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Evaluating the Role of Personality Trait Information in Social Dilemmas

Todd Guilfoos^{*ψ}, Kenneth J. Kurtz^β

Abstract

We investigate whether cooperative behavior in social dilemmas is conditional on information about a partner's personality traits. Using a repeated one-shot continuous strategy Prisoner's Dilemma (two person Public Goods game), we test how information on personality traits of partners influences cooperative actions. Before each game we provide subjects with the rank-order of their partner (relative to all subjects in the session) on one of the personality traits of the Big Five Inventory. Using a within-subjects design we find that subjects are more cooperative when informed that their partner is more 'Agreeable' or 'Open to Experience'. The primary reason for more cooperative behavior is the expectation that partners will give more to the public good.

Keywords: Cooperation, Big five personality inventory, Expectation formation, Social cognition

JEL: C72, C91, D03, D70

Introduction

Cooperation is a key component of many economic situations, for example the co-management of common pool resources, treaty negotiations, or building teams. Cooperation creates opportunities to improve economic outcomes and/or

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increase efficiency through collective action, like in the prisoner's dilemma. The institutions that influence individual cooperative actions are important, such as rules or social norms, and so are the motivations, preferences, and cognitive processes that govern cooperative decisions. We know that cooperation can be conditional on previous play in repeated games via reciprocity and trust (e.g. Fehr and Gächter 2000a, Cox 2004, Berg et al 1995, Nowak and Sigmund 2005) or even through social comparisons (Frey and Meier 2004). In addition to induced cooperation it is known that some individuals have pro-social preferences in social dilemmas, known sometimes as Social Value Orientation (Balliet et al. 2009). Most of the economic research done on non-cooperative games focuses on how past play interacts with institutions to govern behavior. While these aspects of cooperation are well established there is less research on how the perceptions of partners and their traits shape cooperative strategies and pro-social behavior. Information about partner's behavior and traits may both play a role in how cooperation evolves in social dilemmas.

In many real life situations detailed and accurate information on past actions may be difficult to come by without a formal mechanism to enforce accurate reporting. Consider many common pool resources, such as fisheries or aquifers, that depend on management structures that report and audit behavior. Some other forms of information may be more readily available through social interactions, which we call social information. Social information about others (e.g., gender, intelligence, or personality) is likely to be available or impressions of these information sets can be formed from social interactions. Perceptions of social information may be used to condition behavior or form expectations about other's behavior. For instance, when new teams form to accomplish a common task, each individual has an incentive to free ride on other team members in completing the task if individual contributions are hidden. This is a common problem that most college students face when assigned group work for a class where there are

incentives to free ride on other group members.¹ Each team member must decide how much effort to put toward the team objective and may have limited experience or knowledge of other team members. Therefore, individuals are left with little past play information to base inferences on and may use social information of their new team members to form expectations of behavior. Even in repeated play situations, if information is incomplete, then information of player types could be influential to the expectations about other's play. This could be particularly important when groups adopt new rules or regulations as play under the new rules has not been observed even when past behavior is observable. Take for example the initial forming of a coalition of fisherman to undergo joint restrictions on fish harvesting- before all fisherman reduce harvesting effort there is no information on past play under the new restrictions. There are also a host of other situations in which expectations of individual's pro-social preferences are likely to be important such as conflict resolution, negotiations (Hosmanek et al 2014), international agreements, complex governance agreements (Conca et al 2006), and research and design work (Mora-Valentin et al 2004).

The characteristics of other people can play multiple roles in group decisions. Social identification, i.e., the level of kinship with others, can influence trust in partner's behavior since individuals may identify with others based on certain characteristics (Ahmed 2007, De Cremer and Van Vugt 1999). The feeling of kinship with others is also referred to as social distance. Charness and Gneezy (2008) find that providing the names of partners decreases social distance and increases allocations to partners in dictator games. Buchan et al. (2006) find that subjects give more in an investment game to partners of the same country of origin. These examples suggest that social distance may affect other-regarding preferences. Social information like personality traits may also reduce social

¹ Though there are mechanisms to overcome this situation, such as evaluations of each student by their peers.

distance in social dilemmas and influence judgements about whether to cooperate with partners whom subjects identify with based on similar traits.

