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Windfall gains and house money: The effects of endowment history and prior outcomes on risky decision-making

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Abstract

In a seminal contribution, Thaler and Johnson (1990) detected the existence of a house money effect which is defined as an increase in risk tolerance after previous gains resulting from a risky activity. Subsequent studies used the term house money effect also in case of windfall gains, i.e., easily acquired money like show-up fees or initial endowments in experiments which does not result from a risky investment. The present study is to the best of our knowledge the first that disentangles the house money effect and windfall gains. We find a clear and systematic pattern that windfall gains increase risk tolerance. In contrast, the house money effect is far less ubiquitous and seems to require skewed lotteries and/or a large number of rounds played. We, therefore, conclude that a careful distinction between windfall gains and the house money effect is warranted in future research.

Keywords House money effect · Windfall gains · Risk aversion · Quasi-hedonic editing · Prospect theory

JEL Classifications C91 · D81

1 Introduction

Despite classic normative theory assuming rational agents to base their decisions solely on an evaluation of incremental costs and benefits, it has become a widely supported insight that precedent events, outcomes and decisions may have the power to influence actual economic decision making (e.g., Arkes & Blumer, 1985; Staw, 1976; Thaler, 1980).

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Regarding decisions under risk and uncertainty a seminal contribution towards understanding behavior and changes of behavior in multi-round decisions involving monetary gains and losses was put forward by Thaler and Johnson (1990). Based on their experimental observations, they proposed Quasi-Hedonic Editing (QHE) as the underlying process in such contexts. On the one hand, according to QHE, individuals tend to integrate possible future losses with prior gains, i.e., regard them as reductions of previous gains until they are depleted rather than actual losses. In contrast, possible future gains are segregated from previous ones in this process. Assuming a Prospect Theory-like value function (concave in the gain domain, convex in the loss domain and steeper for losses than for gains (Kahneman & Tversky, 1979)), this leads to enhanced risk proneness or at least mitigated risk aversion after a gain, which is called the house money effect.

These effects of prior outcomes in risky environments have been studied extensively in trading behavior in financial markets (Coval & Shumway, 2005; Frino et al., 2008; Hsu & Chow, 2013; Huang & Chan, 2014; Liu et al., 2010; Wen et al., 2014), lottery and portfolio choices (Weber & Zuchel, 2005) as well as in game show behavior (Gertner, 1993). However, in experimental economics, the term house money has also been used synonymously for easily gotten money in general and not been limited to situations where an individual is actually “gambling while ahead” as originally framed by Thaler and Johnson. Notably, the obligatory initial payment of monetary endowments in experimental settings is often referred to as house money (e.g., Ackert et al., 2006; Bosch-Domenech & Silvestre, 2010; Cardenas et al., 2014; Clark, 2002; Corgnat et al., 2015; Dannenberg et al., 2012; Davis et al., 2010; Rosenboim & Shavit, 2012) and also possibly fosters risk-taking behavior due to a generally higher marginal propensity of consumption (Arkes et al., 1994).

This paper draws a clear distinction between extraordinary riskless gains, such as initial payments in experiments, denoted as windfall money, and any positive difference between the current stake and the initial stake that has been acquired by previously taking risk, the house money.¹ We argue that there is no apparent reason to assume a priori that individuals treat these types of money identically, especially whenever an increase of one’s assets included the possibility of monetary losses before. Additionally, not making this distinction unnecessarily exacerbates any endeavor to identify the actual determinants of risk attitude and risk attitude changes in our view. For example, not observing one’s risk proneness to increase after being lucky in a risky environment does not necessarily exclude the existence of a house money effect if the money put at stake was windfall money in the first place and therefore already induced behavior representing the maximum level of individual risk tolerance.

To the best of our knowledge, we report the first experimental results of an approach to disentangle the effects of prior riskless and risky gains on risk-taking behavior and risk attitude changes. In a first step, we aim at varying the extent to which subjects regard the experimental endowment as their own money rather than windfall money. As we cannot let people risk their own money and possibly leave the experiment in debt, we employ two different mechanisms to create the sensation

¹ It is worth noting that Thaler and Johnson (1990) do not draw this distinction.

of putting their own money at stake. Our baseline treatment does not exhibit such manipulation and includes a payment of experimental endowment in connection with a subsequent two round gambling task involving monetary gains and losses to elicit risk attitude and risk attitude changes. Our first manipulation involves a temporal separation of paying the endowment and the actual gambling task to let the money become part of the subjects' own assets in the course of time. This approach builds on contributions by Gourville and Soman (1998) and Shafir and Thaler (2006), who argue that money in certain mental accounts² depreciates over time, and has been employed effectively in the context of decisions under risk by Bosch-Domenech and Silvestre (2010), Rosenboim and Shavit (2012) as well as by Cardenas et al. (2014).

