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

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The limitations 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 the 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, most players may avoid betting on a combination that was drawn recently, because it would seem particularly improbable to be drawn again. We confirm both of these tendencies in two field experiments, building upon Krawczyk and Rachubik (2019, KR19). However, we find no link between these two choices: it is not the same people that show the two biases. In this sense, the RH does not organize the data well. Nevertheless, there are some links related to rationality across the two choices – people who are willing to forgo a monetary payment in order to get the preferred ticket in one task are also willing to do it in the other. We find such preference to be related with misperception of probabilities and providing intuitive, incorrect answers in the Cognitive Reflection Test.

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

JEL codes: C93, D01, D81, D91

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1. Introduction

The *representativeness heuristic* (Kahneman & Tversky, 1972), the erroneous belief that even a small sample should resemble the parent population, appears to correctly organize several empirical findings. In the contest 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 recently drawn combinations, and very distinctive combinations, such as {1, 2, 3, 4, 5, 6}, apparently (incorrectly) believing 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 predictions to an explicit test in our two field experiments. Importantly, we look at the link between these two choices: do individuals preferring random combinations over "distinctive" combinations are typically also preferring random combinations over combinations that have been drawn recently?

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 are offering a number of methodological improvements.

First, in that paper, we had our subjects choose between a Random ticket and a Distinctive ticket and then ask whether they want to switch if we add a small monetary bonus to the initially unwanted ticket (as Bar-Hiller and Neter, 1996 had previously done). Thus, the fact that large majority of our sample stayed with the initial choice (did not switch) could reflect clear preference but was also consistent with a (near) indifference coupled with a status-quo bias. In the current project we employ other elicitation procedures, rendering status-quo bias irrelevant, thus allowing us to establish preference for Random (as postulated by the RH) in an unambiguous way.

Second, the "temporal sequence" task of KR19 involved hypothetical coin tosses. By contrast, in the new experiments, we have an incentivized choice between lottery tickets (just as in the "combination" task). In this sense, we give the RH a new and better chance to organize the data, now pertaining to the same domain, correctly.

Third, we modify the question concerning subjects' justification of the 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 run the Cognitive Reflection Test which, as suggested by Toplak et al. (2011), may be predictive of the use of heuristics in decision-making.

The general method of both experiments is described in the following section. Then, we focus on the design and results of each of the experiments separately, and close with a discussion and concluding remarks.

2. Stimuli

This section describes the elements that are common for both new experiments. The subjects were random passers-by approached in several locations in the city of Warsaw, including metro stations, the central train station, shopping centers, a farmer's market, outside of office buildings, a sports center, a central roundabout, a park and crossings of two streets in a few different districts of Warsaw. They were greeted and asked if they agreed to participate in a very brief study coordinated at the University of Warsaw which would get them some pre-paid lottery tickets. The exact wording used in both experiments can be found in Appendix A.

Both experiments have very similar distribution of demographics. Roughly 52% of subjects are female. Subjects' age varies between 18 and 81 years, with a mean of 39.1 years and a standard deviation of 15.3 years. These statistics are similar to those of the KR19 data and to the national population.[1]

The education structure of our sample is similar to that of the city but starkly different from the nation as a whole. While 66% of our subjects declared to have a higher education, the fraction is 55% in Warsaw and just 26% in Poland.[2]

As in KR19, the experiment involved choices between lottery tickets. We used a popular Multi Multi game from Totalizator Sportowy (a state-owned monopolist in the field of numbers games and lotteries in Poland). Twice daily, 20 numbers between 1-80 are randomly drawn, whereas 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,

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

[2] 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' age ranged between 18 and 81.

for example, 10 numbers is as good as any other,[3] and yields about 1 PLN in expectation, compared to the price of the ticket of 2.50 PLN.

Table 1: Distribution of prizes in Multi Multi (when 10 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

In both experiments, the main tasks involved choices between two lottery tickets, each with 10 numbers displayed in an ascending order. We designed three classes of tickets: Random, Distinctive, and Previous. Not surprisingly, the sequences to be used on the Random tickets were generated randomly; we used six different sequences, see Table 2.

