawing): 21, 24, 25, 30, 32, 34, 38, 43, 46, 52	A / B

We would like to find out what motivated your choices. If you can, please briefly describe the motivations of at least some of them. When referring to a particular pair of sequences, indicate its number.

.....

Now, for each sequence you have seen in this questionnaire, indicate how possible you think it is that it might be drawn in the next drawing (today at 9.50 PM) (mark one of the numbers 1-7 in each row).

	Fully impossible							Fully possible
1A: 01,10, 15, 27, 37, 54, 56, 63, 64, 69	1	2	3	4	5	6	7	
1B: 01, 02, 03, 04, 05, 76, 77, 78, 79, 80	1	2	3	4	5	6	7	
2A: 08, 21, 30, 44, 47, 54, 56, 59, 63, 77	1	2	3	4	5	6	7	

2B: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	1	2	3	4	5	6	7
3A: 05, 10, 15, 20, 25, 60, 65, 70, 75, 80	1	2	3	4	5	6	7
3B: 02, 11, 31, 34, 40, 42, 62, 65, 66, 68	1	2	3	4	5	6	7
4A (previous drawing): 05, 12, 14, 15, 19, 22, 32, 33, 38, 45	1	2	3	4	5	6	7
4B: 05, 12, 14, 15, 19, 22, 32, 33, 38, 45	1	2	3	4	5	6	7
5A (drawing from 12.03.2019): 11, 17, 20, 21, 29, 45, 58, 68, 72, 79	1	2	3	4	5	6	7
5B: 03, 08, 11, 15, 23, 24, 44, 52, 57, 71	1	2	3	4	5	6	7
6A: 01, 11, 12, 38, 41, 44, 50, 59, 60, 77	1	2	3	4	5	6	7
6B (previous drawing): 21, 24, 25, 30, 32, 34, 38, 43, 46, 52	1	2	3	4	5	6	7

Part 2

Please answer the following questions. In the questions where you write the answer yourself, we understand that you may not know the exact value or have to calculate it. However, we ask you to think for a moment and enter a specific numerical answer.

Each of the following open questions **can be answered with a number**.

1. Marta is 28 years old and is single. She is an open and intelligent person. She graduated in philosophy. As a student, she devoted a lot of time to the problems of social justice and discrimination, she used social media to defend evicted tenants. Choose what is more probable?

- ☐ Marta works in a bank
- ☐ Marta works in a bank and is a feminist

2. A taxicab was involved in a hit-and-run accident at night. Only the Green and Blue cab companies operate in the city, where 85% of the cabs are Green, and 15% are Blue. A witness identified the cab as Blue, and when tested under similar conditions, was able to identify 80%

of both Blue and Green cabs correctly. What is the probability that the cab involved in the accident was Blue?

Answer:%

3. A certain town is served by two hospitals. In the larger hospital, about 45 babies are born each day, and in the smaller hospital, about 15 babies are born each day. As you know, about 50% of all babies are boys. However, the exact percentage varies from day to day. Sometimes it may be higher than 50%, sometimes lower.

For a period of 1 year, each hospital recorded the days on which more than 60% of the babies born were boys. Which hospital do you think recorded more such days?

- ☐ The larger hospital
- ☐ The smaller hospital
- ☐ About the same (that is, within 5% of each other)

4. All families of six children in a city were surveyed. In 72 families, the exact order of births of boys and girls was GBGBBG.

What is your estimate of the number of families surveyed in which the exact order of births was BGBBBB?

Answer (number):

5. There are two programmes in a high school. Boys are a majority (65%) in programme A and a minority (45%) in programme B. There is an equal number of classes in each of the two programmes.

You enter a class at random and observe that 55% of the students are boys. What is your best guess – does the class belong to programme A or programme B?