In a second manipulation, participants earn their endowment for the gambling task by completing questionnaires, while being fully informed that they would be compensated for their effort with a fixed payment. Although the effect of earned vs. windfall money has been studied in various domains, including charitable giving (Carlsson et al., 2013; Reinstein & Riener, 2012), dictator games (Cherry & Shogren, 2008; Cherry et al., 2002), public goods games (Cherry et al., 2005; Kroll et al., 2007) and experimental asset markets (Corgnet et al., 2015),³ evidence on how it influences individual decisions under risk is surprisingly scarce. Zeelenberg and van Dijk (1997) contribute to this question by presenting results from hypothetical choices that “behavioral sunk costs”, i.e., effort that has been exerted to earn money, can decrease subsequent risk proneness.

In total, our contribution is threefold. First, we elicit how the endowment's history influences individual risk attitude. Second, we examine how outcomes of initial decisions under risk change risk attitude. Third, we check whether risk attitude changes after losses and gains are influenced by the endowment's history.

The remainder of this paper is organized as follows. Chapter 2 illustrates our design and procedures of the experiment. In Chapter 3 we propose as theoretical background a model where subjects apply QHE with a certain probability. This model allows to derive some hypotheses, in particular with respect to windfall gains. Results are presented in Chapter 4 while Chapter 5 discusses open questions and concludes.

2 Design and procedure

We used a two round lottery game to elicit individual risk attitude which is a modified version of Gneezy and Potter's design (1997, 2003) as employed by Weber and Zuchel (2005). Participants were students enrolled in introductory economics and intermediate microeconomics courses at Kiel University, Germany. In total, 241 subjects participated in four different treatments. All treatments were run as pen and paper tasks in a classroom. The gambling task was designed as follows. All students were endowed with 8€ and assigned an identification number between 1 and n in the beginning. This number was also used for determining outcomes later on. In both of

² For an overview on mental accounting, see Thaler (1999).

³ The authors also separate in time earnings task and market experiment in the same treatment.

the two rounds, participants were allowed to buy lottery tickets, with the maximum number being limited to 10 units per round. One ticket cost 0.4€ and won or lost with equal probability. Each ticket paid 1€ in case of winning and nothing otherwise. Outcomes were perfectly positively correlated within subjects, i.e., all tickets bought by one person either won or lost. So participants effectively had to choose twice between the lotteries presented in Table 1 which are represented as gains and losses relative to the initial endowment in round 1 and the current stake in round 2 respectively.

As our goal was to observe changes in risk attitude following a gain or a loss, the outcome of the first round was known before subjects made their decisions for the second round. The number of tickets bought serves as our measurement of individuals' risk attitude with a larger number representing a lower degree of risk aversion or even risk neutrality or risk proneness.⁴ A coin toss determined whose tickets won after each of the two ticket buying decisions depending on whether the participant's assigned identification number was even or odd. By this mechanism, we ensured the groups of first-round winners and losers to be of similar size. The last part of the experiment was a short questionnaire, including a question about the reasons why subjects made their ticket buying decisions. We are confident that subjects fully understood the incentivization mechanism of the lotteries and have no reason to assume otherwise.

All subjects were paid the money they won in addition to their initial endowment (a maximum of 12€) or had to pay back their losses (a maximum of 8€) at the very end of the experiment, i.e., individuals were confronted with paper gains/losses after round 1 that would not be realized before the end of round 2. The gambling task took around 15–20 min in most sessions.

2.1 Baseline treatment

For the baseline treatment ($n=60$, 33 male, 27 female), students were approached right after the tutorials that accompany the respective lectures. They were asked to participate in an experiment dealing with economic decision making. All subjects were then handed an envelope with 8€ and requested to check whether the money was actually in it. We did so to ensure that all subjects experienced the same sensation of actually holding the money in hand. They were subsequently informed about the procedure of the two round lottery game, both verbally and in writing. It was explicitly stated that no such thing as a 'correct' behavior existed. Both rounds of the gambling task were played subsequently and paid out at the end of the session.

2.2 Time treatment 1

To study the effect of time on risk-taking, in two treatments we separated the payment of the initial endowment from actual play of the two round lottery. In the first of these time treatments ($n=64$, 33 male, 31 female), the procedure was the same

⁴ In fact, due to the lotteries' positive expected values, this method does not allow to distinguish between risk neutral and risk loving behavior as in both cases 10 units would be bought in each round.

Table 1 Menu of implicit lottery choices

No. of tickets	Resulting lottery	No. of tickets	Resulting lottery
0	0		
1	(0.6€, 0.5; -0.4€, 0.5)	6	(3.6€, 0.5; -2.4€, 0.5)
2	(1.2€, 0.5; -0.8€, 0.5)	7	(4.2€, 0.5; -2.8€, 0.5)
3	(1.8€, 0.5; -1.2€, 0.5)	8	(4.8€, 0.5; -3.2€, 0.5)
4	(2.4€, 0.5; -1.6€, 0.5)	9	(5.4€, 0.5; -3.6€, 0.5)
5	(3.0€, 0.5; -2.0€, 0.5)	10	(6.0€, 0.5; -4.0€, 0.5)

as for the baseline treatment, except that students were endowed with 8€ one week before they could bet this money in the lotteries. No decision had to be made at the time of the initial payment and participants were not instructed about the experiment's design at that point but merely informed that they could gamble with the 8€ in the tutorial one week later.