Table 2: Types of "Random" sequences used

R1	01-10-15-27-37-54-56-63-64-69
R2	02-11-31-34-40-42-62-65-66-68
R3	08-21-30-44-47-54-56-59-63-77
R4	01-11-12-38-41-44-50-59-60-77
R5	12-19-27-29-37-39-42-59-74-75
R6	03-08-11-15-23-24-44-52-57-71

For Distinctive tickets, one of six very specific combinations was always used; see Table 3. The labels “low”, “medium” and “high” mean that the sequence involved low, medium or high numbers (on average); these labels were not given to the subjects. We chose three

[3] This is not true in games with a pari-mutuel format, such as Lotto, in which the jackpot, shared among the players who got all the numbers right, 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.

sequences with consecutive numbers and three with numbers ending in 0 or 5, as these can be easily identified as specific when printed out in a row (as they are on Multi Multi tickets).[4]

Table 3: Types of "Distinctive" combinations used

Average	Distance: 1	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}

Tickets in the "Previous" class contained 10 numbers selected from among the 20 that won in the drawing directly preceding 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. Subjects were explicitly told where the numbers came from.

In both experiments, after the two main tasks, we asked our subjects one of the questions of the Cognitive Reflection Test (Frederick, 2005), except that we changed the commodity, because the game of baseball involved in the original version is not popular in Poland (and baseball bats have occasionally been used in violent crimes, an association we certainly wanted to avoid). The revised version, both read out loud by an experimenter and displayed in print, was as follows:

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

We then asked about the subjects' age, their education, gambling habits, superstitious behaviors, and religiosity. The experimenter also coded subjects' gender.

[4] 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.

3. Experiment 1

3.1. Design

In Task 1 we offered the subjects a choice between a Random and a Distinctive ticket, the latter being offered with a bonus of 1PLN. Thus, unlike in the KR19, choosing the ticket without a bonus could unambiguously be identified as a manifestation of sufficiently strong preference (in favor of the Random ticket), rather than as status-quo bias. We did not have a condition in which both tickets would be initially offered with no bonus, as we already had had such data from KR19; *a fortiori*, the Random ticket was never offered with a bonus because based on previously collected data we could be quite confident that almost everyone would go for Random in such a case.

In Task 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 R, we offered no bonuses to half of the subjects and a bonus of 1PLN for choosing Previous to the other half (again, no condition involving a bonus for choosing Random). Then, we asked for a justification of their choice, but we added an extra question to address the shortcoming of KR19, explicitly asking whether any of the tickets has a greater chance of being drawn.

3.2. Results

In Task 1, Random vs. Distinctive, we see results consistent with KR2019, namely, 60% of the 260 subjects chose the Random ticket, foregoing the bonus (see table 4). Recall that in KR2019, 70% of subjects initially chose Random and 85% of these declined to switch when offered a bonus for doing so, which would mean that 59% strongly preferred R. This pattern of outcomes suggests that it is primarily *not* due to a status quo bias that the subjects reject the offer to switch but due to a strong preference for the random- looking sequences.

Table 4: Strong preference for Random against Distinctive: Experiment 1 compared to KR2019

Panel A: Experiment 1

	Random	Distinctive (w/bonus)	Total
	60% (155)	40% (105)	260

Panel B: KR2019

Initially:	Random		Distinctive		Total
	70% (330)		30% (142)		472
Finally (w/bonus):	Stay	Switch	Stay	Switch	
	59% (280)	11% (50)	25% (116)	6% (26)	

As for the preferences for each of the distinctive patterns, we see that M5 was chosen relatively more often than other types (48% of the time), while L1 relatively less (33% of the time), again, consistent with KR2019.