Answer: A / B

6. On each round of a game, 20 marbles are distributed at random among five children: Adaś, Boguś, Czarek, Daniel, and Edzio. Consider the following distributions:

I		II	
Adaś	4	Adaś	4
Boguś	4	Boguś	4
Czarek	5	Czarek	4
Daniel	4	Daniel	4
Edzio	3	Edzio	4

In many rounds of the game, will there be more results of type I or of type II?

Answer: I / II

Questionnaire

1. How often do you play other lotteries from Totalizator Sportowy (e.g., Lotto, scratch cards), bet on sports results, play cards for money, visit (online) casinos, or do similar things?
 - ☐ Once a week or more
 - ☐ Once, twice, or three times a month
 - ☐ Several times a year
 - ☐ Once or several times in my life
 - ☐ Never
2. If you happen to play, do you sometimes do it together with friends or family?
 - ☐ Yes
 - ☐ No
3. Are there people who often play games of chance among your close friends or family?
 - ☐ There are no such people
 - ☐ There is one such person
 - ☐ There are several such people
 - ☐ There are many such people
4. Do you sometimes knock on unpainted wood, blow on a found coin, or perform any activities of this type?
 - ☐ Yes
 - ☐ No
5. Do you consider yourself a religious person?
 - ☐ Yes
 - ☐ No
6. In what year were you born?
7. Gender:
 - ☐ female
 - ☐ male

8. What is your education level?

- ☐ primary
- ☐ secondary
- ☐ higher or currently studying at a higher level
 - field of study:

9. Which of the following terms best describes your household?

- ☐ We live very poorly – we don't have enough for our basic needs
- ☐ We live modestly – we have to manage economically every day
- ☐ We live on average – we have enough money for everyday living, but we have to save for major purchases
- ☐ We live well – we can afford much without saving
- ☐ We live very well – we can afford some luxury

If you have already answered **all** of the questions in this form, please go with it to the payout desk to receive remuneration.

A2. The wording of the Field experiment 1

[*INTRO*] Hello, I represent the University of Warsaw, where we are conducting a scientific study. May I take a couple of minutes of your time? In return, I have a pre-paid lottery ticket for you for a Multi Multi game from LOTTO.

[If YES, then:]

[*TASK 1: Random vs. Distinctive*] Here, I have two lottery tickets for a Multi Multi game. In Multi Multi, out of numbers from 1 to 80, 20 numbers are drawn twice daily, and you can bet on up to 10 numbers – as in the present case. On each of the tickets, ten numbers are already chosen, and the two tickets differ only in these numbers. Both of them are for the next drawing, and if all ten numbers are drawn, there is a guaranteed prize of 250,000 PLN; the fewer numbers match, the smaller the prize and all the prizes are guaranteed regardless of the numbers chosen by other players.

You can choose either this one [*pointing at Random*] or this one [*pointing at Distinctive*], to which I will add 1zł in cash. Please look at them and choose the one you prefer – you will receive it for free.

[subject choosing and receiving the ticket with/without the bonus]

[*TASK 2: Random vs. Previous*] Now I have one more choice for you. Once again, the two tickets differ only in the numbers chosen. You can choose this one [*pointing at Random*] or this one [*pointing at Previous*], whereby this one [*again pointing at Previous*] contains only the numbers which have just won in the previous drawing today at 14:00/yesterday at 21:40 [*depending on the time of experimentation*]. [*If the experiment plan shows to add a bonus of 1zł to this subject, we*

add: To this one [*again pointing at Previous*] I will add 1zł in cash.] You will receive whichever you choose.

Can you please tell me why you chose this one?

[This question was added after the first 62 observations] Do any of these have a greater chance of being drawn?

[*CRT*] As the last task, I have a riddle for you. I will read it out loud, but you can also see it for yourself printed here.

A pencil and a pen together cost one złoty and ten groszy [*1.10zł*]. The pen costs one złoty more than a pencil. How much does the pencil cost?

Now only a few demographic questions left, okay?

What is your age?