2.3 Time treatment 2

The second time treatment ($n=59$, 33 male, 26 female) was designed to yield an intrapersonal measurement of risk attitude changes over time. In contrast to Time 1, participants were informed about the task at the moment they received their initial endowment and were asked to make their ticket buying decision for the first round, though it would be played one week later. During the second meeting, they had to decide again on the number of tickets to buy in the first round, with this second decision being binding. They were not informed about this chance for revision in the first meeting. The second round of the gambling task as well as the payments were performed directly afterwards.

In both time treatments, participants were allowed to pay their losses in one of the following weeks in case they did not have enough money at hand and they were explicitly informed of this.

2.4 Work treatment

To capture the effect of behavioral sunk costs, i.e., effort to earn the endowment, on risk-taking, students in the work treatment ($n=58$, 28 male, 30 female) were recruited to complete two questionnaires and they were told to be compensated with 8€ for doing so. It took around 30 min for most of them. After receiving their payment, they were introduced to the two round lottery game that was played subsequently just as in the baseline treatment.

An overview of the timing and order of the events in all treatments along with the experimental instructions can be found in Appendix A.

3 Theoretical background

We analyze the role of prior outcomes in the framework of (cumulative) prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). Apart from probability weighting, the key difference of prospect theory with respect to expected utility is the existence of a reference-dependent value function $v(\cdot)$ which depends on gains and losses relative to a reference point r rather than on final wealth positions. If the final wealth equals x_i in state i , the overall value of a gamble in cumulative prospect theory is given by

$$V = \sum_i v(x_i - r) \pi_i, \quad (1)$$

where $v(0)=0$ and π_i is the decision weight of state i . As probabilities seem to play a minor role in this context and our experimental design only involves 50:50 bets, we refrain from probability weighting for convenience and, hence, assume that π_i always equals the untransformed probability p_i . In prospect theory it is usually assumed that the value function displays diminishing sensitivity (i.e., $v(\cdot)$ is concave in the gain domain and convex in the loss domain) as well as loss aversion (i.e., $v(x_i - r) < -v(-(x_i - r))$ for $x_i - r > 0$).

A central issue in prospect theory is the question of the location of the reference point. In many applications it is assumed that the reference point equals the status quo which can be normalized to zero. In this case, experimental outcomes can be directly inserted in the value function such that the decisions in our experiment are guided by the following utility:

$$V = 0.5v(0.6q) + 0.5v(-0.4q), \quad (2)$$

where q with $0 \leq q \leq 10$ equals the amount of tickets bought. Equation (2) reflects that for every ticket bought you either make a gain 0.6€ or a loss of 0.4€.

The central question for our analysis is now how prior outcomes enter the utility representation. Suppose there is a previous gain $y > 0$ which can be either a windfall gain (i.e., the initial endowment in our experiment) or a gain from first round ticket purchases. The most obvious alternatives are that y is either integrated or segregated in the utility representation. In the case of integration, (2) becomes

$$V = 0.5v(0.6q + y) + 0.5v(-0.4q + y), \quad (3)$$

in the case of segregation we get

$$V = 0.5v(0.6q) + 0.5v(-0.4q) + v(y). \quad (4)$$

Note that y does not influence the current decision in the case of segregation. In the case of QHE which was proposed by Thaler and Johnson (1990) to explain the house money effect it is proposed that previous gains are integrated with potential future losses but segregated from potential future gains. Hence, QHE corresponds to

$$V = 0.5[v(0.6q) + v(y)] + 0.5v(-0.4q + y). \quad (5)$$

By comparing (2) and (5) it is obvious that in the presence of loss aversion and diminishing sensitivity a prior gain increases subsequent risk tolerance according to QHE.

However, it is clear that not all prior outcomes in the life of the decision maker can be considered in the current decision. Based on the theory of mental accounting, QHE proposes that only prior outcomes which are in the same mental account as the potential outcomes of the current decision enter the evaluation in (5); all other prior outcomes will be segregated and, thus, will not have any impact on the current decision. Applied to our design, the initial endowment may or may not be in the same mental account than potential gains from buying tickets. Let α be the probability that both are in the same account. This means with a probability of α there is QHE, whereas with a probability of $(1 - \alpha)$ outcomes are segregated:

$$V = \alpha[0.5[v(0.6q) + v(y)] + 0.5v(-0.4q + y)] \\ + (1 - \alpha)[0.5v(0.6q) + 0.5v(-0.4q) + v(y)]. \quad (6)$$

Note that α can be also interpreted as the fraction of subjects who perform QHE. The goal of our treatments is to influence the mental accounting of the windfall gain given by the initial endowment such that the probability α differs between treatments. In Time 1 subjects had the initial endowment already in their hands for one week. A loss from buying tickets may, thus, feel more like a real loss than in Baseline since the endowment is in a separate mental account. In the work treatment, people worked for their initial endowment which may clearly be in a different mental account than money from gambling. Therefore, the 8€ may not feel as a windfall gain at all such that every loss from buying tickets may feel as a real loss. Thus, for first round decisions we hypothesize that $\alpha_B(8) > \alpha_{TI}(8) > \alpha_W(8)$ where B indicates the Baseline, TI the Time 1 and W the work treatment.

