Personality and Procedural Invariance: Effects on Bidding Behavior Across Induced
Value Experimental Auction Mechanisms

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Abstract. A growing literature exists on the design, implementation and evaluation of experimental auctions with a variety of non-market valuation applications. With behavioral economic models becoming more mainstreamed in the discipline, a natural question arises about how personality traits might affect bidding behavior in experimental auctions. To address this question, a series of induced-value experiments were carried out in the fall of 2012. Personality traits were measured in pre- and post-surveys aligning with the Midlife Development Inventory Analysis. Regression analysis determined the effects of personality traits on over- and under-bidding behaviors across four frequently used auction mechanism: the Becker-Degroot-Marschak, 2nd Price, Random Nth Price, and English auctions. Results indicate that only the BDM and Random Nth price auctions are significantly affected by personality profile. Specifically, openness, extraversion, and neuroticism are associated with overbidding behavior and agreeableness is associated with underbidding behaviors.

Introduction

Due to the advantage of experimental auction methods in isolating the effect of information provision, auctions have become an increasingly popular avenue for investigating consumer preferences in different informational settings across economic sub-disciplines. According to economic models of rational choice behavior, preferences should be independent of the method used to elicit them. In other words, the concept of procedural invariance demands that strategically equivalent methods of elicitation should give rise to the same preference measurements. Thus, in theory, all incentive compatible auction mechanisms should result in statistically equivalent preference measurements. Although the literature has evolved rapidly in the last few years, many investigating "best practices" when it comes to auction procedures, questions of auction validity continue to arise around "which method is best"?

Personality has been shown to influence a number of economic outcomes. With behavioral economic models becoming more mainstreamed in the discipline, economists have begun to examine personality traits more closely as constructs that can be used to understand behavioral heterogeneity within and across preference situations. We seek to investigate the effect of measurable personality traits on bidding behavior across four commonly used experimental auction mechanisms, controlling for other determinants of preference by situating the participants in an induced-value setting. This work addresses the predictive power of personality, potentially responsible for a degree of procedural invariance present across incentive compatible auction mechanisms popular in the experimental literature.

Personality in Economics

Although psychologists and economists both attempt to identify determinants of heterogeneous behavior, in the past they have used different concepts to study them. Efforts to bridge this interdisciplinary gap have been made. Notably, Borghans and Duckworth (2008) suggest that there is great potential for cooperation and exchange between personality psychology and economics. Specifically, the authors posit that subjecting economic preference measures to the same psychometric standards as personality measures might increase their validity and improve their ability to predict outcomes. Heckman (2011) goes further to review the problems and potential benefits of integrating personality psychology into economics. He suggests that since personality psychologists lack precise models, economics could provide a framework for recasting the field. Furthermore, Almlund et al (2011) concludes that the study of personality might allow economists to resolve some inconsistencies that arise from frequently used preference specifications. Indeed, recent literature provides increasing evidence that personality can explain a significant portion of economic outcomes including variability in: income, job performance, educational attainment, risk taking, and health behavior (Becker et al 2012). In a related application, personality has been shown to influence preferences for the development of an environmental program for forest management in Spain elicited using a discrete choice experiment (Solino and Farizo 2014).

Moreover, economists have written widely on the significance of personality traits in experimental game theory. Personality has been investigated as a predictor of outcomes

in prisoner dilemma games (see Engel and Zhurakhovska 2013, Hirsh and Peterson 2009, Lonnqvist, Verkasalo, and Walkowitz 2011, Boone et al 1999), public goods games (see Fischbacher et al 2001, Gunnthorsdottir et al 2007, Hilbig, Zettler and Heydasch 2012, Kurzban and Houser 2001, Volk, Thoni and Ruigrok 2011), dictator games (see Ben-Ner and Kramer 2011, Ben-Ner et al 2004) and coordination and ultimatum games (see Visser and Roelofs 2011, Bereby-Meyer et al 2012, Schmitt and Shupp 2004, Schmitt et al 2008, Swope et al 2008). Many of these authors conclude that integrating personality measures into their models offers convincing evidence that personality and individual preference jointly impact economic behavior.

Experimental Auctions

While economists have long considered cost-benefit analysis a necessary tool for evaluating the efficiency and effectiveness of proposed regulation, estimating the benefits of non-traditional, non-existent, or non-market goods provides a significant challenge to the investigator and remains a controversial issue. Traditional contingent valuation methods allow investigators to exhibit a degree of control, but are hypothetical in nature. Other revealed preference methods, such as travel cost or hedonic analysis, incorporate a high degree of economic reality for participants, but give the investigator little control. The economics discipline as a whole began to recognize the valuable insight provided by experimental methods only in the past few decades. Experimental methods are unique in their ability to test decision and/or game theoretic models and to examine institutional policies and procedures in a controlled environment.

A growing literature exists on the design, implementation and evaluation of experimental auctions with a variety of non-market valuation applications. Due to the advantage of experimental auction methods in isolating the effect of information provision, it has become an increasingly popular avenue for investigating consumer willingness to pay in different informational settings; for example, experimental auctions have been used in applied economic studies to determine preferences for genetically modified foods, beef tenderness and other quality attributes, various food safety and traceability initiatives, organic and other ecolabels, biodiversity and conservation, irrigation rights, and cigarette packaging, among others. Moreover, experimental auctions have also been used to methodologically study behavioral constructs, such as preference learning, risk reduction, the divergence between willingness to pay and willingness to accept, time preferences, hypothetical bias, coherent arbitrariness, commitment cost theory, discrimination, the excessive choice effect, and the endowment effect (see list in Lusk and Shogren 2007).

