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Revisiting risk aversion: Can risk preferences change with experience?

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HIGHLIGHTS

- We show that Holt–Laury preferences are not stable over repetitions.
- In a laboratory experiment, subjects repeatedly make choices with feedback in the Holt–Laury task.
- We test whether subjects adjust their responses with experience and if so in which direction.
- We find that subjects move towards payoff maximization with experience.

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ABSTRACT

The Holt–Laury measure for risk aversion has been used extensively in economic studies to measure individuals' risk aversion. The idea behind this measure is that individuals have stable risk preferences when making decisions under risk. We show that having repeated experiences with the Holt–Laury task can move individuals from exhibiting "risk aversion" to displaying "risk neutrality." This finding suggests that either risk preferences are not robust to a few experiences or that responses to the tasks indicate something else. We show that a simple model of adaptation can capture this behavioral pattern.

1. Introduction

It is well documented that human decision makers are willing to sacrifice expected payoff in exchange for reduced risk. Risk aversion is a fundamental component of economic behavior (Friedman and Savage, 1948). There are alternative methods and approaches for measuring risk aversion, with nuances, advantages and disadvantages for each. For more comprehensive overviews, see Cox and Harrison (2008) and Charness et al. (2013). The most widely used measure of risk aversion is the Holt–Laury measure (Holt and Laury, 2002). This measure has been used widely to control for individual differences in risk preferences while assessing the effects of experimental manipulations (Brunner et al., 2014; McGee, 2013).

A fair question to ask is whether responses in the Holt–Laury task measure risk preferences. Anderson and Mellor (2009), for example, show that the Holt–Laury measure is uncorrelated with survey responses measuring risk taking behavior in various situations, indicating that it may not capture risk preferences that are manifested in risky behavior. A related question is whether responses in the Holt–Laury task are stable over time (Harrison et al., 2005). A body of work investigates *stability over time* by eliciting risk preferences at different dates (Andersen et al., 2008; Levin et al., 2007; Sahm, 2012). It is important to stress that the experimental results provided here, while temporal in nature, do not address the question of stability of risk preferences *over time*—but rather the question of stability of preferences *over repetitions*.

We show that Holt–Laury preferences are not stable over repetitions. We argue that this is a serious challenge to the interpretation of Holt–Laury responses as stable risk preferences. Specifically, we let subjects repeatedly make choices with feedback in the Holt–Laury task, with only a single decision drawn for payment. By doing so, we aim to test whether subjects adjust

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Table 1
The ten paired lottery decisions.

Decision	Option A	Option B	$\Delta EV = B - A$
1	10/10 of \$2.00; 0/10 of \$1.60	10/10 of \$3.85; 0/10 of \$0.10	\$1.85
2	9/10 of \$2.00; 1/10 of \$1.60	9/10 of \$3.85; 1/10 of \$0.10	\$1.52
3	8/10 of \$2.00; 2/10 of \$1.60	8/10 of \$3.85; 2/10 of \$0.10	\$1.18
4	7/10 of \$2.00; 3/10 of \$1.60	7/10 of \$3.85; 3/10 of \$0.10	\$0.85
5	6/10 of \$2.00; 4/10 of \$1.60	6/10 of \$3.85; 4/10 of \$0.10	\$0.51
6	5/10 of \$2.00; 5/10 of \$1.60	5/10 of \$3.85; 5/10 of \$0.10	\$0.18
7	4/10 of \$2.00; 6/10 of \$1.60	4/10 of \$3.85; 6/10 of \$0.10	−\$0.16
8	3/10 of \$2.00; 7/10 of \$1.60	3/10 of \$3.85; 7/10 of \$0.10	−\$0.50
9	2/10 of \$2.00; 8/10 of \$1.60	2/10 of \$3.85; 8/10 of \$0.10	−\$0.83
10	1/10 of \$2.00; 9/10 of \$1.60	1/10 of \$3.85; 9/10 of \$0.10	−\$1.17

their responses with experience and if so in which direction.[1] With stable risk-preferences, experience should not have any effect on risk aversion because all information is known ex-ante. In other words, under the assumption that the Holt–Laury task captures stable risk preferences, subjects in theory have nothing to learn about the payoff distribution. In contrast, we find that subjects move towards payoff maximization, i.e., risk neutrality, with experience.

