

1-2018

Pre-play Learning and the Preference Reversal Phenomenon

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Recommended Citation

Kim, Younjun and Hoffman, Elizabeth, "Pre-play Learning and the Preference Reversal Phenomenon" (2018). *Economics Working Papers (2002–2016)*. 8.

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Elicited preference rankings for two lotteries are typically inconsistent in choice and price. We test whether pre-play learning makes preference rankings consistent. Pre-play learning denotes ex-ante lottery learning, where subjects observe playing lotteries before making decisions. We find that pre-play learning makes the average selling prices for the p-bet, of subjects who choose the p-bet, higher than their average selling prices for the \$-bet. However, pre-play learning is not strong enough to equalize the rates of standard and non-standard reversals, although pre-play learning reduces the rate of standard reversals.

Keywords

pre-play learning, preference reversal, probability weighting

Disciplines

Behavioral Economics | Econometrics | Economics | Economic Theory

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January, 2018

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Key words: Pre-play learning, preference reversal, probability weighting

JEL: C91, D81, D12

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Introduction

The preference reversal phenomenon is an iconic empirical puzzle in decision theory. Preference reversals have challenged standard economic theory, as well as policy evaluation techniques that rely on preference elicitation.¹ Preference reversals are defined as inconsistent preference rankings for two lotteries in terms of choice and price; subjects choose a low-payoff, high-probability lottery (p-bet), but place a higher minimum willing to sell price on a high-payoff, low-probability lottery (\$-bet). Some researchers have proposed explanations of why preference reversals occur, and others have developed new preference theories to accommodate preference reversals.²

We test whether pre-play learning significantly increases the proportion of subjects who consistently indicate a preference between two lotteries, whether they are asked to make a choice or indicate a minimum willingness to sell price. Pre-play learning is ex-ante lottery learning, where subjects observe a series of lotteries actually played out before making decisions. In the absence of pre-play learning, subjects may overweight the small probability of a negative lottery payoff in the p-bet (Fehr-Duba and Epper 2012). However, pre-play learning may help subjects more appropriately weight possible outcomes by demonstrating the frequencies of realized lottery outcomes. This change may make selling prices for the p-bet, for subjects who choose the p-bet, higher than their selling prices for the \$-bet and thus make subjects' preference rankings consistent in choice and price.

The preference reversal phenomenon has been conjectured to be a product of

¹ For comprehensive reviews on the preference reversals, see Seidle (2002) and Lichtenstein and Slovic (2006).

² For example, Cubitt, Munro and Starmer (2004) tested several explanations of preference reversals. Schmidt, Starmer and Sugden (2008) and Bordalo, Gennaioli and Shleifer (2012) have developed new preference theories to accommodate the preference reversals.

“limited awareness about the immediate environment or the possible longer-run consequences of any acts that might be taken” (p.226) in Plott’s (1996) preference discovery hypothesis. Plott hypothesized that learning about one’s own preferences and decision environments through “repeated choices, practice, incentives (feedback)” and “sobering and refocusing experiences” (p.227) allows one to reach rational choices and avoid preference reversals. Braga and Starmer (2005) reviewed empirical works on the preference reversal phenomenon and speculated that learning one’s own preferences and decision environments could remove preference reversals. In our experiment, pre-play learning may help subjects learn their own preferences and learn more about objective probabilities. Subjects may learn their own preferences by experiencing realized lottery outcomes. Subjects may also improve their understanding of objective probabilities and behave as if they update their subjective probabilities.

To explain our experimental design, we add pre-play learning to a typical preference-reversal experimental design in the economics literature. We adopt Grether and Plott’s (1979) experimental design. Their experiment carefully controlled for potential concerns in other researchers’ previous preference-reversal experiments, such as the absence of monetary incentives and subjects’ confusion and misunderstanding of experimental procedures. Moreover, their experiment became the prototype for subsequent studies.