Do you have primary, secondary, or higher education? [*If higher, then we ask: What did you study?*]

Do you sometimes play the lottery, Lotto, or other games of chance?

Do you sometimes knock on unpainted wood, blow on a found coin, or perform any activities of this type?

Do you consider yourself a believer?

That is all; thank you. Have a nice day.

A3. The wording of the Field experiment 2

[*INTRO*] Hello, I represent the University of Warsaw, where we are conducting a scientific study. May I take a couple of minutes of your time? In return, I have a pre-paid lottery ticket for you for a Multi Multi game from LOTTO.

[If YES, then:]

[*TASK 1: Random vs. Previous*] Here, I have two lottery tickets for a Multi Multi game. In Multi Multi, out of numbers from 1 to 80, 20 numbers are drawn twice daily, and you can bet on up to 10 numbers – as in the present case. On each of the tickets, ten numbers are already chosen, and the two tickets differ only in these numbers. Both of them are for the next drawing, and if all ten numbers are drawn, there is a guaranteed prize of 250,000 PLN; the fewer numbers match, the smaller the prize and all the prizes are guaranteed regardless of the numbers chosen by other players.

You can choose this one [*pointing at Random*] or this one [*pointing at Previous*], whereby this one [*again pointing at Previous*] contains only the numbers which have just won in the previous drawing today at 14:00/yesterday at 21:40 [*depending on the time of experimentation*]. Please have a look and indicate your choice.

What if I add 1zł in cash to this one [*indicating the one which they did not choose*]. Will you choose this or this? You will receive whatever you choose.

[subject choosing and receiving the ticket with/without the bonus]

Can you please tell me why you chose this one?

Do any of these have a greater chance of being drawn?

[TASK 2: *Random vs. Distinctive*]. Now I have one more choice for you. The two tickets differ only in the numbers chosen. I will show them to you in a second, but before that, we will toss a coin to determine to which one of them I will add 1zł. If it is heads, I will add it to the one on the right and if tails then to the one on the left. Is this clear?

[TCDB procedure]

Okay, so to this one, I am adding a bonus. Please have a look at them, and you will receive whichever you choose.

[Subject choosing and receiving the ticket with/without the bonus]

Can you please tell me why you chose this one?

Do you think any of these has a greater chance of being drawn?

[CRT] As the last task, I have a riddle for you. I will read it out loud, but you can also see it for yourself printed here.

A pencil and a pen together cost one złoty and ten groszy [1.10zł]. The pen costs one złoty more than a pencil. How much does the pencil cost?

Now only a few demographic questions left, okay?

What is your age?

Do you have primary, secondary, or higher education? [If higher, then we ask: What did you study?]

Do you sometimes play the lottery, Lotto, or other games of chance?

Do you sometimes knock on unpainted wood, blow on a found coin, or perform any activities of this type?

Do you consider yourself a believer?

That is all; thank you. Have a nice day.

8. Appendix B

Additional analyses and tables

Table B1

Lab exp.: Sample data descriptive statistics in a lab experiment

	Percent	Mean	SD	N
Female	55%			165
Age		35.8	15.1	164
female		37.1	16.1	90
male		33.8	13.8	74
Education				165
higher or currently studying at a higher level	77%			127
secondary	23%			38
basic	-			0
Superstitious	52.7%			165
Religious	52.4%			164
Household financial wellbeing:				165
very poor	1.2%			2
modest	4.2%			7
so,so	44.9%			74
doing well	46.1%			76
doing very well	3.6%			6
Engaging in any form of gambling:				165
once a week or more	4.9%			8
one to three times a month	16.4%			27
a few times a year	26.7%			44
once or a few times in a lifetime	38.2%			63
never	13.9%			23
Playing syndicate?				164
yes	22.6%			37
no	77.4%			127
Do any close friends or family engage in gambling?				165

none	40.0%	66
one such person	23.0%	38
a couple	32.7%	54
many	4.2%	7

Table B2

Lab exp.: Percent choosing Random over other types of sequences

R over Distinctive:	72%
R over M1:	71%
R over M5:	74%
R over Previous	69%
R over Previous 1:	68%
R over Previous 2:	71%
R over Distant Previous:	67%