The model in (6) can also be applied to analyze the impact of gains from first-round investments on risk taking in the second round. Here a strictly positive α implies that risk taking should be higher in the second than in the first round after a first-round gain. Our experimental design allows to detect whether this is indeed the case. In some sense it is likely that the effect from prior gains from first round investments is similar to initial endowments in the work treatment as in both cases the outcomes are, compared to pure windfall gains, deserved either by work or previous risk taking.

4 Results

We discarded from the analysis all observations in the time treatments from subjects who did not show up for the second meeting (6 out of 70 in *Time 1*, 10 out of 69 in *Time 2*).⁵

4.1 Treatment effects on first round risk-taking behavior

To analyze the effects of the different treatments on risk attitude, we simply compare the ticket buying decisions in the first round across treatments, including the first (non-binding) decision made by subjects in *Time 2* (referred to as round 0

⁵ Drop out rates in the time treatments do not differ significantly ($p=0.2741$).

Table 2 Mean number of tickets bought by treatments

Treatment	Observations	Mean Round 0	Mean Round 1
Baseline	n = 60	/	6.25 (2.61)
Time 1	n = 64	/	5.31 (3.12)
Time 2	n = 59	5.69 (2.73)	6.00 (2.85)
Work	n = 58	/	4.10 (2.74)

Standard deviations in parantheses

henceforth). Table 2 depicts the means of ticket buying decisions in round 0 and 1 for all four treatments.

We employ non-parametric Mann-Whitney U tests⁶ to analyze possible treatment effects on risk-taking behavior. Table 3 depicts the respective significance levels for the differences between all reasonable pairings of ticket buying decisions. We exclude comparisons of second round decisions across treatments due to an overall lack of interpretability of those results brought about by different shares of winners and losers and confounding income effects resulting from different decisions in round 1.

The results suggest a clear ranking between the treatments Baseline, Time 1 and Work. The degree of risk aversion appears to be lowest in the baseline treatment, with differences being statistically significant for a comparison with Time 1 ($p < 0.05$) and even more so for a comparison with Work ($p < 0.01$). Additionally, the number of tickets bought in Time 1 is significantly larger than in Work ($p < 0.1$), although only at the 10% level. Round 0 and round 1 decisions in Time 2 were not significantly different from the baseline treatment or Time 1 at any conventional level, with the means being located between those of the other two treatments. Differences between these decisions in the second time treatment and Work are both found highly significant ($p < 0.01$). It is worth noting that the revised decision of round 1 in Time 2 almost differs significantly from the decision of round 1 in Time 1 ($p = 0.1019$), although the only difference between the treatment was an additional non-binding prior decision in Time 2 that could be changed at no (monetary) cost when making the actual ticket buying decision for round 1. Finally, initial and revised decisions in round 1 of Time 2 also do not differ significantly ($p = 0.3412$), while the latter point at a lower degree of risk aversion as slightly more tickets are bought.

We also ran a Tobit regression to check for possible effects of gender, age and whether or not subjects engage at least occasionally in gambling outside the experiment. Using first round decisions, we pooled observations across all four treatments for this analysis. Results show that males take on significantly more risk than females ($p < 0.01$). Additionally, they suggest that the number of tickets bought depends positively on subjects' age ($p < 0.05$) as well as with taking part in gambling outside the experiment ($p < 0.05$).

⁶ Employing t tests instead does not change the qualitative results substantially. The respective significance levels are depicted in Table 8 in Appendix B.

Table 3 Differences in risk attitude between treatments

	Baseline	Time 1	Time 2/0	Time 2/1
Time 1	$p = 0.0285^{**}$	-		
Time 2/0	$p = 0.2796$	$p = 0.3070$	-	
Time 2/1	$p = 0.6976$	$p = 0.1019$	$p = 0.3412$	-
Work	$p = 0.0000^{***}$	$p = 0.0780^*$	$p = 0.0031^{***}$	$p = 0.0003^{***}$

Mann-Whitney U tests

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

4.2 Effects of prior outcomes on risk-taking behavior

To analyze how winning in the first round affects risk attitude in the second round, we compare ticket buying decisions in the first round of those who win with their second decision. Similarly, we check whether a loss in the first round affects risk attitude in the second round by comparing decisions of first round losers in both rounds. We exclude those subjects from the analysis who did not buy a positive amount of tickets in the first round (none in Baseline, five in Time 1, three in Time 2 and nine in Work) and therefore have not experienced an actual gain or loss before making their second round decision. Additionally, we discarded all subjects from the sample who bought the maximum amount of ten tickets in the first round (17 in Baseline, 15 in Time 1, 14 in Time 2 and 5 in Work) to counteract a possible downward bias of risk attitude change assessment.⁷

Table 4 depicts the means of tickets bought in all rounds for winners and losers in all treatments as well as the significance levels that decisions in round 1 differ from decisions in round 2 according to non-parametric Wilcoxon tests.⁸ In the first two rows of the table, we also include a comparison of pooled decisions by first round winners and losers from treatments Baseline, Time 1 and Work, while excluding observations in Time 2 from this part of the analysis. As it will become obvious in the remainder of this section, Time 2 decisions stand out in several ways and cannot be reasonably included in a combined evaluation.