In our experiment, we find that pre-play learning makes the average selling price for the p-bet, among subjects who choose the p-bet, higher than their average selling price for the \$-bet, suggesting that pre-play learning makes subjects’ preference rankings consistent in choice and price at the group level. This result can be explained by the convergence of probability weighting functions toward linearity (Hau et al. 2008; Erev et al. 2010). In the absence of pre-play learning, subjects may overweight a small probability of receiving a

negative lottery payoff in the p-bet, which may lead them to price the p-bet lower than the \$-bet. However, pre-play learning may reduce the overweighting of the small probability of losing in the p-bet, which may lead subjects to increase their selling prices for the p-bet. Thus, pre-play learning may increase the frequency that subjects' indicate preference rankings that are consistent in choice and price.

Researchers have tested lottery feedback in the preference reversal literature (Cox and Grether, 1996). Lottery feedback is different from pre-play learning. Lottery feedback denotes ex-post lottery learning, where lotteries are played each round after subjects have made decisions in that round. Braga, Humphrey and Starmer (2009) find that lottery feedback is problematic because it makes subjects' selling prices for the \$-bet, for subjects who choose the \$ bet, lower than their prices for the p-bet. They may be more sensitive to the realization of a negative lottery payoff of the \$-bet when they own the bet. Thus, lottery feedback may not make subjects' preference rankings consistent in choice and price. However, we do not find such evidence for pre-play learning in our experiment.

Experiment

We recruited 77 subjects via email invitation on a university campus in 2015. All sessions were conducted in a lab with paper and pencil and lasted 30 minutes. Each subject was randomly assigned to either a pre-play learning group (n=42) or a control group (n=35). Decision tasks were identical in these two groups, except for the availability of pre-play learning. Subjects were asked to make decisions in one choice task and two pricing tasks. In the choice task, subjects chose between two lotteries. The two lotteries were a low-payoff, high-probability lottery with a 35/36 chance of winning \$4 and a 1/36 chance of losing \$1 (Expected value=\$3.86), and a high-payoff, low-probability lottery with an 11/36

chance of winning \$16 and a 25/36 chance of losing \$1.50 (Expected value=\$3.85). We call these lotteries a p-bet and a \$-bet, respectively. In the pricing tasks, subjects decided whether they would sell a lottery at given prices. 21 prices were displayed in decreasing order in \$.50 decrements between \$9.99 and \$0. This kind of pricing task has been used in other studies (e.g., Butler and Loomes 2007; Loomes, Starmer and Sugden 2010). We controlled for possible order effects by switching the order of tasks: (pricing tasks) then (choice task) and (choice task) then (pricing tasks).

At the end of each experiment, subjects earned a show-up fee of \$10 and the additional earnings (or losses) from their decisions in a randomly-selected task. The task was selected by drawing a ball from a bingo cage containing three balls: one for the lottery choice task, one for pricing the p-bet, and one for pricing the \$-bet. If a lottery choice task was selected, the lottery that subjects had chosen was played, and its outcome was paid. If a pricing task was selected, one price was randomly drawn by drawing a ball from a bingo cage containing 21 balls, and subjects were paid according to their stated prices. If a subject had decided to sell the lottery at that price, the subject received that price. Otherwise, the lottery was played and payment was determined by the lottery outcome. A bingo cage containing 36 balls was used to determine lottery outcomes. We followed Grether and Plott's (1979) experimental instructions to the extent possible. Our experimental instructions are available in the appendix.

Pre-play learning was conducted only for the pre-play learning group. We played lotteries ten times each by drawing a ball from a bingo cage that contained 36 balls (with replacement each time) before subjects made any decisions in choice and pricing tasks. Half of the subjects saw the p-bet first and half of the subjects saw the \$-bet first. During this demonstration, subjects kept a record of the drawn numbers and circled the corresponding

lottery outcomes on decision sheets.

In analyzing our experimental data, if a subject indicated a willingness to sell a lottery for $\$X$ but not for $\$X-\0.50 , we used the midpoint ($\$X-\0.25) as the subject's lowest named selling price. In lottery-pricing tasks, there were nine subjects who indicated more than one switching point or who indicated unusual choices consisting of keeping a lottery at high prices and selling it at low prices. We included responses of those subjects in our analysis by using a first switching point in the case of multiple switching points, and using a maximum price of $\$9.99$ in the case of the unusual choice pattern.³