Table B3

Lab exp.: Correlation between lottery choices (Choosing Random) and RH puzzles

	Choosing Random	Linda normative	Taxis normative	Hospitals normative	Families normative	High schools normative	Marbles normative
Choosing Random	1.0000						
Linda normative	0.1200 0.1247	1.0000					
Taxis normative	-0.1199 0.1251	-0.0726 0.3538	1.0000				
Hospitals normative	0.0895 0.2530	0.0991 0.2052	0.2026 0.0091	1.0000			
Families normative	0.1478 0.0582	0.0904 0.2484	0.0038 0.9619	0.1121 0.1518	1.0000		
High schools normative	-0.1941 0.0125	0.0137 0.8616	0.1280 0.1014	0.0574 0.4641	-0.2183 0.0049	1.0000	
Marbles normative	0.1319 0.0913	0.1018 0.1932	-0.0516 0.5103	-0.0096 0.9025	0.2443 0.0016	-0.1891 0.0150	1.0000

Table B4

Lab exp.: Correlation between demographics and lottery choices

	gambling habits	gambling habits syndicate	gambling habits others	ofsuperstitious	religious	age	female
gambling habits	1.0000						
gambling habits	0.1022	1.0000					
syndicate	0.1930						
gambling habits of others	-0.1428	-0.0358	1.0000				
	0.0672	0.6490					
superstitious	-0.1002	-0.0693	0.2044	1.0000			
	0.2004	0.3777	0.0085				
religious	-0.0755	-0.0434	0.1087	0.1316	1.0000		
	0.3367	0.5825	0.1659	0.0931			
age	-0.1931	0.2166	0.0402	0.2004	-0.0548	1.0000	
	0.0132	0.0055	0.6097	0.0101	0.4873		
female	0.1370	0.0383	0.0502	0.3302	0.0688	0.1178	1.0000
	0.0794	0.6267	0.5216	0.0000	0.3812	0.1330	
education	0.1782	-0.0890	-0.1298	-0.0566	0.0410	-0.2807	0.1945
	0.0220	0.2573	0.0966	0.4701	0.6025	0.0003	0.0123
income	0.0427	-0.0390	0.0191	-0.1683	-0.2004	-0.0231	-0.0352
	0.5861	0.6199	0.8076	0.0307	0.0101	0.7686	0.6538
R over Dist.(M1)	0.0651	-0.0266	-0.0482	-0.0986	0.0985	-0.0796	-0.1023
	0.4063	0.7354	0.5390	0.2074	0.2097	0.3109	0.1909
R(1) over Dist.(M5)	0.1572	0.0527	0.0793	-0.1285	-0.0239	-0.1513	-0.0247
	0.0438	0.5030	0.3112	0.1001	0.7616	0.0532	0.7531
R(2) over Dist.(M5)	0.0447	0.0926	0.0814	-0.0950	0.0562	-0.1766	-0.1588
	0.5684	0.2380	0.2986	0.2248	0.4750	0.0237	0.0417
R over P1	0.0390	0.1338	-0.1694	0.0246	0.0990	0.0305	-0.0545
	0.6194	0.0876	0.0296	0.7540	0.2072	0.6980	0.4869
R over P2	0.1276	0.1337	-0.0341	-0.1254	0.0046	0.0121	-0.1291
	0.1023	0.0878	0.6639	0.1086	0.9536	0.8778	0.0983
R over DP	0.0723	0.0801	0.0769	-0.0773	0.0993	-0.0155	0.0258
	0.3558	0.3081	0.3260	0.3240	0.2056	0.8442	0.7420