In Lusk and Shogren's (2007) comprehensive guide to the theory and practice of experimental auctions, it is observed that uncertainties about the appropriate design, use, and validity of auctions arise because research on these methods is still relatively new. Included in their "ten questions worthy of future research", the authors posit, "How do personality traits affect bidding behavior in experimental auctions"? A related question has since been addressed by Grebitus, Lusk, and Nayga (2013) in the examination of the role of personality in explaining differences between real and hypothetical choice experiments and experimental auctions. Their results suggest that personality plays a larger role in explaining behavior in hypothetical choice experiments than in auctions. The authors conclude that certain personalities behave differently in real and hypothetical

environments, suggesting that personality might be responsible for a significant portion of observed hypothetical bias. Although the relationship between personality traits and numerous behavioral outcomes have been studied in the psychological literature, no other known studies directly address personality effects on bidding behavior in experimental auctions.

Auction Mechanisms

The four auctions used for the purposes of this study are the Becker-Degroot-Marschak (BDM), the random Nth price, the 2nd price (Vickrey), and the English auctions. All bids were submitted electronically through the use of laptop computers in a computer lab programmed using z-tree experiment software (Fischbacher 2007). As such, all bids were sealed, as each participant did not know the identity or the bids of their competitors.

The Becker-Degroot-Marschak, commonly referred to as the BDM auction, is an incentive-compatible procedure, first introduced in a 1964 volume of the Behavioral Science journal, to measure consumer willingness to pay (Becker, Degroot, and Marschak 1964). The most common variation of the BDM method elicits a bid from an individual participant and compares it to a randomly generated price. If the participant's bid is greater than the random price, the auctioned item is won and the participant pays the randomly generated price, otherwise the participant pays nothing and receives nothing. From the participant's perspective, the method is equivalent to the 2nd price Vickrey auction against an unknown bidder, but requires no competitive agent. The BDM method is most widely used in experimental economics, particularly in the domains of agricultural economics and marketing.

The second price, or Vickrey, auction is a sealed-bid auction first introduced by William Vickrey in 1961, in which participants submit written (or electronic) bids without knowing the bids of their competitors (Vickrey 1961). The highest bidder wins the auction but pays the second highest bid. This auction is strategically similar to an English auction, in that the incentive compatibility for participants to bid their true value is upheld. Vickrey auctions have become more popular in recent years in the experimental economics literature.

The random nth price auction has been shown to induce sincere bidding in theory and in practice, producing better results for off-margin bidders (Shogren et al 2001). In this auction, each participant submits a sealed-bid, which is then rank-ordered from highest to lowest across the sample. A random number, n, is generated from [1,N] where N is the sample size. All (n-1) bids above the nth bid win the auction, but pay the nth bid price. In theory, the random nth price auction is incentive-compatible and has been shown to be a credible value elicitation technique (List 2003).

The most well-known variation of the English auction is the "open outcry" auction, in which an auctioneer opens an auction by announcing an opening bid or starting price and then accepts increasingly higher bids from the auction floor (McAfee and McMillan 1987). If no competing bidder challenges the last standing bid within a certain time frame, the standing bid wins the auction and the item is sold to the highest bidder at a price equal to their bid. More generally, an auction mechanism is considered an English auction if it involves an iterative process of adjusting price in the direction which is unfavorable to bidders. In our experiment, the English auction bids were sealed instead of transparent.

The computerized auction began the bid at $0.00 and increased the bid by $0.02 every second. Each participant chose when to "drop out" of the auction, indicating his or her highest willingness to pay equal to the standing bid at that moment. The last participant left in the auction wins and pays the price equal to the standing bid at the time the second-to-last participant dropped out. Thus, the expected payment is theoretically equivalent to that in the Vickrey auction. Although procedurally different, both auctions award the item to the bidder with the highest value at a price equal to the value of the second highest bidder.

Experimental Design and Procedures

To test the impact of personality on induced value bidding behavior in these four auction mechanisms, we conducted 8 experimental sessions, with between 12 and 24 subjects each, for a total of 144 subjects. The subjects were undergraduate students at Michigan State University and were recruited via email from a list of eligible participants maintained by the MSU Agricultural Economics Lab. The students in this list are from a variety of majors, years and backgrounds.

In all sessions, each participant completed 7 rounds of induced-value bidding (one for practice and six that were eligible for payment) in each of the four types of auctions (BDM, Random Nth, Vickrey, English). The order of the auctions and the timing of the personality survey were varied across sessions in order to account for any possible ordering or priming/afterglow effects. Specifically, the experiment consisted of four treatments as outlined in the following table.

Table 1. Experimental Design Treatments

	Auction Order	
Survey Timing	BN2E	E2NB
Before Auctions	2 Sessions (36 participants)	2 Sessions (36 participants)
After Auctions	2 Sessions (36 participants)	2 Sessions (36 participants)

While there are many variations of auction order, given limited resources, we chose to order auctions by level of "competitiveness" assuming that this might be one of the auction characteristics most likely to impact bidding behavior and be associated with specific personality types. The BN2E auction order (BDM, random Nth price, second price and English) ascends from least competitive to most competitive, while the E2NB ordering reverses so that the most competitive auction is first. It is important to note that we are defining competitiveness here rather loosely. One can think about competitiveness in terms of either the number of potential winners or in terms of how interactive the task is. In terms of number of winners, the most competitive auctions would be the English and 2nd price since they have only one winner (except in the event of a tied bid) while the random nth price winner has n-1 winners, and the BDM has the possibility of all participants winning. In terms of interaction, we believe that participants feel that the English auction is the most competitive since in this auction, a price clock is ticking up and one can actually see in real time the other bidders drop out. Similarly, we believe participants will perceive

the BDM auction as the least competitive since they are not bidding against the other participants.