Figure 1a gives a graphical representation of decisions for first round winners while Fig. 1b depicts the respective results for first round losers. For treatments *Baseline*, *Time 1* and *Work*, the analysis suggests no significant effect of the first round outcome on risk-taking behavior in the second round of the lottery. This holds true both for an evaluation of those who experienced a gain as well as for those who lost in the first round. Treatment *Time 2* is different since here we find a significant increase of risk aversion in round 2 for both first round winners ($p < 0.01$) and first round losers ($p < 0.05$). This result will be discussed below.

⁷ Retaining all maximum buyers in the analysis does not considerably change the following qualitative results.

⁸ Employing t tests instead does not change the qualitative results substantially. The respective significance levels are depicted in Table 9 in Appendix B.

Table 4 Differences in risk attitude between rounds within treatments

Treatment	Observations	Mean / Round 1	Mean / Round 2	p-value
All (except Time 2)/winners	n=65	4.43 (1.37)	4.37 (2.93)	0.3603
All (except Time 2)/losers	n=66	4.47 (1.56)	4.70 (3.18)	0.8682
Baseline /winners	n=22	4.73 (1.28)	5.18 (2.58)	0.8102
Baseline /losers	n=21	4.81 (1.33)	5.57 (3.08)	0.3228
Time 1/winners	n=22	4.41 (1.40)	3.86 (3.11)	0.3023
Time 1/losers	n=22	4.23 (1.66)	4.45 (2.96)	0.8908
Time 2/winners	n=19	4.68 (1.49)	2.84 (1.57)	0.0008***
Time 2/losers	n=23	5.35 (1.61)	4.26 (2.47)	0.0180**
Work/winners	n=21	4.14 (1.42)	4.05 (3.04)	0.3921
Work/losers	n=23	4.39 (1.64)	4.13 (3.43)	0.5290

Wilcoxon tests

Standard deviations in parantheses

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Having established that neither first round winners nor first round losers seem to be affected by first rounds' outcomes in a significant and predictable way (except in Time 2), we take a closer look at possible differences in reactions to winning or losing within treatments. We therefore compare cross-subject behavioral changes (the changes in numbers of tickets bought) of first round winners with those of first round losers and find that these differences too are not significant at any conventional level, now also in Time 2. Significance levels of two-sample, two-sided t tests⁹ are given as $p=0.73$ in Baseline, $p=0.32$ in Time 1, $p=0.20$ in Time 2 and $p=0.87$ in Work.

We now turn to an investigation of how the magnitude of gains or losses in the first round affects behavior in round 2. We use OLS regressions to quantify the impact of relative earnings, i.e., any deviation from the 8€ endowment after round 1, on the change of the amount of tickets bought between rounds. Table 5 shows coefficient values and significance levels of these regressions for winners and losers combined in each treatment as well as for pooled observations of all treatments except Time 2. Across columns, Table 5 also depicts main results of separate regressions conditional on winning or losing for all treatments as well as for pooled observations (again, excluding subjects in Time 2).

As in the binary win/loss analysis, we do not find significant effects of relative earnings at any conventional level except for winners and the combined evaluation in Time 2. By looking at the first row, we can at best detect an overall tendency that subjects react more cautiously as previous gains or losses increase, as captured by a decreasing change in numbers of tickets bought in both cases. However, additional to emphasizing the lack of significance, some further words of extreme caution are in order when interpreting these results. As the number of tickets that can be bought

⁹ The results change only slightly by employing non-parametric Wilcoxon tests instead. P values are then given by 1.000 (Baseline), 0.2197 (Time 1), 0.0968 (Time 2) and 0.9440 (Work).

