Personality and the Consistency of Risk Taking Behavior: Experimental Evidence

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Researchers have found that an individual's risk attitude is not stable across elicitation methods. Results reported by Deck et al. (2009) suggest that personality may help explain the apparent inconsistency, offering support to Borghans et al.'s (2008) argument that economists should consider a multi-domain approach to measuring risk attitudes. This paper uses laboratory methods to compare risk attitudes as measured by the Holt and Laury (2002) procedure under two different frames. We find that, as in Deck et al. (2009), one's willingness to take financial risks (as measured by Weber et al. 2002) significantly affects behavior; however the effect is significantly greater when the task is framed as a financial decision. This paper also asks whether personality can explain the well documented behavioral difference between first price and Dutch auctions. While one's gambling attitude (as measured by Weber et al. 2002) affects bidding behavior, it does not do so differentially between auction formats.

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1. Introduction

In virtually every situation, a decision maker faces uncertainty. Therefore, understanding how people make choices under uncertainty is critical to economic science. The standard economic approach has been to assume a given structural form (e.g. CARA and CRRA) for one's risk attitude and then estimate model parameters to make predicted behavior match observed behavior. To this end, scholars have used data from a wide variety of sources to measure risk attitudes: realized stock market returns (Mehra and Prescott 1985), large scale surveys like the NLSY and HRS (Barsky et al., 1997) and television game shows like Deal or No Deal (Baltussen et al. 2008 and Deck et al. 2008).

Controlled laboratory experiments offer another source of data on decision making under uncertainty and have been used to measure risk aversion in a variety of ways. One technique receiving considerable attention is the procedure of Holt and Laury (2002), hereafter H&L, in which subjects are given a series of binary choices over lotteries. An alternative approach is to infer risk attitudes from behavior in auctions (see for example Isaac and James 2000). Frustratingly, there is little consistency between elicitation techniques. Schoemaker (1990), Isaac and James (2000) and Berg et al. (2005) all report inconsistent risk taking behavior between elicitation techniques.

In part the behavioral inconsistency is driven by an assumption that the same mathematical form and the same parameter values should hold for each situation a person faces. In contrast, Borghans et al. (2008), following developments in the psychology literature, argue that economists should consider a multi-domain model of risk taking behavior. This is the type of approach taken by Weber et al. (2002), which claims that people view risk over six domains, not one. According to Weber et al. (2002) people distinguish between financial, gambling, social, ethical, recreational, and health safety risks. Furthermore, they claim people view risks within each domain similarly, but may have distinct risk tolerances in different domains. For example, a person willing to engage in extreme sports like hang gliding may not be willing to invest their retirement savings in high risk speculative stocks.

There is some experimental economics support for the Weber et al. (2002) domains. Deck et al. (2009) conducted two sets of experiments on the same subjects. One was a laboratory version of the game show Deal or No Deal and the other was a variation of the H&L procedure. The researchers report that behavior was not consistent between the two tasks, and that this variation could be explained in part by the subject's propensities to take risk in the domains identified by Weber et al. (2002). Specifically, Deck et al. (2009) find that risk taking behavior in Deal or No Deal was associated with a willingness to take gambling risks, while risk taking in the H&L procedure was associated with a willingness to take financial risks.

The purpose of this paper is two-fold. First, we want to directly test the multi-domain approach. If people possess multi-domain risk attitudes, then we should be able to frame the same choice in two different ways so that the perceived domains differ causing behavior to change accordingly. Our results indicated that we can. To do this, we present subjects with two versions of a modified H&L task: one framed as gambling and the other framed as investing. The tasks are numerically identical, but differ in language and presentation. Our finding that one's personality can help explain behavioral differences

across elicitation techniques further calls into question the appropriateness of attempts to model risk as simply depending upon payoffs and probabilities (as in CARA and CRRA). The second goal of this paper is to determine if a multi-domain approach can explain the well known behavioral result that people bid as though they are more risk averse in a first price auction than in a Dutch auction with private independent values, even though the two institutions are theoretically isomorphic. We explore this question with a separate set of experiments. While we do find evidence that personality affects bidding in both institutions, it does not appear to do so differentially.