In all of the auctions, the participants were bidding to purchase a token that could take on a random resale value of between $0 and $5 (uniform distribution). Participants had a different resale value in each round and resale values were private information. If the participant won the auction, they purchased the token (how much they paid depended on the auction rules) and sold the token back to the experimenter for the resale value. Participants were endowed with $5 in each round with which to bid on the token. Auction results were reported in each round (if they won, how much they paid, and what their earnings were), but they knew that only one round from each auction type would be chosen for payment at the end of the experiment.

As participants arrived at a session, they were assigned a random participant number to allow tracking of personality survey responses and bidding behavior. In all sessions, participants were given a general outline of the experiment (timing, general rules of participation, etc.) and asked to sign a consent form. Next, participants in the 'survey before auction' sessions were asked to fill in the online personality survey on their computer (it was referred to as a 'survey' by experiment monitors). After completion of the survey, the auction portion of the experiment was conducted. For participants in the 'survey after auction' sessions, the participants moved directly into the auction experiment and completed the survey after everyone was done.

In the auction portion of the experiment, participants were first given general instructions on the computer explaining that they were about to participate in a series of auctions and that there would be four different types of auctions, each with different rules. They were told that each auction type would have 7 rounds and that the first round in each would be a practice round and only one of the other six rounds would be chosen randomly for payment. It was explained that the computer would randomly and anonymously assign them to a new group of six for each round and that they would be bidding against these six participants. These general instructions were repeated at the beginning of each new auction type, along with instructions for that specific auction type. Each auction type was implemented as described in the auction mechanisms section above.

Results

Personality Measures

To measure participant personality traits we used the Midlife Development Inventory (MIDI) scale developed by Lachman and Weaver (1997). The MIDI scale measures the Big Six personality traits: agency, openness, conscientiousness, extraversion, agreeableness, and neuroticism, commonly referred to by their acronym "A OCEAN". The traits are elicited through participant evaluation of thirty adjectives on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), indicating how well any single adjective described them. The MIDI scale was chosen over alternative personality measurements for its short time completion relative to reliability and for its simplicity of analysis. The six personality dimensions are evaluated using the MIDI scale for each individual by calculating the mean value of all adjectives associated with a given trait.

Thus, each participant has six personality trait scores to use as independent variables in the following analysis. Personality trait means, and associated adjectives, across the sample are reported in Table 2. Mean values for Agency and Neuroticism lie close to neutral (3), while values for Openness, Conscientiousness, Extraversion, and Agreeableness lie further towards agree (4) on the five point scale. Overall, Agency has the lowest mean score and Agreeableness the highest. Table 3 outlines the matrix of correlation coefficients between personality traits, leading us to the conclusion that personality traits are not highly correlated with each other, as the highest correlation (between extraversion and openness) is approximately 0.44. In other words, the personality scales used in this analysis pass the test of discriminative validity, commonly used in psychology to ensure measurements that are supposed to be unrelated, in fact, are unrelated (Campbell and Fiske 1959).

Table 2. Descriptive Statistics: Personality Traits Based on MIDI Scale

TRAIT	MEAN*	VARIABLE	MEAN	STDEV
Agency	3.08	Assertive	3.28	1.00
		Self-Confident	3.76	1.02
		Forceful	2.33	1.03
		Outspoken	3.05	1.07
		Dominant	2.97	1.00
Openness	3.93	Creative	3.75	0.96
		Imaginative	3.76	0.92
		Curious	4.36	0.65
		Intelligent	4.25	0.60
		Broad-Minded	3.89	0.86
		Sophisticated	3.45	0.77
		Adventurous	4.01	0.92
Conscientiousness	3.59	Responsible	4.30	0.70
		Organized	3.75	1.01
		Hardworking	4.19	0.78
		Careless	2.10	0.94
			3.59	0.40
Extraversion	3.8	Lively	3.86	0.85
		Outgoing	3.59	1.07
		Friendly	4.25	0.67
		Active	3.83	0.90
		Talkative	3.48	1.06
Agreeableness	4.07	Caring	4.40	0.64
		Warm	3.89	0.81
		Helpful	4.31	0.66
		Soft-hearted	3.78	0.93
		Sympathetic	3.97	0.88
Neuroticism	3.22	Moody	2.78	1.08
		Worrying	3.33	1.11
		Nervous	3.02	1.01
		Calm	3.76	0.93

Table 3. Correlation Matrix of Personality Traits Based on MIDI Scale

	Agency	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Agency	1					
Openness	0.233	1				
Conscientiousness	0.175	0.109	1			
Extraversion	0.241	0.444	0.231	1		
Agreeableness	0.123	-0.145	0.187	0.359	1	
Neuroticism	0.073	0.000	-0.076	-0.097	0.073	1

Personality and Auction Behavior

In contrast to the study done by Grebitus, Lusk, and Nayga (2013), employing homegrown values for apples and wine, this work is founded on the ability to isolate personality effects by removing the incentive for preference-based bidding behavior. First introduced by Vernon Smith in 1976, Induced Value Theory is a means to achieve experimental control of individual valuation by "using a reward structure to induce prescribed monetary value on actions" (Smith 1976). In our experimental auctions, participants bid on tokens that had a random, exogenously determined resale value. Thus, we can determine the degree to which each participant under- or over-bid in any given auction scenario and measure the extent of correlation with specific personality traits. For the purposes of this analysis, bidding behavior will be categorized as either "underbidding" or "overbidding" relative to the induced resale value.