Forming expectations about player personality may also be an important aspect of the social cognition that underlies the interaction (Frith and Singer 2008, Bodenhausen 2010) – including the formation of beliefs about the player’s intentions and the appropriate way to respond in a social situation. Psychological studies have demonstrated how perceptions of others, through facial features or eye gaze, are used to make judgements about personality types (Bayliss and Tipper 2006, Bayliss et al 2006, Wolffhechel et al 2014). Research has also connected personality types to the categorization of others to make decisions in social contexts (Macrae and Bodenhausen 2001) though this line of inquiry has not been linked specifically to economic decisions and incentives.

Why might social information be used in conditioning expectations about another person’s behavior? Primarily because social information has power in predicting economic behavior and preferences. Studies have established that behavior can vary across important attributes of the population such as personality type (Borghans et al 2010). The attributes of individuals can affect pro-social preferences: intelligent groups cooperate more than less intelligent groups (Jones 2008), females cooperate more often than males (Molina et al. 2013), and social identity increases cooperation (Chen et al 2014). Along these lines, Cobb-Clark and Schurer (2012) show that personality traits are stable inputs into economic decisions. Therefore, individuals can demonstrate stable preferences for cooperation. Stable personality traits and cooperative preferences would allow for perceptions of types to become more salient in the real world. Ben-Ner et al (2004) report that personality measures have predictive power in the dictator game – sharing behavior relates to Agreeableness in both males and females. Team composition and Openness to Experience explain performance in group tasks: greater Openness to Experience of team members improved team performance

(LePine 2003). LePine et al (2001) also find that Agreeableness explains cooperative behavior in team tasks. Muller and Schwieren (2014) report that personality traits are important in predicting behavior in trust related games, especially in situations where economic incentives are weak. Openness to Experience is also related to increased responses in the reward-sensitive region of the brain when choosing cooperative actions in a social context (Morawetz et al 2014). Schroeder et al (2015) find that Extraversion is associated with less free-riding when individuals are subject to the institution of punishment. The authors also report that agreeableness is associated with more giving to the public good, while neuroticism is associated with less giving to the public good. The personality traits of subjects can predict behavior in the prisoner's dilemma game. Boone et al (1999) finds that internal locus of control, high self-monitoring, and high sensation seeking traits are associated with more cooperative play in the prisoner dilemma games. Al-Ubaydli et al (2014) find that group's average Openness to Experience predicts first round cooperative behavior in a repeated Prisoner's Dilemma experiment.

A small number of studies explore whether players use social information to condition their strategies in non-cooperative economic games: Schwieren and Sutter (2007) find that men trust female more than male partners in their mathematical ability; and Van Lange and Liebrand (1994) report that subjects expected high contributions to the public good in partners perceived as honest or less intelligent. Other studies have established that perceptions are important to game play in other ways. Labels such as 'trust', 'cooperate', or 'defect' used in a prisoner's dilemma game to describe strategies induce more cooperation by subjects and increased the perceptions that others would play cooperatively (Zhong et al 2007). Tinsley et al (2002) demonstrate that perception of partner's experience in negotiations affected the reputation and ultimately the behavior of subjects. Experience is viewed negatively by novices which reduces the ability of

experienced negotiators to capitalize on their real negotiation expertise. These studies establish that the expected value of strategies are not only conditional on past play but on perceptions as well.

The critical question we address is: how does information about personalities of partners change cooperative play and expectations of partners in a non-cooperative economic game? We employ a laboratory experiment and provide subjects with personality information about their partners to investigate this question. Exploring expectations of personality types in a non-cooperative economic game furthers the research on other-regarding preferences and cooperation. Other-regarding preferences are required for cooperation in this game because the Nash Equilibrium of the one-shot prisoner's dilemma is to defect regardless of the partner's strategy. Other-regarding preferences are well established – we test whether other-regarding preferences depend on personality trait information.