The remainder of the paper is organized as follows. The next section details the design of the first experiment focusing on framing the H&L procedure and the third section describes the formal hypotheses and the experimental results. The fourth section provides the design of the second set of (exploratory) experiments focusing on behavior in auctions and the fifth section describes the results. A final section provides concluding remarks.

2. Experimental Design: Framing the Holt and Laury (2002) Task

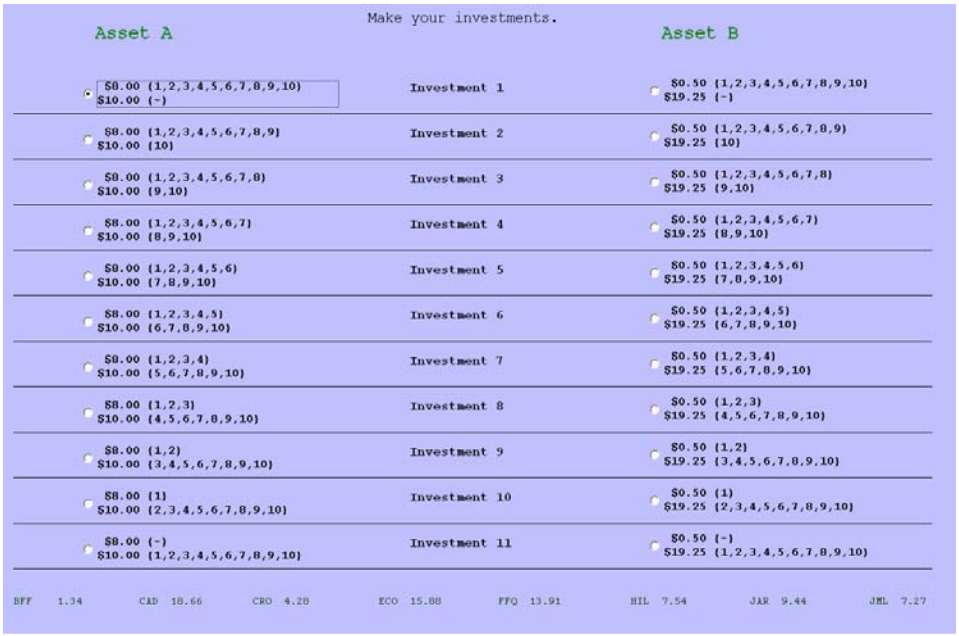
In the H&L task, a person has to make series of choices over two lotteries. In the versions we use, the safe lottery prizes are always $8.00 and $10.00 while in the risky lottery the prizes are always $0.50 and $19.25. The amounts are five times those of the baseline in the original H&L study. The series of choices are typically presented in a table so that the chance of receiving the higher payoff amount, which is the same in both lotteries, is increasing as the subject moves down the table. In the first row, the subject is assured of receiving the lowest prize. In the second row the subject has a 10% chance of receiving the larger amount and in each subsequent row the chance of receiving the larger amount increases by an additional 10%. With this construction, a subject should select the safe lottery up to a point and then switch to choosing the risky lottery, although it is not uncommon for some subjects to switch back and forth.

Figure 1 shows the two framings of the H&L procedure: gambling task (top panel) and financial task (bottom panel). In the gambling task, the subjects must "place a bet" by putting a gambling chip on a betting circle. The background, use of playing card images, and the (flashing) symbols at the bottom of the screen were meant to emulate a casino. In the financial task, the subjects had to choose between two investment opportunities by selecting as asset. The (moving) ticker symbols at the bottom of the screen were meant to emulate a financial trading environment.

Each subject completed three tasks during the experiment: the gambling task, the financial task, and a survey. The survey included the complete Domain-Specific Risk-Taking (DOSPERT) scale of Weber et al. (2002), which consists of a series of questions with 5 point Likert responses from 1 = Highly Unlikely to 5 = Highly Likely about the subjects' likelihood of engaging in certain activities. A willingness to take gambling risks is measured via statements such as "Betting a day's income at a high stakes poker game." The financial domain is measured by statements such as "Investing 5% of your annual income in a very speculative stock." In both cases the personality score was a simple average of the responses for the associated questions. Demographic information such as gender and year of birth were also included on the survey.