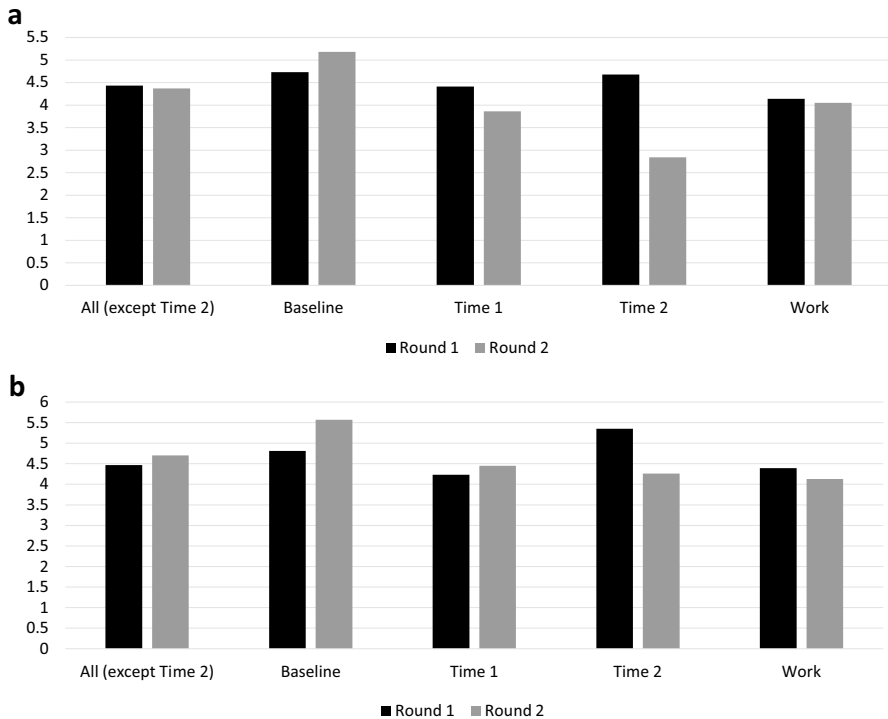


Fig. 1 **a** Mean numbers of tickets bought/first round winners. **b** Mean numbers of tickets bought/first round losers

is limited, high first round gains or losses entail a reduction of options to increase the number of tickets in the second round compared to a low previous gain or loss, although they leave the choice set unchanged (a maximum of 10 tickets can be bought in round two, regardless of the first round outcome). For example, anyone making her

Table 5 Effect of relative earnings on differences in numbers of tickets bought

Treatment	Winners	Losers	Combined
All (except Time 2)	$\beta = -0.67$ $p = 0.125$	$\beta = 0.70$ $p = 0.244$	$\beta = -0.075$ $p = 0.498$
Baseline	$\beta = -0.93$ $p = 0.216$	$\beta = 1.91$ $p = 0.164$	$\beta = -0.06$ $p = 0.729$
Time 1	$\beta = -0.41$ $p = 0.606$	$\beta = -0.73$ $p = 0.300$	$\beta = -0.21$ $p = 0.204$
Time 2	$\beta = -1.17^{**}$ $p = 0.011$	$\beta = 0.01$ $p = 0.984$	$\beta = -0.20^{*}$ $p = 0.075$
Work	$\beta = -0.93$ $p = 0.257$	$\beta = 1.62$ $p = 0.162$	$\beta = 0.04$ $p = 0.848$

OLS regressions

* $p < 0.1$; ** $p < 0.05$

Table 6 Behavioral changes between treatments conditional on first outcome

	Baseline	Time 1	Time 2
Time 1	winners: $p = 0.240$ losers: $p = 0.525$	-	
Time 2	winners: $p = 0.002^{***}$ losers: $p = 0.029^{**}$	winners: $p = 0.095^*$ losers: $p = 0.032^{**}$	-
Work	winners: $p = 0.533$ losers: $p = 0.322$	winners: $p = 0.627$ losers: $p = 0.575$	winners: $p = 0.035^{**}$ losers: $p = 0.331$

Two-sided t-tests

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

second round decision after a gain of 3€ (implying 5 tickets were bought in the first round) can increase or decrease the number of tickets by 5 units each, while after a 1.2€ gain one can increase it by 8 units but decrease it by only 2. In fact, assuming that subjects just randomly pick one of their options in round 2 independently of the previous outcome, the same pattern as reported above would emerge.

Finally, we investigate if winning or losing in the first round effects second round behavior differently in the four treatments. We therefore employ pairwise comparisons of behavioral changes (the changes in numbers of tickets bought) for both, first round winners and first round losers between treatments. Table 6 shows significance levels of two-sample, two-sided t tests.¹⁰

We do not observe any significant differences for comparisons between winners and losers in *Baseline*, *Time 1* and *Work*, suggesting that their reaction does not depend on the initial endowment's history in a predictable way. The only significant differences occur if we compare reactions of winners and losers in *Time 2* with those in the remaining three treatments, which does not come as a surprise in the light of the previously reported results. Table 7 depicts the share of subjects who changed their behavior between rounds.

These descriptive results provide further evidence for a lack of a clear pattern in how first round outcomes influence subsequent decisions and can be backed up by additional results from simple Probit regressions. We check whether the likelihood of observing a winner is significantly depending on observing that the number of tickets bought has increased in round 2 and find that it does not at any conventional significance level ($p=0.284$ for *Baseline*, $p=0.499$ for *Time 1*, $p=0.383$ for *Work* and $p=0.298$ for pooled observations). *Time 2* constitutes a special case here, as none of the first-round winners actually increase the number of tickets bought. Around one third of subjects in all treatments do not change their behavior after round 1 at all. In *Baseline*, *Time 1* and *Work*, we observe a considerable number of subjects changing behavior in both directions, which holds for both first round winners and losers with the direction of the changes being ambiguous. In *Time 2*, none of the winners and

¹⁰ Employing non-parametric Wilcoxon tests instead does not change the qualitative results substantially. The respective significance levels are depicted in Table 10 in Appendix B.