In our study, participants answer a 44 question Big Five Personality Inventory that scores subjects in each of the Big Five personality traits. Subjects then play a repeated one-shot public goods game with anonymous partners and are provided with one piece of personality information about their partner. In five separate treatments subjects are provided with the rank-order of their partner on one of the Big Five Personality Traits (Agreeableness, Extraversion, Neuroticism, Conscientiousness, or Openness to Experience). Having completed the inventory at the beginning of the session, subjects are likely to take the ranking information at face value. Subjects receive a short, clear description of the personality trait and how to interpret high versus low rankings (shown in Table 1). Partner identity is kept completely anonymous. Subjects are not given their own ranking or raw scores. The information treatment is the relative position of their partner within the group on a given trait – which prompts a particular perception of the partner. We argue traits are perceived because we provide the rank-order of the given trait and

it does not necessarily provide accurate information about the level of any trait.² For example, the agreeableness of a subject's partner could be ranked first among all subjects in a session, but that same partner could potentially have a low absolute score in agreeableness if all subjects scored low in Agreeableness, so the ranking information is a measure of perceived Agreeableness. The claim that subjects receive perceived trait information is less stringent than the claim that subjects have accurate information about the actual traits of their partners; subjects are provided with accurate information about their partner's relative traits to the current subject pool. The anonymous one-shot game is used to isolate the effect of perceptions of partners and separate the perceptions from reciprocity from past or future play.³ Specifically, repeated interactions could lead to cooperation in expectation of greater future profits through reciprocity or punishment by partners in the future.

To preview our results: we find that partner's personality traits are important to cooperative decisions. Specifically, subjects with partners who ranked high in terms of Agreeableness and Openness to Experience give more to the public good. We find that the primary reason for increased giving to the public good is reciprocal expectations of partners with high Agreeableness and Openness to Experience. Using the difference between the absolute scores of personality traits between subjects and their partners we also measure the effect of this distance measure on behavior. We find a decrease in the distance between Neuroticism scores of players increases their contributions to the public good – though the distance between other personality trait scores does not affect cooperative behavior. These results demonstrate that personality information and perceptions of others are important to cooperation in social dilemmas.

² It could be that subjects view the rankings to be objective measures of personality, it is also plausible that subjects completely recognize the difference in how ranking measures may diverge from raw scores.

³ Repeat interactions between subjects would be an interesting future work, as it could identify the relative importance of characteristics of subject's partners relative to knowledge of past behavior.

Experimental Design

There are three stages in the experiment. The first stage is comprised of collecting personality trait and demographic information through a questionnaire. The second stage, the main part of experiment, is a repeated one-shot, two-person public goods game with information treatments revealing partner's rank ordering of a given personality trait (detailed in Table 2). In the third stage, subjects are allowed to choose which of the Big Five personality trait rankings they receive for each round of a public goods game. This last stage provides a measure of the relative value of the different personality trait rankings.

In the first stage, subjects take a forty-four question personality inventory (Filiz-Ozbay et al. 2013) on the computer. Subjects were asked to provide truthful answers to these questions, but were not told of any further use of the data at this point in the experiment. Since the questionnaire was implemented on the computer, the raw scores and rank-ordering of all subjects in a given session were calculated immediately upon completion of the survey. Rank-ordering refers to the rank of the subject relative to other subjects in the same session for a given trait.

In the second stage of the experiment subjects play a repeated one-shot public goods game with randomly assigned anonymous partners in each round. This game is the same as a typical prisoner's dilemma game except that the decision space is continuous. Subjects must decide how to allocate 10 tokens between the private good and the public good; 0 tokens to the public good being the same as 'defect' and 10 tokens to the public good being the same as 'cooperate' in the prisoner's dilemma game.⁴ The game is linear and has payoffs of \$0.75 for each token invested in the private good option and \$0.50 for each token invested by the subject and their partner in the public good option. Subjects are provided with

⁴ We frame the choice as taking away from the common pool, which is more similar to a common pool resource, but has the same theoretical equilibrium that the public good framing contains.