Figure 1. Framed Risk Attitude Elicitation Tasks

Gambling Task



Financial Task

Upon entering the lab, a subject drew a slip of paper with a printed code number. This practice ensured privacy and served to randomize the order in which the subjects observed the gambling and financial tasks.[1] Subjects then read written directions for one of the H&L styled tasks and answered a brief quiz.

[1] The included health risk questions were potentially sensitive, as they asked about unprotected sex and illegal drug use. Even numbered codes completed the gambling task first, while odd numbered codes completed the financial task first.

Once the experimenter had checked the subject's responses for correctness, the subject was allowed to make her decisions for the first task. Consistent with previous studies and in order to control wealth effects, one of the choices was randomly selected to determine the subject's payoff for the first task. The survey was always the second task to create a minimal separation between the two mathematically identical H&L style tasks, potentially biasing our results away from finding a framing difference. After completing the survey, the subject received the directions for the final task, which was completed only after the subjects had correctly answered the accompanying quiz. The directions for the gambling and financial tasks were as similar as possible and the numerical answers to the quizzes were identical. Copies of the directions and the surveys are available upon request.

A total of 50 subjects, drawn from the undergraduate student population at Chapman University, participated in the experiment. While some of the subjects had participated in unrelated economics experiments, none had participated in any related studies. The average salient payment was approximately $11.00 and subjects also received a $7 participation payment. The experiment lasted approximately 30 minutes and although the tasks were individualized, multiple people were in the lab at the same time. Each subject was seated at a desk that was visually isolated by privacy dividers. Once a subject completed the experiment, she privately flipped a coin to determine which task would be used for her payment. She then received her cash payment and was dismissed from the experiment. The coin flip procedure was designed to control wealth effect and was known to the subjects at the start of the experiment, although they did not know what the specific tasks would be.

3. Experimental Results: Framing the Holt and Laury (2002) Task

This study is not concerned with finding a specific functional form for risk aversion, but rather with comparing observed behavior between framings. Following H&L and Baker et al. (2007), we use the number of safe choices as our measure of risk tolerance in the H&L tasks. Let #SG and #SF denote the number of safe choices a subject makes in the gambling and financial tasks, respectively. Further, let FDom and GDom denote a subject's score on the financial and gambling portions of the DOSPERT scales[2]. We assume that #SG and #SF are functions of FDom, GDom, and other characteristics such as age and gender.

The basis for each of our first two hypotheses is based upon Deck et al. (2009), which found that one's score on the financial portion of the DOSPERT was negatively correlated with how much risk one would tolerate in a neutrally framed H&L task. Therefore, we expect that a higher FDom score will lead to a smaller number of safe choices in both H&L tasks. While we expect one's financial score on the DOSPERT to matter in both tasks, we expect it to have a greater effect when the task is framed as a financial choice. This is the main hypothesis tested by the experiment.

Although previous research did not find a significant relationship between one's gambling attitude and behavior in the H&L task, it is still reasonable to expect that an increase in one's willingness to accept gambling risks will weakly decrease the number of safe choices. That is, we expect that a higher GDom

[2] A higher FDom or GDom score indicates a greater willingness to take risks in the financial or gambling domain, respectively.

score will lead to a smaller number of safe choices in both H&L tasks. Further, we expect that one's willingness to take gambling risks would have a (weakly) greater effect in the gambling frame.

To test the null hypotheses of no risk domain effects, we rely upon the OLS estimations reported in Table 1. GFirst = 1 if the subjects completed the gambling task first and is 0 otherwise. Estimation (1) has #SF as the dependent variable while estimation (2) has #SG as the dependent variable. The dependent variable for estimation (3) is #SF - #SG. From (1) and (2) one can reject the null hypothesis that FDom does not affect the number of safe choices for both frames, respectively. This result is consistent with Deck et al. (2009), as is the lack of significance for GDom in (1) and (2).