The magnitude of under- or over-bidding is computed as the difference between the resale value and the bid in a given round. In this analysis, negative bid differences indicate overbidding, or bidding above resale value, while positive bid differences indicate underbidding, or bidding below resale value. A bid difference of zero indicates that a participant bid exactly the resale value; the outcome that is expected for incentive compatible auction mechanisms. Bid differences were used as the dependent variable in the analysis that follows. Mean bid differences across auctions and rounds are reported in Table 4. Bids tended to stabilize after the fourth round. In general, participants overbid on average across auctions. However, the degree of overbidding is small, in the range of 1- 6 percent of the endowment. On average, participants overbid the most in the 2nd and random Nth price auctions, and least in the English auction.

Table 4. Mean Bid Differences (Resale – Bid) Across Auctions and Rounds

Auction	Round 1 (Practice)	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7
BDM	$0.34	-$0.06	-$0.21	-$0.05	-$0.19	-$0.19	-$0.18
Nth	-$0.03	-$0.14	-$0.24	-$0.30	-$0.27	-$0.28	-$0.31
2nd	-$0.07	-$0.22	-$0.28	-$0.29	-$0.16	-$0.31	-$0.33
English	$0.11	$0.09	-$0.32	-$0.07	-$0.01	-$0.08	-$0.02

(-) sign indicates "overbidding", i.e. bidding above resale value

To analyze effects of personality on bidding behavior we regressed, using least squares, bid differences on the six personality trait scores, controlling for gender, age, auction order, and survey order. In addition to the personality traits, dummy variables for each round were included in the model. We estimated four models, one for each of the auction mechanisms, as described below. Table 5 outlines the statistically significant coefficients from this analysis.

$$Bid\ Diff\ (Auction\ i)$$

$$= \alpha_i + \beta_i \begin{pmatrix} Gender \\ Age \\ Auction\ Order \\ Survey\ Order \end{pmatrix} + \delta_i \begin{pmatrix} Round\ 1 \\ Round\ 2 \\ Round\ 3 \\ Round\ 4 \\ Round\ 5 \\ Round\ 6 \end{pmatrix} + \gamma_i \begin{pmatrix} Agency \\ Openness \\ Conscientious \\ Extraversion \\ Agreeable \\ Neuroticism \end{pmatrix} + \varepsilon_i$$

Table 5. Statistically Significant Coefficients on Predictor Variables Across Auctions

Auction	Variable	Coefficient	StDev
English	Round 3	-0.33*	0.14
	BN2E	-0.28*	0.08
2nd Price	Gender	-0.18*	0.09
	BN2E	-0.36*	0.08
	Before	0.23*	0.07
Nth Price	Gender	-0.32*	0.07
	BN2E	-0.15*	0.07
	Before	0.26*	0.07
	Openness	-0.19*	0.09
	Extraversion	-0.16*	0.07
	Agreeable	0.26*	0.07
BDM	Gender	-0.29*	0.08
	Age	-0.09*	0.04
	BN2E	0.18*	0.07
	Before	0.19*	0.07
	Agency	0.11**	0.06
	Extraversion	-0.27*	0.08
	Neuroticism	-0.13**	0.07

* significant at 5% level
** significant at 10% level
(-) sign indicates "overbidding", i.e. bidding above resale value

Results show that personality traits significantly affect bidding behavior only in the random Nth price and BDM auctions. Specifically, in the random Nth price auction scoring highly on openness or extraversion is associated with overbidding behavior, while scoring highly on agreeableness is associated with underbidding behavior. Likewise, in the BDM auction, scoring highly on extraversion or neuroticism is associated with overbidding behavior, while scoring highly on agency is associated with underbidding behavior. Variation in personality seems to have an insignificant effect on bidding behavior in the 2nd price and English auctions.

With regard to the control variables, gender was significant in all but the English auction, indicating that females tended to overbid more than their male counterparts. Age played a significant role only in the BDM auction, with older participants overbidding slightly more than their younger peers. Additionally, the auction ordering was significant for all four auction mechanisms.

The coefficients on auction order suggest that participants tended to underbid in the BDM auction when it was the first auction encountered. Subsequently, when the auctions were ordered from least competitive to most competitive, determined by the number of winners (BDM then random Nth price, then 2nd price, then English auction), participants tended to overbid in all auctions following the BDM. Finally, we found that when participants took the personality test prior to bidding in auctions, the results suggest they tended to underbid, relative to those that took the personality survey following the experiment, in all auctions, except the English.

These results, in particular, suggest that auction behavior is sensitive to different forms of priming; priming is an implicit memory effect in which exposure to one stimulus influences later responses to another stimulus. In our experiments, participants underbid if they completed the personality test prior to the experiment, in effect being primed to think about their own behavior first. Our participant sample tended to rank themselves highest in agreeableness, a personality trait associated with likeability, which may have influenced their subsequent underbidding behavior.

Interpretation of Personality Effects

Openness is associated with originality, intellect and creativity. Open-minded people tend to have a preference for novelty over convention and like to have fun. Thus, the statistically significant degree of overbidding found in the random Nth price auction for people with high openness scores might be explained by their desire to "just have fun" during the auction leading to an increase in their bids overall.