	education	income	R Dist.(M1)	overR(1) Dist.(M5)	overR(2) Dist.(M5)	overR over P1	R over P2	R over DP
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education	1.0000							
income	0.2440	1.0000						
	0.0016							
R over Dist.(M1)	0.1884	-0.0308	1.0000					
	0.0154	0.6941						
R(1) over Dist.(M5)	0.1735	0.1458	0.1672	1.0000				
	0.0258	0.0617	0.0318					
R(2) over Dist.(M5)	0.1851	0.0837	0.2493	0.2368	1.0000			
	0.0173	0.2849	0.0012	0.0022				
R over P1	-0.0064	-0.1175	0.1024	-0.1093	0.1451	1.0000		
	0.9355	0.1328	0.1908	0.1623	0.0630			
R over P2	-0.0334	-0.1079	0.1774	0.0779	0.1258	0.1881	1.0000	
	0.6700	0.1675	0.0227	0.3199	0.1075	0.0155		
R over DP	0.0407	-0.0991	0.1415	0.0478	0.0397	0.1193	0.0000	1.0000
	0.6036	0.2056	0.0698	0.5422	0.6129	0.1269	1.0000	

Table B5

Lab exp.: Correlation between demographics and RH puzzles

	gambling habits	gambling habits syndicate	gambling habits others	ofsuperstitious	religious	age	female
gambling habits	1.0000						
gambling syndicate	0.1022	1.0000					
	0.1930						
gambling habits of others	-0.1428	-0.0358	1.0000				
	0.0672	0.6490					
superstitious	-0.1002	-0.0693	0.2044	1.0000			
	0.2004	0.3777	0.0085				
religious	-0.0755	-0.0434	0.1087	0.1316	1.0000		
	0.3367	0.5825	0.1659	0.0931			
age	-0.1931	0.2166	0.0402	0.2004	-0.0548	1.0000	
	0.0132	0.0055	0.6097	0.0101	0.4873		
female	0.1370	0.0383	0.0502	0.3302	0.0688	0.1178	1.0000
	0.0794	0.6267	0.5216	0.0000	0.3812	0.1330	

education	0.1782	-0.0890	-0.1298	-0.0566	0.0410	-0.2807	0.1945
	0.0220	0.2573	0.0966	0.4701	0.6025	0.0003	0.0123
income	0.0427	-0.0390	0.0191	-0.1683	-0.2004	-0.0231	-0.0352
	0.5861	0.6199	0.8076	0.0307	0.0101	0.7686	0.6538
Linda normative	0.0114	-0.1670	-0.0012	-0.0598	0.0443	-0.2045	0.0222
	0.8843	0.0326	0.9881	0.4452	0.5734	0.0086	0.7769
Taxis normative	0.0174	0.0655	0.0477	0.0309	-0.0185	-0.0019	0.0605
	0.8243	0.4047	0.5429	0.6934	0.8137	0.9808	0.4398
Hospitals normative	0.1046	0.0748	-0.0378	-0.0876	-0.1439	-0.1432	-0.1661
	0.1812	0.3412	0.6302	0.2630	0.0660	0.0673	0.0330
Families normative	0.0928	-0.0671	-0.0968	-0.1442	0.0007	-0.1862	0.0620
	0.2356	0.3932	0.2159	0.0646	0.9930	0.0170	0.4291
High schools normative	-0.0787	-0.0838	-0.0223	0.1222	-0.1153	-0.0081	-0.0766
	0.3150	0.2859	0.7758	0.1178	0.1414	0.9177	0.3281
Marbles normative	0.1296	0.0795	-0.0514	-0.1528	-0.0012	-0.0631	-0.0443
	0.0971	0.3114	0.5117	0.0501	0.9879	0.4220	0.5724