Table 7 Share of different decisions between rounds

Treatment		0→1			1→2		
		>	<	/	>	<	/
All	combined (n = 173)				23.7%	41.6%	34.7%
	winners (n = 84)				20.2%	44%	35.7%
	losers (n = 89)				27%	39.3%	33.7%
Baseline	combined (n = 43)				34.9%	27.9%	37.2%
	winners (n = 22)				27.3%	27.3%	45.5%
	losers (n = 21)				42.9%	28.6%	28.6%
Time 1	combined (n = 44)				27.3%	40.9%	31.8%
	winners (n = 22)				31.8%	50%	18.2%
	losers (n = 22)				22.7%	31.8%	45.5%
Time 2	combined (n = 42)	23.8%	14.3%	61.9%	7.1%	54.8%	38.1%
	winners (n = 19)				0%	63.2%	36.8%
	losers (n = 23)				13%	47.8%	39.1%
Work	combined (n = 44)				25%	43.2%	31.8%
	winners (n = 21)				19%	38.1%	42.9%
	losers (n = 23)				30.4%	47.8%	21.7%

only three losers buy more tickets in the second round. Notably, only around 40% changed their initial decision (round 0) in *Time 2*. So, the insignificant effects of first round outcomes on average risk-taking behavior in the former three treatments might be driven by these effects being ambiguous rather than nonexistent at all.

To gain further insight in this regard and to test whether the behavioral changes are just due to some kind of general noise (i.e., not causally linked to a previous outcome at all), we ran an additional treatment (n = 33, 16 male, 17 female), that closely resembled the protocol of the *Baseline* treatment. The only difference was that subjects would not learn about the first round's outcome before they would have to make their decision for round two, which was of course common knowledge.

We find that decisions do not differ significantly between rounds at any conventional level, confirmed by both Wilcoxon and t tests. Again excluding all non-buyers and all maximum-buyers from the analysis as before, we find that 50% do not change their decision between rounds, while 25% increase and 25% decrease their number of tickets bought. This fraction of non-changers is the highest we observe overall, yet not significantly different from those in the other treatments at any conventional level. However, if we check whether the intensity of reactions after round one increases if subjects learn about the first round outcome between rounds, i.e., if we compare the average absolute behavioral changes defined as the absolute values of the differences of number of tickets bought between rounds, we find that this is lower in this additional treatment compared to *Baseline*, *Time 1* and *Work* according to one-sided t tests (*Baseline*: $p=0.0304$, *Time 1*: $p=0.0568$, *Work*: $p=0.0132$).

With all due care, we conclude here that much of the variation between rounds can be reasonably attributed to noise, but it seems legit to infer that winning or losing in round one amplifies behavioral changes between rounds on average.

5 Discussion and conclusion

On the one hand, our results suggest the effectiveness of our treatment manipulation with respect to risk attitude. Consistently with our model, giving away the endowment as windfall money directly before the decision obviously induces the strongest willingness to gamble, while earning the endowment makes individuals most reluctant to do so. The passage of time seems to dampen the risk proneness enhancing effect of being granted windfall money, with this effect not being strong enough to outright resemble the situation in the work treatment. We interpret this as unambiguous evidence for the existence of a windfall money effect with respect to risk attitude. Additional support for this interpretation is found in participants' post-experiment answers to the question of the considerations which guided their decisions. In the baseline treatment, ten subjects actually stated explicitly that they had the feeling that they were not actually gambling with their own money, while five in time treatment 1, seven in time treatment 2 and only one in the work treatment made such statements.

On the other hand, we fail to identify any systematic pattern of risk attitude changes following a first round gain or loss in the baseline treatment, time treatment 1 and the work treatment, challenging the existence of a house money effect as defined in our analysis, regardless of the initial endowment's history.

Observations in time treatment 2 constitute a remarkable exception in this regard, as individuals show substantially increased risk averse behavior in round 2, both after winning and losing in round 1. Several deliberations can be employed to shed some light on these peculiar results, although all of them should be treated with caution due to their speculative nature. Recall that subjects' decisions in round 0 do not significantly differ from those in the baseline treatment for round 1.¹¹ This should not come as a surprise, as individuals cannot reasonably be expected to actually include a correct forecast of their risk attitude change as observed in time treatment 1. It seems permissible to assume that this first decision serves as an anchor (Tversky & Kahneman, 1974) for the second decision when the actual gambling is performed (56 out of 59 subjects stated afterwards that they remembered their decision in round 0 when making their decision in round 1).

While there is no plausible reason to assume that individuals' "true" risk attitudes differ significantly from the ones in time treatment 1, a majority of subjects do not revise their decision and buy more tickets in round 1 than they presumably would have without this anchor. This may be the result of a generally effective status quo bias (Samuelson & Zeckhauser, 1988), i.e., a general inertia or reluctance to change one's previously made decision. This inertia may be amplified by an experimenter demand effect (Zizzo, 2010), as modalities of the gambling task have not changed and subjects feel obliged to stick to their initial decision, in order not to appear "inconsistent" or "irrational" in their own view. Six participants rationalized their sticking to their first decision by explicitly stating that there "had been no reason to change" in the post-experiment questionnaire. In fact, subjects may be

¹¹ Although not within the scope of this paper, note that this implies that we do not observe evidence for systematically distinct discount rates for possible future gains and losses in this decision (see Ahlbrecht & Weber, 1997).

even inadvertently pushed into not changing their decision as they were explicitly told that “the conditions had not changed from last week’s”. Nevertheless, once the first round is played, subjects are relieved of that aforementioned anchor when making their decision in round 2 and free to choose according to their “true” risk attitude. This effect may be enhanced by people feeling the necessity to make up for the “overgambling” in round 1 by acting more cautiously in the following, resulting in a significant decrease of number of tickets bought. In sum, our manipulation in the second time treatment did not enable us to assess an intrapersonal measure of reduced risk proneness as originally intended but yielded some insights that are noteworthy in their own right.