Similarly, extraversion is associated with high activity, sociability, and dominance. Extraverts tend to have a preference for excitement and stimulation. Thus, the statistically significant degree of overbidding found in the random Nth price auction for people with high extraversion scores might be explained by their desire to be the center of attention by winning the auction, leading to an increase in their bids overall.

Agreeableness is associated with kindness, likeability, and trustworthiness. Agreeable people are good at managing relationships because they have a tendency to be good-natured and cooperative. Thus, the statistically significant degree of underbidding found in the random Nth price auction for people that are highly agreeable might be

explained by their desire not to cause trouble, and might be related to altruism, leading to a decrease in their bids overall.

The significance of openness, extraversion, and agreeableness was also found by Grebitus, Lusk, and Nayga (2013) in 2nd price auctions for wine. This is an interesting point of comparison, because our analysis did not find any significance in personality traits on bidding behavior in our 2nd price auction, but found very similar results in our random Nth price auction. The auction mechanisms are identical in terms of incentive compatibility, and similar in their determination of the winner, although the random Nth price auction is likely to result in more winners overall.

In the Becker-Degroot-Marschak auction, extraversion was also found to be significantly correlated with overbidding behavior. Additionally, agency and neuroticism were found to be significant predictors of bidding under and over resale value, respectively.

Agency is associated with being forceful and dominant. People that score highly in agency tend to be extremely assertive, self-confident, and outspoken. Thus, the statistically significant degree of underbidding in the BDM mechanism could be explained by extreme profit-seeking behavior, since underbidding is the only way to make money in the induced value setting.

Neuroticism is a personality trait associated with emotional instability and anxiety. People with neurotic tendencies are more self-conscious than most, and get caught up easily in stressful situations. The BDM mechanism introduces a high degree of uncertainty for the participant, since winning the auction is determined solely on comparison with a randomly drawn price, this may lead to an increase in bids overall for individuals that score highly in neuroticism.

Visual Analysis

To visualize distributions of bidding behavior, mean bid differences across auctions were plotted against personality scores for all 144 participants. The scatter plots in Figures 1 – 4 measure personality trait scores on the x-axis and mean bid differences for each of the four auctions, respectively, on the y-axis. Many of the points cluster around a mean bid difference of zero (bid = resale value) across all personality scores.

Additionally, predicted bid differences were plotted against personality scores for this sample. The predicted bid differences are fitted to polynomials in Figures 1-4 for each of the four auctions, respectively, with personality trait scores on the x-axis and predicted values on the y-axis. It should be noted that the scales on the y-axis in each fitted graph differ, depending on the minimum and maximum predicted bid difference. However, almost all graphs exhibit y-axis scales in negative values; this is consistent with the findings of overbidding behavior on average across mechanisms and rounds, as outlined earlier in Table 4. The general shape of each graph depicts overall trends in bidding behavior for the range of personality trait scores, where moving left to right on the x-axis can be interpreted as an increased tendency to exhibit a given personality trait, and moving vertically up the y-axis can be interpreted as a decreased tendency towards overbidding behavior. However, predicted bid differences cannot be compared in magnitude directly from these graphs.

The predicted bid difference graphs are consistent with results from the regression analysis. In Figure 3 we find that as openness and extraversion scores increase, the degree

of overbidding in the Random Nth price auction also increases. We also find that as agreeableness score increases past neutral, the degree of overbidding decreases for the Random Nth price auction. In Figure 4 we find that as extraversion and neuroticism scores increase, overbidding behavior also increases in the BDM auction. The trends illustrated in these graphs are also useful for comparing predicted bidding behavior across personality scores within a specific trait, as well as across personality traits within a specific auction. We find that overall trends, specifically in the convexity of the predicted bid differences fitted polynomial, are consistent within personality traits across all four auctions, with the exception of agency. This result offers supporting evidence that, in general, agreeableness reduces the likeliness of overbidding behavior and openness, neuroticism, and extraversion increase the likeliness of overbidding behavior in the four experimental auctions identified in this study, although statistically significant correlation is only found in the Random Nth Price and BDM auctions.