Similarly, in Task 2, in a choice between a Random and a Previous sequence, we see that vast majority of the 260 subjects, namely 77%, preferred the Random ticket. While, naturally, this tendency is weaker when the alternative (Previous) was offered with a bonus, compared to the no-bonus benchmark, the difference is small and insignificant, (73% vs. 80% choosing Random $p = 0.24, z = 1.18$). In this task we also explicitly asked the subjects, if any the tickets had a greater chance of being drawn. From Table 5 we can see that the answer Random (consistent with the gambler's fallacy) was given 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. While the specific numeric values are not comparable, these results qualitatively confirm the results of our hypothetical coin task from KR2019, where gambler's fallacy also prevailed, followed by the normatively correct answer 50/50, the hot-hand fallacy option being the least common. Table 5 also shows that the choices were perfectly consistent with judgments of probability: essentially all the subjects picked the ticket they said was more likely to win and the choices were split roughly 50/50 when they said the chances were identical or the answer was unclear.

Table 5: Choice of Random vs. Previous and beliefs about probability

	Which has a greater chance?				
Choice	Random	Previous	Equal	Other	Total
Random	98% (143)	0	43% (16)	33% (2)	81% (161)
Previous	2% (3)	100% (9)	57% (21)	67% (4)	19% (37)
Total	74% (146)	5% (9)	19% (37)	3% (6)	100% (198*)

*this first 62 subjects were not asked this question, hence the lower sample size

Across the two tasks, we find no correlation suggested by the representativeness heuristic; we do, however, find the tendency to be either rational (take the bonus) in both tasks or in neither of them, see Table 6. In other words, we do find a consistent willingness to take cash across the two tasks, but no consistent willingness to go for the Random ticket.

Table 6:

Panel A: Decisions of the subjects who **were not** offered a bonus in the R vs. P choice

	Choice in R vs. P		
Choice in R vs. D	Random	Previous	Total
Random	57% (59)	58% (15)	57% (74)
Distinctive (w/bonus)	43% (45)	42% (11)	43% (56)
Total	100% (104)	100% (26)	100% (130)
		Pearson chi2(1) = 0.0078	*Pr = 0.929*

Panel B: Decisions of the subjects who **were** offered a bonus in the R vs. P choice

	Choice in R vs. P		
Choice in R vs. D	Random	Previous (w/bonus)	Total
Random	71% (68)	38% (13)	62% (81)
Distinctive (w/bonus)	29% (28)	62% (21)	38% (49)
Total	100% (96)	100% (34)	100% (130)
		Pearson chi2(1) = 11.3604	*Pr = 0.001*

Cognitive Reflection Task results are presented in Table 7. Overall only 15% gave the correct answer of 0.05, and among those who gave an incorrect answer, 93% (205 subjects) 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) were more likely to give an incorrect answer in the CRT, see Table 7. This is confirmed in a probit regression, see Table B1 in Appendix B.[5]

Table 7: Random vs. Distinctive with direct bonus and CRT results

	Choice in R vs. D		
CRT	Random	Distinctive (w/bonus)	Total
Correct	38% (15)	**62%** (24)	15% (39)
Intuitive	**62%** (128)	38% (77)	79% (205)
Other	**75%** (12)	25% (4)	6% (16)

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

The same is true for those choosing Random rather than Previous with a bonus, but not for those choosing Random rather than Previous when no bonus was offered, see Table 8. Thus, correct CRT answers appear to be predictive of 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 B2 in Appendix B.

Table 8: Random vs. Previous and CRT answers

Panel A: Choice in R vs P **without** bonus

CRT	Random	Previous	Total
Correct	76% (13)	24% (4)	13% (17)
Intuitive	80% (82)	20% (21)	79% (103)
Other	90% (9)	10% (1)	8% (10)

Panel B: Choice in R vs P **with** bonus

CRT	Random	Previous w/bonus	Total
Correct	**55%** (12)	**45%** (10)	17% (22)
Intuitive	77% (79)	23% (23)	78% (102)
Other	83% (5)	17% (1)	5% (6)

Overall, the results are consistent with our findings reported in KR2019. We confirm that people have a strong preference towards randomly-looking tickets and that this preference is not caused by the status quo bias. Despite the tendency to choose Random, we see no consistent use of the RH in both tasks; however, we do see that subjects tend to be either rational (go for the bonus) in both tasks or in neither. We also find that going for the bonus is predicted by answering the CRT question correctly.