Results

Figure 1 reports the average minimum willingness to sell prices for lotteries by subjects' lottery choices. In the fifth and the sixth bars (without pre-play learning), subjects choosing the p-bet assign similar minimum willingness to sell prices to the p-bet ($\$3.94$) and the $\$$ -bet ($\$4.26$). These two values are not significantly different in a two-sided Wilcoxon signed-rank test (p-value: 0.47). In contrast, in the first two bars (with pre-play learning), subjects choosing the p-bet assign higher selling prices to the p-bet ($\$5.16$) than to the $\$$ -bet ($\$4.41$). These two values are significantly different in the same test (p-value: 0.03). With and without pre-play learning, subjects choosing the $\$$ -bet consistently assign higher selling prices to the $\$$ -bet (p-value <0.05 in the both cases using the same test). These results show that pre-play learning makes the preference rankings of subjects choosing the p-bet consistent in terms of choice and price at the group level.

We compare subjects' preference rankings for two lotteries in terms of choice and

³ Excluding the responses of the nine subjects does not change the general findings in our subsequent analyses.

price at the individual level. Two types of preference reversals are possible. One is the standard reversal: a subject who chooses the p-bet values the \$-bet higher than the p-bet. The other is the non-standard reversal: a subject who chooses the \$-bet values the p-bet higher than the \$-bet. The rate of standard reversals among subjects who choose the p-bet is typically greater than the rate of non-standard reversals among subjects who choose the \$-bet. Previous studies focused on whether this asymmetric pattern is removed by a particular method. Preference reversals can be viewed as subjects' decision errors and no longer challenge standard economic theory if the rates of standard and non-standard reversals are the same.

In the right half of table 1 (without pre-play learning), the rate of standard reversals is 56%: 7 out of 16 subjects who chose the p-bet valued the \$-bet higher than the p-bet. The rate of non-standard reversals is 27%: 2 of 14 subjects who chose the \$-bet valued the p-bet higher than the \$-bet. These two rates are different in a two-sided sign test (p-value: 0.07), which suggests that subjects' preference rankings for lotteries are different in choice and price at the individual level, in the absence of pre-play learning. In the right half of the table (with pre-play learning), the rates of standard and non-standard reversals are 27% and 10%, respectively. These two rates are still significantly different (p-value: 0.07), which suggests that pre-play learning is not strong enough to equalize the rates of standard and non-standard reversals. Note, however, that pre-play learning decreased the rate of standard reversals by half, from 56% to 27%, which suggests that pre-play learning makes subjects' preference rankings more consistent at the individual level than choices without pre-play learning. Also, note that pre-play learning does not seem to increase the rate of non-standard reversals. The rate of non-standard reversals is 14% without pre-play learning and 10% with pre-play learning. In contrast, Braga, Humphrey and Starmer (2009) found that lottery feedback

increased the rate of non-standard reversals. In this sense, pre-play learning has a more pronounced effect on preference reversals than lottery feedback.

Discussion

Our results can be explained by the psychology of “tail events”—rare, high-impact events—discussed in Barberis (2013). In the absence of pre-play learning, subjects tend to overweight the probability of tail events (Fehr-Duba and Epper, 2012). That is, subjects may overweight the probability (i.e. 0.03) of receiving the negative lottery payoff of the p-bet when they value the bet. However, pre-play learning may help subjects balance their attention across lottery outcomes in the p-bet and reduce their overweight of the tail event in the p-bet. This line of explanation is empirically supported by Hau et al. (2008) and Erev et al. (2010). These authors found that probability weight functions converged toward linearity when subjects observed playing lotteries multiple times before making decisions. Moreover, this line of explanation seems likely because the majority of people have non-linear probability weight functions in the absence of pre-play learning. Bruhin, Fehr-Duda and Epper (2010) found that, without pre-play learning, about 80% of subjects exhibited non-linear probability weight functions, while the remainder exhibited linear probability weight functions.