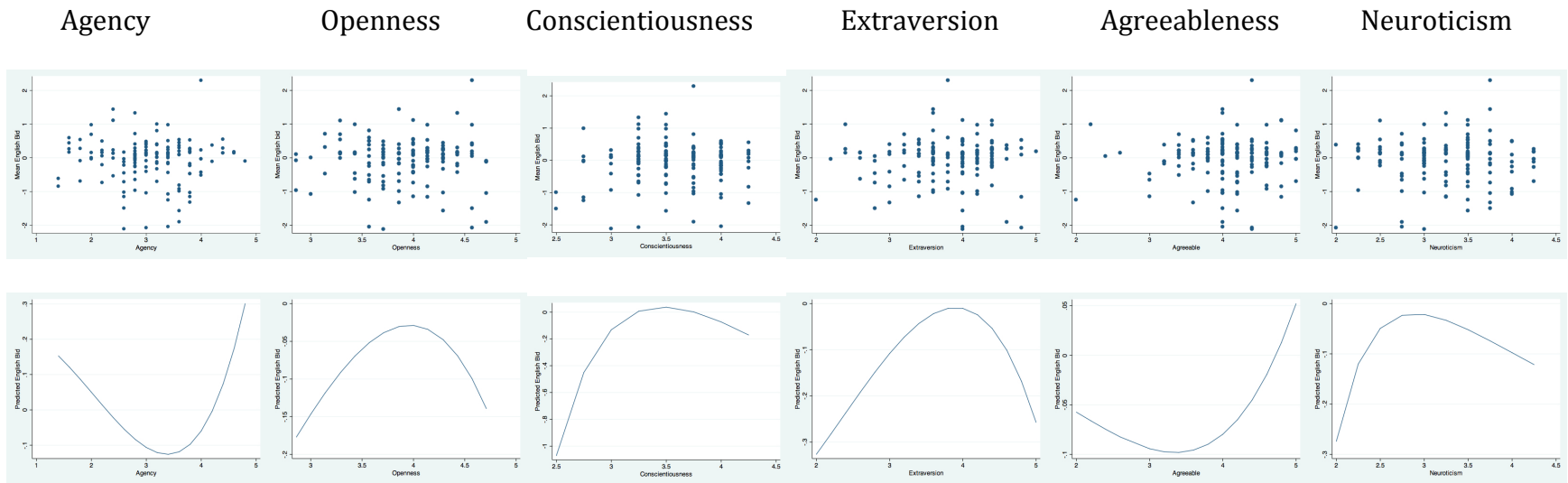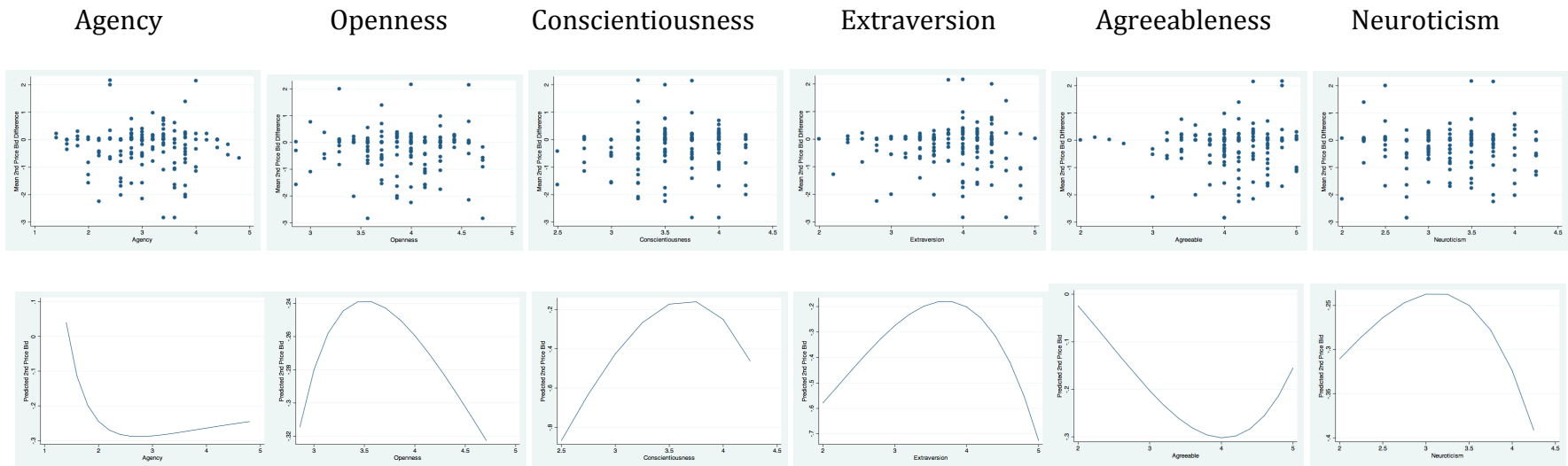Figure 1. English Auction Mean and Predicted Bid Differences versus Personality Scores

Figure 2. 2nd Price Auction Mean and Predicted Bid Differences versus Personality Scores

x-axis = personality trait score (1-5)
Scatter Plot: y-axis = Mean Bid Difference
Polynomial Plot: y-axis = Predicted Bid Difference