Table 1. Estimation Results for Number of Safe Choices in Holt and Laury (2002) Tasks.

Dependent Variable	(1) #SF		(2) #SG		(3) #SF - #SG	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Constant	5.456*	0.073	3.649	0.246	1.807	0.277
FDom	-0.803***	0.009	-0.446*	0.095	-0.357*	0.096
GDom	0.232	0.539	0.313	0.403	-0.080	0.806
Age	0.177	0.210	0.198	0.195	-0.020	0.336
Male	-0.043	0.928	-0.333	0.437	0.290	0.526
GFirst	-0.158	0.726	-0.353	0.403	0.195	0.277

*, **, and *** indicate significant difference from 0 at the 10, 5, and 1 percent significance levels. p-values are calculated using White heteroskedasticity corrected standard errors.

We now turn to our main question of interest: can we manipulate behavior in a direction predicted by the subject's personality? The answer, from (3), is yes. Specifically, the negative coefficient on FDom in (3), although being marginally significant, indicates the null hypothesis of no effect can be rejected in favor of the alternative that one's propensity to take financial risks has more influence in the gambling frame. It is worth recalling that this effect is present even though the tasks are extremely similar and only separated by a few minutes. One's gambling attitude does not have a differential effect in either framing. Finally, we note that there is no significant age or gender effect for either framing, nor does the ordering of the tasks have a significant effect in any of the three specifications.

4. Experimental Design: Comparing Dutch and First Price Sealed Bid Auctions

One of the most puzzling and persistent experimental findings in economics is the lack of a behavioral isomorphism between the first sealed price and Dutch clock auctions with independent private values. In the first price auction, each bidder privately submits a bid and the highest bidder is awarded the item at a price equal to her bid. The other bidders earn nothing. In the Dutch auction, the selling price is initially set above the (anticipated) values of the bidders. The price is then decreased incrementally until some bidder stops the price and agrees to purchase at the current price. Again, other bidders receive nothing. Theoretically, these two auction formats should generate the same price and bidders should employ the same strategy (bid as a function of value) even allowing for non-risk neutral bidders.

However, in the laboratory this result does not hold; subjects appear more risk averse in the first price auction (see Cox et al., 1982, Turocy, Watson, and Battalio 2007, and Deck and Wilson, 2008).

We propose an alternative explanation for the lack of a behavioral isomorphism between first price and Dutch auctions, namely that the institutions are perceived as belonging to different risk domains. Deck et al. (2009) reported that behavior in Deal or No Deal was drawn from the gambling domain. Like a Dutch auction, the Deal or No Deal game has a sequential process where excitement builds as the game progresses. By contrast, a first price auction is a static comparison of lotteries, like the H&L task which draws upon one's financial outlook. Therefore we expect that one's gambling attitude will have a greater effect on behavior in the Dutch auction than in the first price auction and that one's financial attitude will have a greater impact in the first price auction. It also seems reasonable to expect that a greater willingness to take financial or gambling risks will lead to weakly more risk loving behavior in both auction formats.

To test our hypotheses, we conducted a series of auction experiments. As in the H&L experiments discussed above, each subject in this experiment completed three tasks (Dutch auctions, first price auctions, and the survey). The survey, which was always administered as the second task, was identical to the one described above. Subjects were again given codes to protect their privacy; however, this code did not affect the ordering of the two auction tasks because subjects were bidding against other subjects in the lab during the auctions. Half of the subjects completed the Dutch auctions first while the other half completed the first price auctions first.

The implementation of the auction experiments differed from H&L experiment in several ways, in part due to the multi-person nature of the experiment and in part to be consistent with previous auction experiments. The computerized directions were read aloud to ensure that everyone in the lab was receiving the same information. This necessitated that only a single ordering be run in each session. To ensure that subjects did not know who they were bidding against, there were multiple concurrent auctions. As is standard in auctions experiments, subjects completed a series of auctions with fixed matching (i.e. bidding against the same people in each auction) and were paid their cumulative earnings.