examples of the payoffs in the instructions and experience four practice rounds to gain experience with the game. There are six experimental information treatments as shown in Table 2; a treatment is defined as a set of six rounds with information on one of the personality traits (the rank-ordering of the subject's partner). The treatments are randomly ordered between sessions to guard against ordering effects. Subjects are not told how many rounds or how many treatments to expect, but are reminded of the random and anonymous partner assignment at the beginning of each treatment.⁵ We instruct subjects that the rank-ordering of a trait is computed from their responses to the personality questionnaire given in stage 1 and provide subjects with a written description of high and low rankings of the personality trait of that information treatment. The experimenter reads the description for only the relevant personality trait during each information treatment. Within each information treatment subjects do not encounter the same partner twice to eliminate reciprocal play or punishment based on identity of their partner – this design choice isolates the effect of perceived traits in behavior within a treatment.⁶

In the third stage of the experiment subjects choose which personality trait rank-ordering information they gain access to in another anonymous one-shot public goods game one round at a time. Subjects play an additional six rounds of the public goods game in this stage of the experiment.

⁵ Subjects are probably able to guess by the end of the experiment that each treatment is six rounds, but this likely does not matter since subjects are playing a series of one shot games – this design feature would likely matter more if the six rounds were played with the same partner inducing an end round effect.

⁶ We use a predetermined random matching system based on the subject's computer station in the lab that ensures that subjects do not encounter the same partner during the same treatment, as this information could be used to punish previous partners for low contributions to the public good in earlier rounds. Since there are 14 subjects in each session, subjects will interact with the same partner's approximately 3 times over the course of the experiment. Even though there are repeat interactions across the experiment, there is no way for subjects to know how many repeat interactions are likely (since they do not know how many rounds are in the experiment), or when they are interacting with another person (since it is anonymous).

The flow of information to subjects is critical in this study. In the first stage, subjects are not aware of the personality categories or how their answers in the questionnaire will be used during the rest of the experiment. No materials are provided to subjects with information about the personality rankings or categories. During the second stage of the experiment subjects learn about each personality trait individually and are provided instructions that describe only the personality trait ranking in that treatment. Knowledge about future personality trait categories or number of traits being used in the experiment is not available to subjects – only at the last information treatment are subjects aware of all of the personality trait categories. At the beginning of the third stage, subjects are provided with a handout that contains all personality trait categories and interpretations of the rankings. At this point in the experiment subjects know all the possible personality trait categories. Our primary hypotheses are addressed in stage two of the experiment.

Experimental Procedures

We recruited 98 undergraduate subjects at a large public university in the United States during the spring and fall of 2015 through class announcements and email. The experiment was programmed and conducted in z-Tree (Fischbacher 2007). Sessions were run in a laboratory environment where subjects were in private work stations with dividers and could not communicate or make eye contact with other subjects during the experiment. Instructions were read aloud and provided on-screen with supplemental information printed out in the order dictated by the treatment ordering for that session (materials provided in Appendix A). Each session included 14 subjects who completed all three stages of the experiment in the order described above. The symmetry in the size of session groups allows for the comparability of the rank ordering across sessions. After the third stage, subjects were provided with cash payments based on their cumulative earnings

across all the games. Average earnings per subject were \$26.57. Each session lasted approximately 1.5 hours including reading the instructions and making payments.

Expected Outcomes

This study is an exploratory analysis of perceptions about partner personality traits and conditional expectations. The mechanism that we believe is at work is that real world experience leads to expectations of partners with particular traits – in the present study we expect to see changes in behavior based on rank ordering information about partners enabling identification of subject’s beliefs about personality types and the resulting effect on cooperative behavior. Previous economic and psychology studies suggest more Agreeable individuals cooperate more (LePine et al 2001). Openness to Experience is found to be related to cooperative behavior in non-cooperative games (Al-Ubaydli et al. 2014) and is related to responses in the reward center of the brain (Morawetz et al. 2014) in social settings. If individuals with these traits, Agreeableness and Openness to Experience, exhibit pro-social behavior in everyday interactions, then people may develop expectations that partners with these traits would be more cooperative. If subjects are reciprocal and prefer to give more to the public good when they expect their partner to give more to the public good, then partner’s traits can affect cooperative behavior. The findings from the literature reviewed above suggest the following hypotheses:

Hypothesis 1: Subjects whose partners have higher rankings of Agreeableness are more cooperative.

Hypothesis 2: Subjects whose partners have higher rankings of Openness are more cooperative.