Figure 3. Random Nth Price Auction Mean and Predicted Bid Differences versus Personality Scores
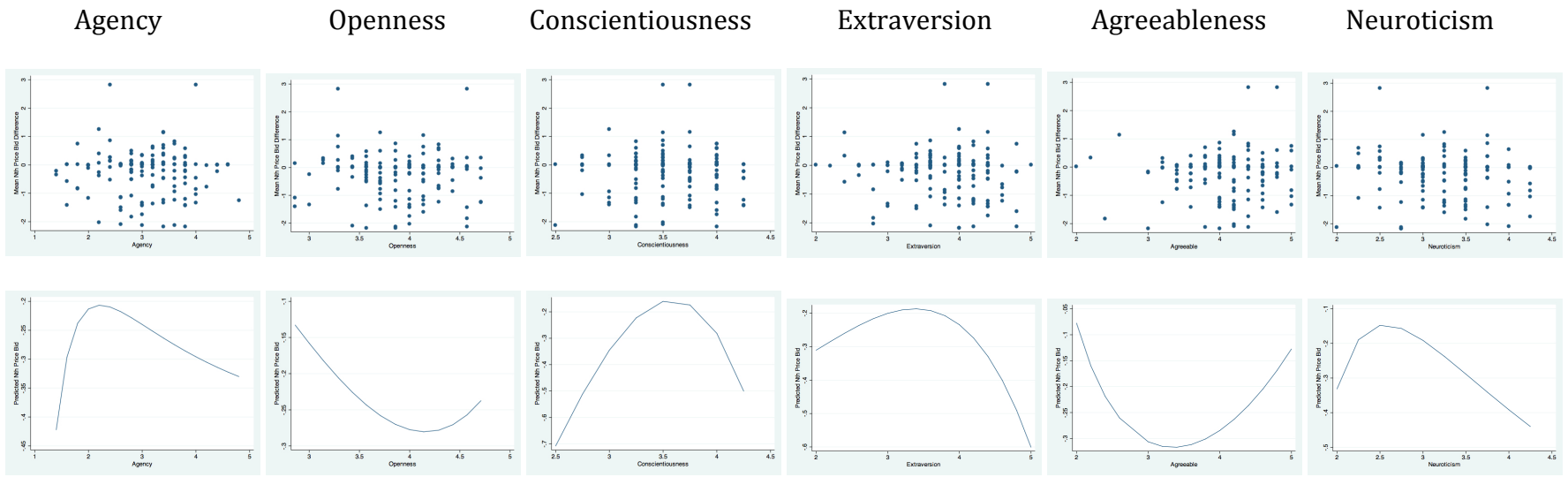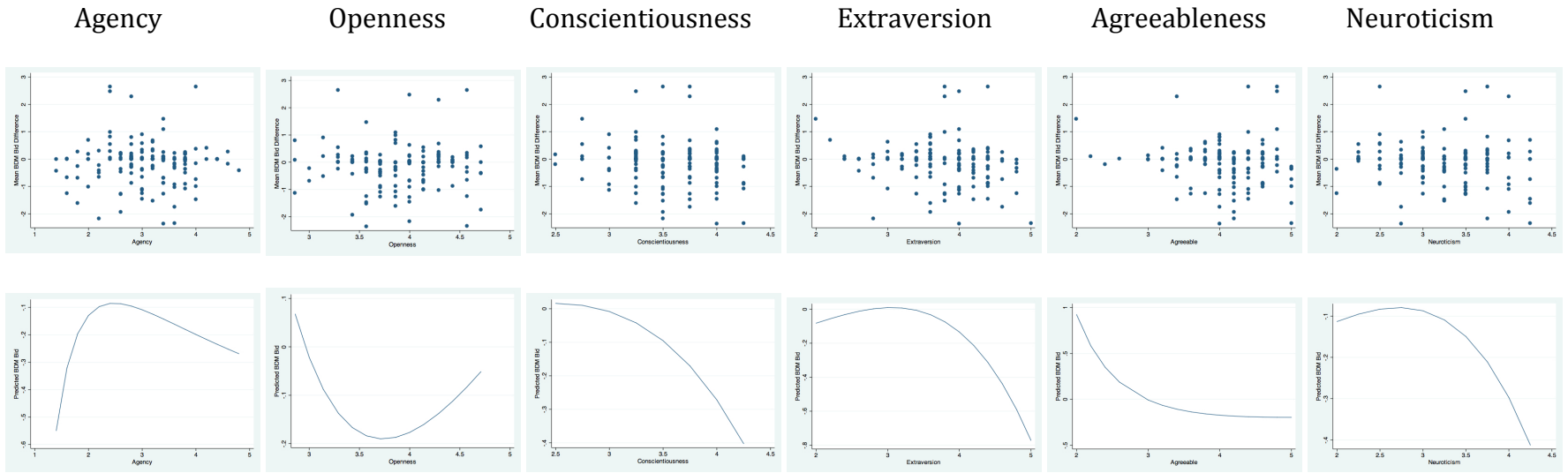

Figure 4. BDM Auction Mean and Predicted Bid Differences versus Personality Scores

x-axis = personality trait score (1-5)
Scatter Plot: y-axis = Mean Bid Difference
Polynomial Plot: y-axis = Predicted Bid Difference

Conclusions

Experimental auctions have increased in popularity as a method for investigating consumer preferences in different informational settings across economic sub-disciplines. Economic models of rational choice behavior assume preferences are independent of the method used to elicit them. The literature on experimental auctions has expanded quickly with investigations into "best practices" when it comes to auction procedures. However questions of auction validity continue to arise around "which method is best"?

Personality has been shown to influence a number of economic outcomes in work forged at the intersection of psychology and economics. This study addresses the predictive power of personality, potentially responsible for a degree of procedural invariance present across incentive compatible auction mechanisms popular in the experimental literature. Using an induced-value experimental design allowed us to isolate the affect of personality on under- or over-bidding behavior, by eliminating potentially confounding preference determinants present in homegrown values.

Our analysis concludes that there is a systematic correlation between openness, extraversion, and neuroticism with overbidding strategies. We also found a systematic correlation between agreeableness and underbidding behavior across the four auctions explored. While these correlations appear consistent across auctions, our analysis finds a statistically significant effect only in the Random nth and BDM auctions. Our findings suggest that the English auction and 2nd price auction might be more appropriate, methodologically speaking, as they seem to be less affected by psychological measures, such as personality.

Moreover, the significance of survey order and auction order suggest that auction behavior is sensitive to different forms of priming. In our experiments, participants underbid more if they completed the personality test prior to the experiment, in effect being primed to think about their own behavior first. Participants also had an increasing tendency towards overbidding behavior when the auctions were ordered such that the competitive nature of the task was rising.

The results of this work inform questions of auction validity when examples of procedural invariance arise; thus providing insight into, "which method is best"? Implicit in this discussion is the idea that WTP is not only a function of preferences for the good being valued, but also preferences for the environment or situation in which the value is elicited that may be determined, in part, by intrinsic personality traits. This naturally incites some to argue that individuals therefore do not have a single, stable, true preference. However, an alternative interpretation might be that people also have preferences for the market and institutional environments in which they operate, with broad implications for both the private and public sector. These results should be replicated with larger and more diverse population samples before conclusions can be made regarding the validity of these auction mechanisms for eliciting consumer preferences.