2. Experimental procedure

Sixty undergraduate students served as paid participants in the experiment. In each of 200 periods the subjects are presented with Holt and Laury's Multiple Price List (MPL) task (Table 1) and have to choose in each of the 10 decisions between option *A* and option *B*. After each period they receive feedback, which includes a realization of their choice and the outcome of the alternative option, about one randomly selected decision in that period. The last column in Table 1, not shown to subjects, displays the expected value differences between each pair of options. At the end of the experiment, they received payment according to the realization of their choice in one randomly chosen period.

3. Model predictions

We examine two competing theories in the current setting. One posits that subjects in the Holt–Laury task have stable preferences which can be captured by their ten decisions and indicate their risk preference. The other states that subjects are facing an unfamiliar environment and learn how to optimize in that environment over time with feedback.

3.1. The constant relative risk aversion model (CRRA) for a one-shot play

Holt and Laury posit that players engage in noisy expected value maximization with constant relative risk aversion (CRRA). Under this model any observed *A* choice before decision 7, where the riskier option *B* is associated with higher EV, is explained by risk aversion. Any observed *B* choice in decisions 7–10 can be attributed to risk seeking.

This explanation can be captured with two equations. Denote by $dec \in \{1, \ldots, 10\}$ the decision number in Holt–Laury's 10 decision task. Denote by $EU_{dec,j}$ the expected utility function for a two-outcome lottery j ($j = A, B$). Each lottery j has two possible outcomes; outcome 1 yielding payoff π_{j1}, and outcome 2 yielding payoff π_{j2}. Denote the probability for outcome 1 in lottery j by $p_{dec,j}$. Then the expected utility for lottery j is:

$$EU_{dec,j} = p_{dec,j}\pi_{j1}^{1-r} + (1 - p_{dec,j})\pi_{j2}^{1-r}. \tag{1}$$

This specification implies risk seeking for $r < 0$, risk neutrality for $r = 0$ and risk aversion for $r > 0$, and r is the *inherent risk preference* parameter to be estimated. The model assumes a probabilistic choice rule, which is typically implemented as a logit.

$$\Pr\,(\text{choose option } A \text{ in decision dec}) = \frac{\exp\left(\gamma EU_{dec,A}\right)}{\exp(\gamma EU_{dec,A}) + \exp(\gamma EU_{dec,B})}, \tag{2}$$

where γ is the "payoff sensitivity" parameter ($0 < \gamma < 1$) that determines the degree to which the differences in expected utilities between the two options' influence the probability of choice (Pr). Essentially, the model predicts that each of the lottery choices a player makes is independently made with *i.i.d.* errors. A decision maker is assumed to be more likely to choose an outcome which yields higher expected value than the alternative. When a player is observed to choose a lottery which yields in expectation lower expected payoff, it can be inferred that this is either due to error or there exists a mapping between payoffs and expected utility by which the chosen lottery is the higher expected utility choice, despite having a lower expected payoff than the alternatives.

Now let us take a close look at a commonly used variation on Eq. (1), used to model binary choice in general. Namely, in binary choice econometric modeling, it is common to assign an intercept to one of the choices, implying a non-equal propensity between the two choices when they are equal on all other dimensions.

$$EU_{dec,j} = \alpha(j = A) + p_{dec,j}\pi_{j1} + (1 - p_{dec,j})\pi_{j2}. \tag{1'}$$

It turns out that the model of Eqs. (1), (2) and the model of Eqs. (1′), (2) are econometrically equivalent. That is, for every parametrization (r, γ) of (1) and (2), there exists a set of parameters (α, γ') for (1′) and (2) that yields the exact same choice probabilities and therefore the exact same likelihood.

We have not yet discussed any economic interpretation for α in model 2 that could be applied generally to economic modeling. One natural interpretation is that decision makers have an *inherent propensity* in the choice between safe and risky choices that is resistant to the expected payoffs computed from the instructions. We interpret α as the product of the weight on that inherent propensity and the difference between the alternatives implied by that propensity. If this inherent propensity story happens to describe people's behavior, then almost any feedback—even very limited feedback (as in the current experimental implementation) about payoffs would move people away from their otherwise seemingly risk-averse (or risk-seeking as is the case for some subjects) behavior towards payoff maximization.

[1] Recent evidence suggest that the provision of feedback might affect risk taking behavior even when people receive full description of the prospects they face (Erev et al., 2016).