We premise much of our analysis on the expectations formation by subjects about their partner's play though we cannot completely discern between two explanations of cooperative behavior: that increasingly cooperative actions are based on either reciprocal expectations of partners or charitable intentions by subjects. Therefore, in the last three sessions we prompted subjects to provide written responses to inquiries about their strategies and how they used the personality information provided during the experiment (these prompts were given as the last task in the experiment after all games were played).

Results

Rankings of Partners

We explore public good contributions by subject using a random-effects two limit Tobit model. This model incorporates the fact that data is censored at both 0 and 10 and that each subject had six decisions in a given treatment, accommodating the nature of our data.⁷ The key identifying feature of our data will be the within-subject design of public good giving by subjects conditional on partner's ranking. In Table 3 and Table 4 we present our main results from this experiment and establish whether the traits of partners influence cooperative actions in the public goods game. In both tables the column headings are the trait that the ranking information corresponds with and controls are added for the subject's personality scores, distance to partner's personality score, period of the

⁷ We cannot compute the corresponding fixed effects Tobit model as there is not a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood function. We do examine the robustness of the results estimating a fixed effect censored regression as suggested in Honore (1992) and an unconditioned fixed effects Tobit model which is available upon request, and which support the findings presented in Table 3 and 4.

game, gender, session fixed effects, and number of previous experiments completed. The distance to partner's personality score is a control for social distance and is defined as the absolute value of the difference between the raw personality scores of subject and their partner. We refer to this as the personality distance and calculate the variable by information treatment.⁸ The session fixed effects control for the ordering of the information treatments. The variable of interest, rank ordering of partner's personality traits, is a continuous measure of ranking in Table 3. This method uses rankings as a linear control in the public goods game and retrieves the average slope of public good investments with respect to partner's ranking for each trait. In Table 4 we test the same hypothesis but use three groups of partner's rank to test for non-linearities in response to partner rankings. The omitted group is "Group 1", the highest ranking individuals for each personality trait (rank 1 to 5), while "Group 2" consists of the middle ranking individuals (rank 6 to 9), and "Group 3" are individuals with the lowest ranking (rank 10 to 14); there are 14 participants in each session.

We find that subjects with higher ranking partners in terms of Agreeableness contribute more to the public good in both the continuous control for partner ranking and the group measure of partner rankings, supporting hypothesis 1. The negative coefficient on the ranking of the partner shows that a partner with a 'high' ranking (e.g. ranking = 1) would result in greater contributions to the public good. The results suggest that subjects do contribute more to the public good if their partner is highly ranked in terms of Agreeableness, although as shown in Table 4 only the differences between the highest ranking partners and lowest ranking partners is statistically significant. This suggests that more contributions

⁸ We include the personality distance for agreeableness scores during the rounds for the information treatment in which agreeableness rankings are provided to subjects and personality distance for openness scores when the rankings for partner's openness are provided and so on for the other personality traits.

to the public good are made when partners are thought to be in the highly “Agreeable” group compared to other lower ranked subjects.

Subjects with higher ranked partners in terms of Openness to Experience contribute more to the public good as well, supporting hypothesis 2. In Table 3 we find highly significant estimates that subjects will contribute more to the public good when their partner is highly ranked in terms of Openness to Experience. The findings in Table 4 are also similar to the results of Agreeable partners: more is given to the public good only when partners are perceived as highly ‘Open’ compared to the rest of the subject pool.

We also find evidence that personality distance for Neuroticism is significant. The negative and significant sign in Table 3 column 4 on the personality distance coefficient shows that subjects give more to the public good when paired with similarly neurotic partners. Pairs of subjects that both identify as nervous and high-strung or calm and relaxed give more to the public good than pairs of subjects with differing Neuroticism scores. It is important to clarify that subjects are not given their own scores or rankings; so the effect and interpretation we posit here depends on subjects identifying with a particular trait and that they also exhibit that same trait. Some self-knowledge about subject’s own personality, without explicit scores, is required. There exists some evidence that individuals are self-aware to a degree of their own personality traits (Vazire and Carlson 2010) lending credence to our interpretation of personality distance.