As described by Cox et al. (1982), one must be careful in setting up the institutions so as not to introduce asymmetry. The following values were selected for our auctions: n = 3 bidders, values drawn from U~[0,240] in increments of 15, bids and Dutch prices $\in$ [0,10,20,…,240], clock speed = 1 second. The auction winner received her value minus bid (sealed or clock) in cents thus inducing the values and making the decisions salient. Under the assumption of risk neutrality in each auction a bidder should bid 0.75 $\times$ value, the expected price is 120, and the expected profit per bidder was 20. The bid and value increments are set so that bidders could follow the risk neutral Nash equilibrium strategy. Our subjects completed 30 first price auctions and 90 Dutch auctions. The distribution of values is similar to that used in Smith and Dickhaut (2005), who also run a total of 120 auctions.[3] In the Dutch auction, only the winner actually bids, meaning that no information is collected on the other n - 1 bidders. The number of

[3] Their auctions involve four bidders with values drawn from U~[0,250] so the expected profit per bidder is greater in our experiments.

bidders is small to reduce this information loss. This is also the reason we ran three times as many Dutch auctions; we expect to observe thirty bids in each institution for each subject.[4] Finally, the clock speed for the Dutch auction is an important design variable. Katok and Kwasnica (2008) report that faster clocks generate lower prices. They argue that slower clock speeds impose greater monitoring and opportunity costs on bidders and suggest this may explain why Lucking-Reiley (1999) failed to replicate the laboratory auction price ordering results in field experiments conducted via online auctions. An alternative explanation consistent with our hypothesis is that slower clocks are boring and thus not perceived as gambling. Our clock speed, which falls by 4.2% of the maximum value per second, is similar to the (exciting) fast speed of a 5% drop per second of Katok and Kwasnica (2008).

A total of 42 new subjects participated in these experiments; 21 in each auction ordering. The subjects were drawn from the undergraduate population at Chapman University and none had participated in any related experiments including the H&L experiments described above. The experiments lasted approximately 90 minutes and the average salient earnings were approximately $13. Subjects also received a $7 participation payment.

5. Experimental Results Design: Comparing Auctions

As in section 3, we are not concerned with any specific functional form of risk aversion. Therefore we use the simple measure of bid/value as the dependent variable.[5] A more risk averse subject would bid a larger fraction of her value while a less risk averse bidder would seek a greater profit by lowering her bid. Table 2 gives the relevant estimation results based upon useable observations from 40 subjects. The dependent variable is the subject's average bid/value in the first price auction (1) and the Dutch auction (2).[6] Estimation (3) is our primary interest as its dependent variable is average bid/value in the first price auction minus average bid/value in the Dutch auction. DFirst is a dummy variable for a subject having gone through the Dutch auction first. Other variables are as before.

Based upon the estimated coefficients in (1) and (2), one's attitude towards gambling (GDom) has a significant impact on bidding behavior in both the first price and Dutch auctions. In both cases, a greater willingness to gamble is associated with more risk loving bidding, consistent with our expectations. However, the GDom variable is not significant in (3) indicting that one's attitude towards

[4] The actual number of observations in the Dutch auction varied depending on realized values and the behavior of other bidders.

[5] An issue with measuring risk aversion in Dutch auctions is that losing bids are not observed. Thus, if bids are not linear, as in the case of CRRA when risk parameters are assumed to be drawn from a known distribution, then the resulting implied bid function or risk attitude is biased. In our analysis, we are constructing a single observation for each subjects and then comparing this measurement across subjects, thereby avoiding this issue. Turocy, Watson, and Battalio (2007) considered a hybrid auction where the Dutch clock ran until bids were observed from all participants, but the authors report that this institutional change led to different behavior than the standard Dutch auction.