Recently, attention has been drawn to possibly different effects of paper gains/losses vs. realized gains/losses. Davis et al. (2010) report that paying a show-up fee after the experiment rather than before decreases risky behavior, measured as refraining from information purchases in their experiment. Reinstein and Riener (2012) show that donations in a dictator game decrease substantially if the endowment to be allocated is handed to recipients in cash instead of being shown on a computer screen. Imas (2016) observes individuals to take on greater risk after a paper loss while taking on less risk after a realized loss.

Our design includes both the tangibility of endowment paid at the beginning and paper losses/gains after round 1, as the final payments were not realized before the end of round 2. It is worth noting at this point that we neither observe an increase in risk-taking behavior after paper losses, nor after paper gains that had been generated by betting money that participants actually held at hand. Our results on paper losses are in contrast to those of Imas (2016) who observes a significant increase in risk-taking after paper losses with a rather similar experimental design. The only difference to our design is that Imas uses skewed lotteries and four instead of two investment rounds. Also Langer and Weber (2008) observe increased risk-taking after paper losses in a design with skewed lotteries and multiple (namely 30) rounds. Since we have about twice the sample size of Study 1 of Imas our failure to detect a house money effect cannot be attributed to an underpowered study but should be due to the design differences. The question whether and how exactly the skew of lotteries, the number of rounds or the combination of both can lead to the emergence of a house money effect is left for future research, but a reference to two well-documented phenomena of individual behavior with respect to decision making in risky environments, namely the *gambler’s fallacy* and the *hot-hand fallacy* (e.g., Rabin & Vayanos, 2010), may shed some initial light on this matter and reconcile our findings with Imas’. The former describes individuals’ inclination to deem an event less likely to happen when it has recently occurred, the latter works in the opposite direction and makes people think that one who has just been (un)lucky in a task is more likely to be (un)lucky subsequently. In the context of our design, that only involved 50:50 bets, it is reasonable to assume that some subjects fall for the gambler’s fallacy, i.e., think that heads is more likely to turn up after tails (and vice versa), while some think that it is more likely to win (lose) again after just having won (lost). Assuming that both fractions of subjects are of similar size, this explains our observation that individuals react stronger in absolute terms if the first round’s outcome is revealed compared to the general noise that we identified by implementation of our additional treatment where the first round’s outcome was unknown to the subjects when

making their second-round decision. The relative relevancy of these biases is likely to change with the skewness of the lottery as well as the number of round played. A hot-hand fallacy is arguably more pronounced if a subject was (un)lucky in a gamble that had a low instead of very high probability of winning (loosing). A gambler's fallacy, on the other hand, is more likely to appear as the previous streak of identical outcomes is extended. Recalling in this context that the significant increase in risk taking after round 3 in Imas' paper-loss treatment was calculated for those who had lost in all three previous rounds and keeping in mind that the probability of losing was $5/6$ in every round, it is well possible that a gambler's fallacy at least partly drives the results, such that they are not necessarily contradicting our findings.¹²

Systematically varying prospects' payoffs and probabilities as well as the number of rounds may shed more light on necessary presuppositions for risk-taking to change systematically after gains or losses. Therefore, it should be emphasized here that we do not claim that our results rule out the existence of such an enhancing effect on risk-taking propensity of prior risky gains per se, but rather that this phenomenon is certainly far from being reasonably considered a behavioral regularity, as we do not observe such systematic behavior in any of our treatments.

While we cannot detect a predictable change of risk-taking behavior by first round losers, caution is in order when interpreting this result. Our findings are not generally at variance with the concept of a break-even effect, i.e., an inclination to take on greater risk to equalize prior losses if possible. In fact, "breaking even" is always possible in our experiment without changing behavior between rounds and even by reducing the number of tickets bought whenever a minimum of three tickets was bought in round 1.

A worthwhile question to address in future research is how long the time span between paying the endowment and the actual task should be and if a systematic variation of this length would yield systematically different results. For the moment, time spans in the literature are extremely different (three days in Corngnet et al., 2015; one week in our study; two weeks in Rosenboim & Shavit, 2012; three weeks in Cardenas et al., 2014; and four months in Bosch-Domenech & Silvestre, 2010) and seem determined arbitrarily, but all still yield significant effects.

Concluding, our results suggest carefully differentiating between a windfall gain effect and the house money effect. They should also intensify the awareness that paying experimental endowments as windfall money may significantly decrease observable risk aversion.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11166-023-09411-5>.

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¹² A break-even effect as described by Thaler and Johnson may be additionally at work here. While, as in our design, breaking even is, for most subjects, possible by not taking more risk in round 4 than in round 3, the relative complexity of the design (accumulated losses over 3 rounds, the invested amount is multiplied by seven in case of winning) might have obscured this and lead to a considerable increase in risk taking.

Data availability Data is available upon request.

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