The personality traits Neuroticism, Extraversion, and Conscientiousness of partners are not found to be statistically significant. The fact that not all the personality rankings are significant increases our confidence that the findings of Agreeableness and Openness to Experience are in fact categorizations that subjects use and are not simply induced by providing information to subjects. We surmise that these trait rankings are used in sufficiently noisy ways or completely ignored by subjects. For instance, subjects may ignore rankings that do not conform to

initial beliefs. Without consistent play by many subjects we will not find robust evidence of the use of personality information since our identification relies on within-subject variation across all subjects. Our findings support both hypothesis 1 and 2 and expectations of subjects conform to the pro-social behavior of Agreeable and Open individuals found in other studies (LePine et al. 2001, Al-Ubaydli et al. 2014). It is noteworthy that the increase in contributions to the public good is economically significant: an increase of roughly 20% to 30% of the total possible contribution is made when subjects have partner types that are highly ranked in Agreeableness or Openness.

Personality of Subjects

To investigate how the personality of subjects affects contributions to the public good we estimate a different set of regressions that includes all the information treatments. In Table 5, we present results of such a regression with controls for demographics, information treatment effects, personality distance, partner's ranking by treatment controls, session fixed effects to control for differences in cohorts, and a lag variable of the group contributions to the public good in the previous period which may account for global strategies by players. We again use a random effects Tobit model to account for the nature of the data. Here subjects make thirty decisions across a session which include all the information treatments.⁹ The control for partner's rank is interacted with information treatment effects, from Table 1. This control is equivalent to the results presented in Table 3, but restricts other controls to have the same coefficients and includes all the data across treatments in one regression. We provide a correlation matrix of the personality measures in Table 6 to investigate co-linearities between traits that may

⁹ The 6 rounds without any information treatment are not included because of the interaction between treatment and partner's rank is used as a control, therefore these observations are dropped.

obfuscate their significance in the regression analysis. There does not appear to be much concern as most of the traits are not highly co-linear.

The information treatment controls interacted with partner's rank are consistent with the results from Table 3. The point estimates are also stable with the increase in lags of total contributions to the public good. This result increases the robustness of the main result of the experiment and confirms that subjects with partners of high Agreeableness and Openness lead to greater pro-social behavior.

We also include the measure of personality distance interacted with the information treatment. Similar to the results in Table 3 and Table 4, we find that the distance between personality scores does matter, but only for the information treatment of Neuroticism (Treatment D). We find no evidence that personality distance matters for any other personality trait. This also implies that the description of Neuroticism provided to subjects may have an important meaning to them and subjects likely identify and express more other-regarding preferences for similar partners along this dimension of personality.

Interestingly we find some differences from our expectations of the personality traits of subjects. Specifically, Openness to Experience is the opposite sign of our expectations and not statistically significant. This implies that while subjects would give more when their partners were highly ranked in Openness to Experience, the expectation that these partners were contributing more to the public good on average was actually incorrect. On the other hand, subjects were correct about their partners that were ranked higher in terms of Agreeableness – which likely reinforced those expectations.

Further, there is stronger evidence that other personality traits, Neuroticism and Conscientiousness, are significant to cooperative behavior, but not to expectations. Subjects who were rated as more neurotic were less cooperative and gave less to the public good. While we did not have strong a priori expectations with regard to Conscientiousness – and subjects did not appear to form expectations

about players with varying levels of Conscientiousness – this personality trait appears to be strongly linked to more selfish play. Players rated highly in Conscientiousness are more deliberate and play closer to the Nash Equilibrium – which recall other studies showing that subjects under time pressure tend to cooperate more or that their intuitive responses are more cooperative (Rand et al 2014). We posit that a potential reason for the difference in personality measures and expectations of partners is that this game may be unfamiliar to some subjects and therefore priors formed before this experiment may be consistent with cooperative behavior and traits in everyday social interactions, but not consistent within the experiment. While it is surprising that the personality traits do not conform to beliefs, it is important to recognize that subjects did not have many rounds to adjust their prior beliefs to this new information provided in the experiment.