Bibliography

Almlund, Mathilde, et al. (2011) Personality psychology and economics. No. w16822. National Bureau of Economic Research, Inc.

Becker, A., Deckers, T., Dohmen, T., Falk, A., & Kosse, F. (2012). The relationship between economic preferences and psychological personality measures. Annual Review of Economics, 4(1), 453–478.

Becker, G. M., DeGroot, M. H., & Marschak, J. (1964). Measuring utility by a single‐response sequential method. Behavioral science, 9(3), 226-232.

Ben-Ner, A., & Kramer, A. (2011). Personality and altruism in the dictator game: Relationship to giving to kin, collaborators, competitors, and neutrals. Personality and Individual Differences, 51(3), 216-221.

Ben-Ner, A., Putterman, L., Kong, F., & Magan, D. (2004). Reciprocity in a two-part dictator game. Journal of Economic Behavior & Organization, 53(3), 333-352.

Bereby‐Meyer, Y., Moran, S., Grosskopf, B., & Chugh, D. (2013). Choosing between lotteries: remarkable coordination without communication. Journal of Behavioral Decision Making, 26(4), 338-347.

Boone, C., De Brabander, B., & van Witteloostuijn, A. (1999). The impact of personality on behavior in five Prisoner's Dilemma games. Journal of Economic Psychology, 20(3), 343–377.

Borghans, L. & Duckworth, A. (2008). The economics and psychology of personality traits. Journal of Human Resources 43(4), 972-1059.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological bulletin, 56(2), 81.

Engel, C., & Zhurakhovska, L. (2013). When is the risk of cooperation worth taking? The prisoner's dilemma as a game of multiple motives (No. 2012/16). Preprints of the Max Planck Institute for Research on Collective Goods.

Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. Economics Letters, 71(3), 397-404.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. Experimental economics, 10(2), 171-178.

Grebitus, C., Lusk, J. L., & Nayga Jr, R. M. (2013). Explaining differences in real and hypothetical experimental auctions and choice experiments with personality. Journal of Economic Psychology, 36, 11-26.

Gunnthorsdottir, A., Houser, D., & McCabe, K. (2007). Disposition, history and contributions in public goods experiments. Journal of Economic Behavior & Organization, 62(2), 304-315.

Heckman, J. (2011). Integrating personality psychology into economics. NBER Working Papers 17378, National Bureau of Economic Research, Inc.

Hilbig, B., Zettler, I., & Heydasch, T. (2012). Personality, punishment and public goods: Strategic shifts towards cooperation as a matter of dispositional honesty–humility. Journal of Personality, 254(July 2011), 245–254.

Hirsh, J. B., & Peterson, J. B. (2009). Extraversion, neuroticism, and the prisoner's dilemma. Personality and Individual Differences, 46(2), 254–256.

Kurzban, R., & Houser, D. (2001). Individual differences in cooperation in a circular public goods game. European Journal of Personality, 15(S1), S37-S52.

Lachman, M. E., & Weaver, S. L. (1997). The Midlife Development Inventory (MIDI) personality scales: Scale construction and scoring. Waltham, MA: Brandeis University.

List, J. A. (2003). Using random nth price auctions to value non-market goods and services. Journal of Regulatory Economics, 23(2), 193-205.

Lönnqvist, J.-E., Verkasalo, M., & Walkowitz, G. (2011). It pays to pay – Big Five personality influences on co-operative behaviour in an incentivized and hypothetical prisoner's dilemma game. Personality and Individual Differences, 50(2), 300–304.

Lusk, J. L., & Shogren, J. F. (2007). Experimental auctions: Methods and applications in economic and marketing research. Cambridge University Press.

McAfee, R. P., & McMillan, J. (1987). Auctions and bidding. Journal of economic literature, 25(2), 699-738.

Soliño, M., & Farizo, B. A. (2014). Personal Traits Underlying Environmental Preferences: A Discrete Choice Experiment. PloS one, 9(2), e89603.

Schmitt, P., & Shupp, R. (2004). Personality Preferences and Pre-Commitment: Behavioral Explanations in Ultimatum Games.

Schmitt, P., Shupp, R., Swope, K., & Mayer, J. (2008). Pre-commitment and personality: Behavioral explanations in ultimatum games. Journal of Economic Behavior & Organization, 66(3), 597-605.

Shogren, J. F., Margolis, M., Koo, C., & List, J. A. (2001). A random nth-price auction. Journal of economic behavior & organization, 46(4), 409-421.

Smith, V. L. (1975). Experimental economics: Induced value theory. University of Arizona, College of Business and Public Administration, Division of Economic and Business Research.

Swope, K. J., Cadigan, J., Schmitt, P. M., & Shupp, R. (2008). Personality preferences in laboratory economics experiments. The Journal of Socio-Economics, 37(3), 998-1009.

Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. The Journal of finance, 16(1), 8-37.

Visser, M. S., & Roelofs, M. R. (2011). Heterogeneous preferences for altruism: gender and personality, social status, giving and taking. Experimental Economics, 14(4), 490–506.

Volk, S., Thöni, C., & Ruigrok, W. (2011). Personality, personal values and cooperation preferences in public goods games: A longitudinal study. Personality and Individual Differences, 50(6), 810–815.