[6] One subject did not fully complete the survey and another subject went bankrupt in the Dutch auction. Once a subject goes bankrupt, the experimenter has effectively lost control over the subject's incentives as losses cannot be imposed due to institutional constraints. If the subject will receive $0 if she has experimental losses of $5 or $5000, then her incentive is to take long shot gambles regardless of risk attitude as losses or small gains do not affect her real payoff.

gambling does not have a differential effect in the two auction formats. An increase in one's willingness to accept financial risks does not significantly lower one's bid in either auction format as shown in estimations (1) and (2), nor does it explain any behavioral difference between auctions as shown in (3). Together these results indicate that one's risk domain personality does affect bidding behavior in the auctions, but cannot explain behavioral differences between them.

Table 2. Estimation Average Bid/Value in Auctions.

Dependent Variable	(1) Avg (Bid/Value) in First		(2) Avg (Bid/Value) in Dutch		(3) Avg (Bid/Value) in First - Avg (Bid/Value) in Dutch	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Constant	0.664***	<0.001	0.759***	<0.001	-0.095	0.309
FDom	0.019	0.239	0.004	0.842	0.015	0.384
GDom	-0.036**	0.015	-0.049***	0.007	0.013	0.580
Age	0.006*	0.051	0.007**	0.032	-0.002	0.647
Male	0.004	0.858	-0.006	0.821	0.010	0.754
DFirst	0.044*	0.074	-0.026**	0.322	0.070*	0.059

*, **, and *** indicate significant difference from 0 at the 10, 5, and 1 percent significance levels. P-values are calculated using White heteroskedasticity corrected standard errors.

The other coefficient estimations reported in Table 2 reveal interesting patterns as well. First, age has equal and significant explanatory power in both auctions. Older subjects behave in a more risk averse manner in both the Dutch and First price auctions. Evidence that the age effect is equal is given by the lack of significance on age in (3). Second, we find no evidence of a gender effect in either auction as evidence by the lack of significance on male in all three estimations. Finally, there is clear evidence of an ordering effect. Those subjects who experienced the Dutch auction first were relatively more risk averse in the first price auction and relatively less risk averse in the Dutch auction as evidenced by the coefficients on DFirst. This suggests that subjects are relatively more risk averse in their second auction format, regardless of format. From (3) the difference in behavior between auctions is larger when subjects experience the Dutch auction first.

6. Conclusions

The standard economic model assumes that people walk around with hard and fast choice rules regarding decision making under uncertainty. While such an assumption provides mathematical tractability, this paper offers further evidence that its usefulness for understanding economic behavior may be limited. Specifically, this paper reports experimental results suggesting personality impacts behavior.

In the first set of experiments presented in this paper, we find that behavior in an H&L "gambling" task differs from behavior in an H&L "financial" task where the only difference between the two is the presentation. Further, we find this within subject difference can be partially explained by the subject's personality; a subject's willingness to take financial risks affects her behavior in both frames, but it has a

greater impact on behavior in the financial task. This result is evidence that people do view risk in different domains and that "[a] deeper understanding of personality traits promises to enrich economic theory and to understand the sources of, and solutions for, human inequality" (Borghans et al., 2008, p.85).

In our second set of experiments we find that gambling propensity affects behavior in both first price sealed bid and Dutch clock auctions with independent private values. This result, together with our finding that H&L behavior is related to financial risk taking attitude but not gambling, affirms the conclusion of Deck et al. (2009) that different elicitation methods may generate seemingly inconsistent behavior because they appeal to different aspects of personality. This may help explain the (seemingly) inconsistent results of previous studies including Schoemaker (1990), Isaac and James (2000) and Berg et al. (2005).

The implications of our findings are potentially quite broad, extending beyond measuring risk aversion in the lab. For example, how researchers should model retirement savings and medical insurance decisions may be different. Allowing for a multi-domain approach to economic decision making could help explain why individuals often appear to have altruistic or other regarding preferences in dictator and other strategic interactions but not in market experiments (see, e.g., Plott and Smith 2008). We are not arguing that Weber et al. (2002) have or have not identified a complete and correct set of domain, nor are we claiming a multi-domain approach is sufficient for modeling behavior. However, we do believe that there is sufficient evidence that a multi-domain approach has merit and should be investigated further with more challenging and stringent experiments that ultimately yield improvements for theoretical modeling.

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