4. Experiment 2

4.1. Design

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

The choice between Random and Distinctive (now coming as Task 2) was thus 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. In this way, it was clear that the bonus was *not* a valuable signal of quality. Once this was settled, the subject was asked to choose. Again, we asked why they chose what they did and if any of the two tickets has a greater chance of being drawn.

In the other task (now coming as Task 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 just described either, 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, allowing investigation of the status quo effect also in the Random vs. Previous choice. Again, we would then ask why they decide so and if any of the tickets had a greater chance of being drawn.

As mentioned before, the order of the tasks was reversed compared to Experiment 1: subjects first made the two-stage choice between Random and Previous and only then the toss-the-coin-to-determine-the-bonus (TCDB choice between Random and Distinctive. The main reason for that is that subjects first exposed to the TCDB procedure could be inclined to ask about the bonus in the subsequent two-stage procedure.

4.2. Results

In both tasks we once again see a clear preference for Random. In the toss-the-coin-to-determine-the-bonus (TCDB) procedure applied to the choice between Random and Distinctive we see that large majority of subjects (77%) chose Random if it is offered with a bonus, see Table 9. Even if the bonus was, conversely, added to the Distinctive ticket, a slight majority (56%) still chose Random. While the latter figure is not significantly different from the equal split, it is not different from the 60% choosing random against distinctive (with bonus) in Experiment 1 either ($z = 0.7, p = 0.48$), suggesting that the bonus added directly, without explicit randomization, did not cause an effect of perceived inferiority we had hypothesized. Further, the TCDB procedure does not allow for the status quo bias and we see that despite that,

more than a half of subjects still rejected the bonus, which again suggests a very strong preference towards Random.

Table 9: Choices in Random vs. Distinctive

	Choice		
Bonus added to	Random	Distinctive	Total
Random	77% (73)	23% (22)	100% (95)
Distinctive	56% (58)	44% (46)	100% (104)
Total	66% (131)	34% (68)	100% (199)

From the results of the two-stage Random vs. Previous choice, it is obvious that subjects definitely preferred the Random ticket and the offer to switch with the bonus did not change much, see table 10. We do see, however, that among those choosing Previous initially, nearly half decided to switch when the bonus was introduced, suggesting that this preference is often quite weak.

Table 10: Choices in Random vs. Previous

Initial preference	Random	Previous
	87% (173)	13% (26)
Final choice		
Stay	88% (152)	58% (15)
Switch	12% (21)	42% (11)

The question we subsequently posed to our subjects, namely whether they thought that any of the tickets had a greater chance of being drawn, made it possible to further investigate whether the fact of not switching to the other ticket when bonus was offered may stem from the misperception of probabilities. In Table 11 we can see that willingness to switch correlated very highly with the belief that both tickets had the same probability. We can stipulate that, consistent with our other results, 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.

Table 11: R vs. P stay/switch and chances of being drawn answers

	Which has a greater chance?				
Final choice	Random	Previous	Equal	Other	Total
Stay	**71% (118)**	4% (7)	22% (37	3% (5)	100% (167)
Switch	16% (5)	0	**84% (27)**	0	100% (32)
Total	62% (123)	3.5% (7)	32% (64)	2.5% (5)	100% (199)

Looking across the two tasks (Table 12) we observe, again, that those choosing Random against Previous were not necessarily the same subjects as those choosing Random against Distinctive. This suggests, consistent with all our previous findings, that representativeness heuristic does not show consistently across different tasks.

Table 12: Across R vs. D and initial choice of R vs. P

	Initial choice in R vs. P		
Choice in R vs. D	Random	Previous	Total
Random	66% (115)	62% (16)	66% (131)
Distinctive	34% (58)	38% (10)	34% (68)
Total	100% (173)	100% (26)	100% (199)
	Pearson chi2(1) = 0.2448		*Pr = 0.621*

Cognitive Reflection Task results are presented in Table 13. Overall, only 23% gave the correct answer of 0.05, and among those answering incorrectly, 92% (126 subjects) chose the intuitive option of 0.1.