Pre-play learning does not change subjects’ selling prices for the \$-bet, probably because subjects do not overweight the probability (i.e. 0.31) of winning a positive lottery payoff in the \$-bet, even in the absence of pre-play learning. This conjecture is supported by typical probability weight functions reviewed in Fehr-Duba and Epper (2012); the probability weight functions are close to the objective probability in the range between 0.3 and 0.4. Hau et al. (2008) and Erev et al. (2010) found that the observation of playing

lotteries had little impact on subjects' probability weight functions in the range between 0.3 and 0.4. We expect that pre-play learning would equalize the rates of standard and non-standard reversals if we used another \$-bet with a smaller probability of winning a positive lottery payoff than the current one (i.e. 0.31). Subjects are likely to overweight a probability of winning a positive lottery payoff that is smaller than 0.3 in the absence of pre-play learning. We expect that pre-play learning would decrease subjects' selling prices for the new \$-bet and thus decrease the ratio of standard reversals further than in the current result. We leave this hypothesis for the future research.

Our results bring researchers' attention to a cause of preference reversals that has been relatively little considered in the literature. The overpricing of the \$-bet has been considered the main cause for preference reversals (Lichtenstein and Slovic, 2006). That is, when subjects value a bet, their valuation is anchored at the higher lottery payoff of the bet. Subjects adjust their valuation downward from the higher lottery payoff based on the probability of winning. If the downward adjustment is insufficient for the \$-bet, the \$-bet would be overpriced. This anchoring-and-insufficient-adjustment explanation is not consistent with our result that the overweight of a small probability of not receiving a positive lottery payoff in the p-bet may result in the preference reversals. Thus, our results provide a new insight into the preference reversal literature.

References

- Barberis, Nicholas. 2013. "The Psychology of Tail Events: Progress and Challenges." *The American Economic Review* 103 (3): 611–16.
- Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2012. "Salience Theory of Choice under Risk." *The Quarterly Journal of Economics* 127 (3): 1243–85.
- Braga, Jacinto, Steven J Humphrey, and Chris Starmer. 2009. "Market Experience Eliminates Some Anomalies—and Creates New Ones." *European Economic Review* 53 (4): 401–16.
- Braga, Jacinto, and Chris Starmer. 2005. "Preference Anomalies, Preference Elicitation and the Discovered Preference Hypothesis." *Environmental and Resource Economics* 32 (1): 55–89.
- Bruhin, Adrian, Helga Fehr-Duda, and Thomas Epper. 2010. "Risk and Rationality: Uncovering Heterogeneity in Probability Distortion." *Econometrica* 78 (4): 1375–1412.
- Butler, David J, and Graham C Loomes. 2007. "Imprecision as an Account of the Preference Reversal Phenomenon." *American Economic Review* 97 (1): 277–97.
- Cox, James C, and David M Grether. 1996. "The Preference Reversal Phenomenon: Response Mode, Markets and Incentives." *Economic Theory* 7 (3): 381–405.
- Cubitt, Robin P, Alistair Munro, and Chris Starmer. 2004. "Testing Explanations of Preference Reversal." *The Economic Journal* 114 (497): 709–26.
- Erev, Ido, Eyal Ert, Alvin E Roth, Ernan Haruvy, Stefan M Herzog, Robin Hau, Ralph Hertwig, Terrence Stewart, Robert West, and Christian Lebiere. 2010. "A Choice Prediction Competition: Choices from Experience and from Description." *Journal of Behavioral Decision Making* 23 (1): 15–47.
- Fehr-Duda, Helga, and Thomas Epper. 2012. "Probability and Risk: Foundations and Economic Implications of Probability-Dependent Risk Preferences." *Annual Review of Economics*. 4 (1): 567–93.
- Grether, David M, and Charles R Plott. 1979. "Economic Theory of Choice and the Preference Reversal Phenomenon." *The American Economic Review* 69 (4): 623–38.
- Hau, Robin, Timothy J Pleskac, Jürgen Kiefer, and Ralph Hertwig. 2008. "The Description–experience Gap in Risky Choice: The Role of Sample Size and Experienced Probabilities." *Journal of Behavioral Decision Making* 21 (5): 493–518.
- Lichtenstein, Sarah, and Paul Slovic. 2006. *The Construction of Preference*. Cambridge University Press.