	education	income	Linda normative	Taxis normative	Hospitals normative	Families normative	High schools normative	Marbles normative
education	1.0000							
income	0.2440	1.0000						
	0.0016							
Linda normative	0.0499	0.0176	1.0000					
	0.5242	0.8226						
Taxis normative	-0.0225	-0.0358	-0.0726	1.0000				
	0.7739	0.6483	0.3538					
Hospitals normative	0.1147	0.1314	0.0991	0.2026	1.0000			
	0.1424	0.0924	0.2052	0.0091				
Families normative	0.2758	-0.0136	0.0904	0.0038	0.1121	1.0000		
	0.0003	0.8622	0.2484	0.9619	0.1518			
High schools normative	-0.0772	0.0678	0.0137	0.1280	0.0574	-0.2183	1.0000	
	0.3242	0.3867	0.8616	0.1014	0.4641	0.0049		
Marbles normative	0.1539	-0.1261	0.1018	-0.0516	-0.0096	0.2443	-0.1891	1.0000
	0.0484	0.1066	0.1932	0.5103	0.9025	0.0016	0.0150	

Table B6

Field Exp. 1: Determinants of choosing R rather than D; probit analysis

Variable	r0	r1	r2	r3
male		-0.066	-0.178	-0.132
male_exp				-0.292
male_male_experimenter				-0.114
age		-0.004	0.001	0.001
religious		0.202**	0.185**	0.181**
superstitious		0.167	0.194	0.188
only_high_school		-0.012	0.083	0.098
gambling_intensity		0.048	-0.014	-0.017
CRT_correct		-0.615**	-0.823**	-0.798**
Distinctive: medium	-0.230	-0.066	-0.184	-0.176
Distinctive: high	-0.201	0.070	-0.021	-0.025
Distinctive: distance 5	-0.143	-0.134	-0.244	-0.249
Random displayed on the right	0.190	0.296	0.376*	0.369*
Day of the week and Location dummies	No	No	Yes	Yes
Note: legend: * p<0.1; ** p<0.05; *** p<0.01				

Table B7

Field Exp.1: Determinants of choosing R rather than P; probit analysis

Variable	(1)	(2)	(3)	(4)
RvsP_bonus	-0.244	-0.195	-0.175	-0.318
male		-0.137	-0.170	-0.500
religious		-0.018	-0.088	-0.080
superstitious		0.202	0.261	0.278
only_high_school		0.256	0.044	0.002
male_bonus				0.208
male_male_experimenter				0.530
age		0.006	0.017*	0.018*
gambling_intensity		-0.054	-0.015	-0.035
CRT_correct		0.327	0.652	0.488

CRT_corr_bonus		-1.282*	-1.693**	-1.592**
Distinctive: medium	0.147	0.160	0.041	0.081
Distinctive: high	-0.026	-0.030	-0.184	-0.146
Distinctive: distance 5	0.280	0.235	0.305	0.360
Random displayed on the right	0.060	0.000	-0.034	0.005
Day of the week and Location dummies	No	No	Yes	Yes
Note: legend: * p<0.1; ** p<0.05; *** p<0.01				

Table B8

Field Exp.2: Determinants of choosing R rather than P; probit analysis

Variable	(1)	(2)	(3)	(4)
male		-0.205	-0.399	-0.779**
male_male_experimenter				0.718
age		0.001	0.020*	0.022**
religious		-0.052	-0.089	-0.121
superstitious		0.252	0.378	0.402
at_most_high_s		0.418	0.597*	0.602*
gamb_inten		-0.045	-0.192*	-0.190
CRT_correct		-0.290	0.199	0.339
CRT_correct X bonus_with_R		1.694***	1.619**	1.588**
Distinctive: medium	-0.079	-0.079	-0.006	0.035
Distinctive: high	-0.229	-0.086	-0.028	0.043
Distinctive: distance 5	-0.394**	-0.542**	-0.787***	-0.786***
Day of the week and Location dummies	No	No	Yes	Yes
Note: legend: * p<0.1; ** p<0.05; *** p<0.01				



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