Table 13: Cognitive Reflection Task results

	Incorrect			
Correct	Intuitive	Other	Knew*	Total
23% (42)	70% (126)	6% (11)	10% (20)	100% (199)

*20 subjects said they knew the problem before, possibly because it was recently featured in a popular TV show

In the choice between the Random and Distinctive, if the bonus was associated with R, CRT-correct subjects chose Random particularly often, while if the bonus was with Distinctive, we see no dependence, see Table 14. Again, the fact that answer CRT was only associated with hunger for bonus, is confirmed by probit regression, see Table B3 in Appendix B.

Table 14:

Panel A: Choice in R (w/bonus) vs. D

CRT	Random (w/bonus)	Distinctive	Total
Correct	**94%** (16)	6% (1)	100% (17)
Incorrect	70% (47)	30% (20)	100% (67)
Total	75% (63)	25% (21)	100% (84)
		Pearson chi2(1) = 4.1545	*Pr = 0.042*

Panel B: Choice in R vs D (w/bonus)

CRT	Random	Distinctive (w/bonus)	Total
Correct	52% (13)	48% (12)	100% (25)
Incorrect	59% (41)	41% (29)	100% (70)
Total	57% (54)	43% (41)	100% (95)
		Pearson chi2(1) = 0.3243	*Pr = 0.569*

Once again, however, replicating results of KR2019 we see rationality across the tasks. Those giving a correct answer to CRT chose Previous initially more often and regardless of the initial choice *switched* with the bonus more often (Table 15).

Table 15:

		CRT	
		Correct	Incorrect
Initially	Random	79% (33)	91% (125)
	Previous	**21%** (9)	9% (12)
Pearson chi2(1) = 4.9827; Pr = 0.026			
Finally	Switch	**31%** (13)	9% (12)
	Stay	69% (29)	91% (125)
Pearson chi2(1) =13.1766; Pr = 0.000			

Overall, correct answers to the CRT are strongly correlated with age and somewhat with religiosity, however the effect is not very robust. The strongest predictor of switching with the bonus is being a male and answering to the CRT correctly. Other features, such as superstition, religiosity or gambling habits do not predict the choice.

5. Discussion

Previous **experiments** on preference for lottery tickets (Bar-Hilel and Neter 1996; Risen and Gilovich, 2007; KR19) established that people are reluctant to *exchange* a ticket they first got. 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, the fraction of people willing to forgo a monetary payment to get the preferred ticket was just as high in the one-stage procedure as in the two-stage procedure, although only the latter involved tickets being given-up, thus giving more scope for regret and (especially) the Risen-Gilovich effect. We confirm thereby 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 most 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). Yet, preference for Distinctive is very rare. Third, if anything, we observe the reverse of the Risen-Gilovich effect. Indeed, among the people choosing Random over Previous when no bonus was offered in a one-stage procedure (Task 2 of Experiment 1), 90.5% say that R was more likely to win. Among those who chose R over P *in the first stage* (in Task 1 of Experiment 2) and were subsequently offered to switch (which some of them did), only 70.7% said that R was more likely to win. Thus, giving an incentive to switch, if anything, shifted the belief against the ticket that could be given up, but not in favor of it– a reversed Risen-Gilovich effect.

One important 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 gets the discarded ticket etc. Strong regret/dwelling on the possibility

[6] That said, in KR19 and in two-stage choice between Random and Previous reported here we tried to minimize such a possibility, in particular the subjects did no physically get the ticket after their initial choice.

that the given-up ticket is going to win eventually in someone else's hands could thus be somewhat specific to these designs, with less bearing on natural real-world stimuli that we are using.

While regret does not seem to play a role in our findings, we do find representativeness heuristic to be quite relevant. Since tickets with Random sequences are generally preferred and hold onto regardless of the task or the alternative ticket, RH prevails in the decisions of our subjects. However, consistent with KR2019 we find no 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. In this sense, RH may not a be a stable trait showing up consistently over time and across tasks. What seems to operate in such a manner is the willingness and ability to undertake cognitive reflection: correct answers to the Cognitive Reflection Test predict choosing tickets which come with the bonus, predict switching, and stating that the two tickets have the same probability of being drawn.