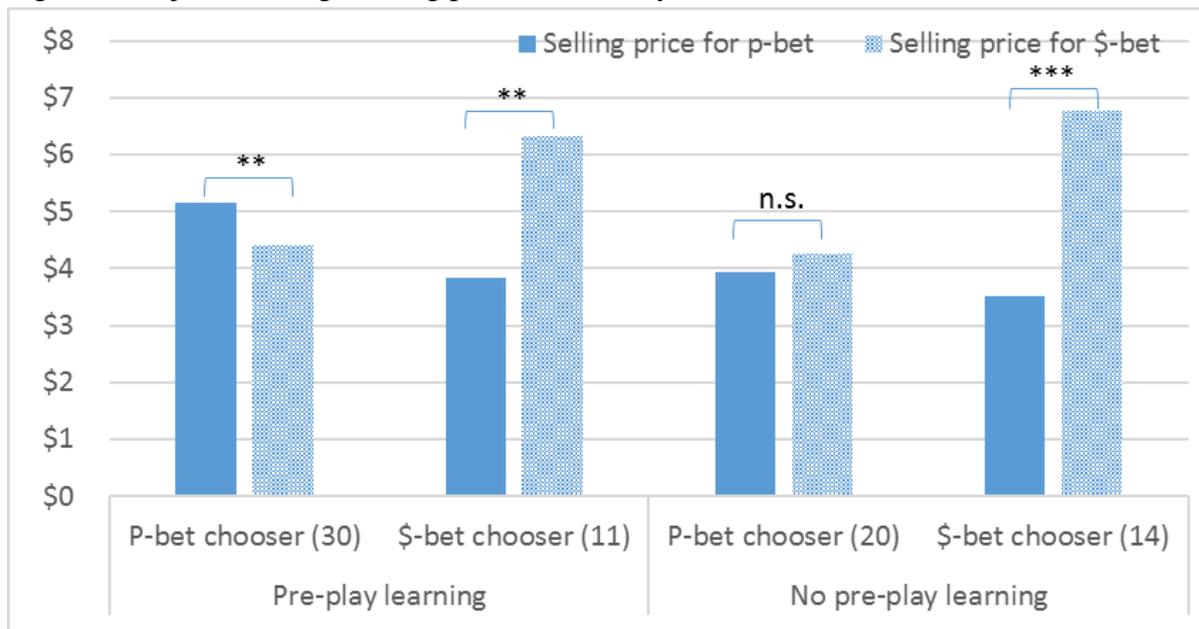
Loomes, Graham, Chris Starmer, and Robert Sugden. 2010. "Preference Reversals and Disparities between Willingness to Pay and Willingness to Accept in Repeated Markets." *Journal of Economic Psychology* 31 (3): 374–87.

Plott, Charles R. 1996. "Rational Individual Behavior in Markets and Social Choice Processes: The Discovered Preference Hypothesis." In *Rational Foundations of Economic Behavior*, edited by M. Perleman and C. Schmidt K. Arrow, E. Colombatto. London: McMillian. 225–50.

Schmidt, Ulrich, Chris Starmer, and Robert Sugden. 2008. "Third-Generation Prospect Theory." *Journal of Risk and Uncertainty* 36 (3): 203-23.

Seidl, Christian. 2002. "Preference Reversal." *Journal of Economic Surveys* 16 (5): 621–55.

Figure 1 Subjects' average selling prices for bets by choice



Notes: P-values are reported from two-sided Wilcoxon signed-rank tests for the equality of selling prices for the p-bet and the \$-bet. ***: P-value<0.01, **:<0.05. The numbers of subjects are in the parentheses. Subjects who chose an indifferent option between the p-bet and the \$-bet are omitted.

Table 1 Subjects' preference rankings for bets in terms of choice and price

	With pre-play learning (n=42)				Without pre-play learning (n=35)			
	Selling price for p-bet > Selling price for \$- bet	Selling price for p-bet < Selling price for \$- bet	Selling price for p-bet = Selling price for \$- bet	Rate of inconsistent preference rankings	Selling price for p-bet > Selling price for \$- bet	Selling price for p-bet < Selling price for \$- bet	Selling price for p-bet = Selling price for \$- bet	Rate of inconsistent preference rankings
Chose p-bet	19	7	4	0.27	7	9	4	0.56
Chose \$-bet	1	9	1	0.10	2	12	-	0.14
Indifferent	-	1	-	-	-	1	-	-
P-value	0.07				0.07			

Note: P-values are reported from a sign test of the null hypothesis that standard and non-standard reversals are equally likely.