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7. Appendix A: Wording of Experiments 1 and 2

7.1. Wording of Experiment 1

Verbal version:

[INTRO] Hello, I'm representing the University of Warsaw, where we're conducting a scientific study, can I take a couple of minutes of your time? In return, I have a pre-paid lottery tickets 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 being drawn twice daily, and you can bet on up to 10 numbers –so is in the present case. In each of the tickets 10 numbers are already chosen, and the two tickets differ only in these numbers. Both of them are for the nearest drawing and in if all 10 numbers are drawn there is a guaranteed prize of 250,000 PLN, the fewer the numbers match, the smaller the prize, and all the prizes are regardless of the numbers that other players chose.

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

[subject choosing and receiving the ticket/the ticket with 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 did you choose this one?

[this question added after first 62 observations] Does 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 if 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 the pencil. How much does the pencil cost?

Now only few demographic questions left, okay?

What is your age?

Do you have a basic, 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's all, thank you. Have a nice day.

7.2. Wording of Experiment 2

Verbal version:

[INTRO] Hello, I'm representing the University of Warsaw, where we're conducting a scientific study, can I take a couple of minutes of your time? In return, I have a pre-paid lottery tickets 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 being drawn twice daily, and you can bet on up to 10 numbers –so is in the present case. In each of the tickets 10 numbers are already chosen, and the two tickets differ only in these numbers. Both of them are for the nearest drawing and in if all 10 numbers are drawn there is a guaranteed prize of 250,000 PLN, the fewer the numbers match, the smaller the prize, and all the prizes are regardless of the numbers that other players chose.

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, which do you choose.

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

[subject choosing and receiving the ticket/the ticket with the bonus]

Can you please tell me why did you choose this one?

Does 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 the coin to determine to which one of them I will add 1zł. If it's heads I will add to the one on the right if tails then to the one on the left. Is it clear?

[TCDB procedure]

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

[subject choosing and receiving the ticket/the ticket with the bonus]

Can you please tell me why did you choose 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 if 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 the pencil. How much does the pencil cost?

Now only few demographic questions left, okay?

What is your age?

Do you have a basic, 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's all, thank you. Have a nice day.

8. Appendix B: Additional analyses

Table B1. Determinants of choosing R rather than D in Experiment 1: 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_s		-0.012	0.083	0.098
gamb_inten		0.048	-0.014	-0.017
CRT_correct		-0.615**	-0.823**	-0.798**
medium	-0.230	-0.066	-0.184	-0.176
high	-0.201	0.070	-0.021	-0.025
seq_5	-0.143	-0.134	-0.244	-0.249
RvsD_R_on_right	0.190	0.296	0.376*	0.369*
Day of the week and Location dummies	No	No	Yes	Yes

legend: * p<.1; ** p<.05; *** p<.01

Table B2. Determinants of choosing R rather than P in Experiment 1: 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_s		0.256	0.044	0.002
male_bonus				0.208
male_male_experimenter				0.530
age		0.006	0.017*	0.018*
gamb_inten		-0.054	-0.015	-0.035
CRT_correct		0.327	0.652	0.488
CRT_corr_bonus		-1.282*	-1.693**	-1.592**
medium	0.147	0.160	0.041	0.081
high	-0.026	-0.030	-0.184	-0.146
seq_5	0.280	0.235	0.305	0.360
RvsP_R_on_right	0.060	0.000	-0.034	0.005
Day of the week and Location dummies	No	No	Yes	Yes

legend: * p<.1; ** p<.05; *** p<.01

Table B2. Determinants of choosing R rather than P in Experiment 2: 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** **
medium	-0.079	-0.079	-0.006	0.035
high	-0.229	-0.086	-0.028	0.043
seq_5	-0.394**	-0.542**	-0.787***	-0.786***
Day of the week and Location dummies	No	No	Yes	Yes

legend: * p<.1; ** p<.05; *** p<.01

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