In addition to personality measures, we find support that gender plays a significant role in cooperative decisions. Female subjects choose to provision for the public good at a much higher level than male subjects. This finding conforms to results from previous experiments (Schwieren and Sutter 2008) where female subjects tend to be more cooperative and give more in trust games.

Value of Information

In the third stage of the experiment we allow subjects to choose just one of their partner's personality traits to get information about in each round. This provides insight into which personality trait information is considered more valuable by subjects. The frequency of each personality ranking choice is provided in Table 7. The trait that has the highest frequency of being chosen is Agreeableness: roughly 40% of the time. This is evidence of the higher value of rankings of Agreeableness as an information set and reinforces the findings from the regression analysis that this information is being used by subjects in

provisioning of the public good. Information on Agreeableness is also likely more valuable because it conforms to expectations and predicts play of subjects. Other traits are chosen approximately in the same frequency giving little evidence of their relative value. The ranking of Openness to Experience is not chosen in greater frequencies than other traits which is consistent with the fact that the trait of Openness to Experience is used in cooperative decisions, but does not conform to expectations (as shown in Table 5) potentially reducing its value. When expectations are reinforced by experience, as they are for Agreeableness, that information becomes more valuable to subjects. This leads us to presume there may be some learning about traits, information, and play across the stages of the experiment. Since our experiment is not designed to elicit the effects of learning, we do not address the effects of learning on play. Extensions of this work could lead to a better understanding of equilibrium play in non-cooperative games as personality traits interacts with the building of reputation, trust, or punishment.

Player Motivation

We ask subjects to provide free form responses explaining their play and strategies at the end of the experiment (note: this was only for the last three sessions out of seven total).¹⁰ There is extensive literature in economics on other-regarding preferences which suggest that reciprocal expectations and charitable giving are important to social preferences and cooperative behavior. Sometimes the motives of subjects are assessed through the design of the game – increased giving in dictator games suggest charitable motives (Hoffman et al 1996) while repeat interaction games suggest reciprocal motives (Clark and Sefton 2001). In line with this literature the authors provide three categories that the written responses are

¹⁰ It did not occur to the researchers to gather information about strategies through open ended questions until after the fourth experimental session, and therefore we do not have this information for all subjects.

assigned to by two independent research assistants not involved in the running of the experiment and naïve to the experimental hypotheses. The three categories responses are assigned to are: (1) *ambiguous* – motivation of subjects is unclear or they explicitly say they did not use the rankings information; (2) *cooperative expectations* – subjects indicate expectations of partners with certain traits will also give more to the public good; and (3) *charitable giving* – subjects indicate that they gave more to partners with certain traits because of the likability of those types of partners.

There were forty-two responses scored by two independent raters with a 86% R-square between their categorical assignments. For further use of the scoring, disagreements were resolved by a third research assistant without knowledge of the experimental hypotheses. The analysis suggests that very few subjects are motivated by charitable giving: 5%. The written responses for charitable giving were vague. One respondent reported that they gave more to the public good because their partner was “nice”, which does not shed light on if the subject had expectations of a ‘nice’ partner or if they felt like sacrificing their own payoff for a ‘nice’ partner. 33% of subjects report that they did not use the ranking information. Among reasons for this behavior were selfish motives to maximize payoffs which indicate potential Nash Equilibrium play. Approximately 62% of subjects report that they expected partners with certain traits to give more to the public good and therefore also gave more. This analysis, in conjunction with the previous results, indicates that larger contributions to the public good are made with reciprocal expectations of partners with high perceived Agreeableness and Openness to Experience.

Conclusion

Our experiment tested whether information about partner’s personality traits influence cooperative behavior of subjects in a non-cooperative economic

game and establishes that social information is used in cooperative game strategies. Using a two-person public goods game, we find that the perception of high Agreeableness and Openness to Experience of subjects' partners increases contributions to the public good. When partners are ranked as more 'Agreeable' or more 'Open' they are thought to be more likely to contribute to the public good which leads subjects to also give more to the public good. Therefore, pro-social behavior is observed in play and is conditionally expected of others with certain traits. The differences in public good contributions based on personality of partners appears to be significant with only non-marginal changes in partner's traits: statistical differences are only found when comparing the highest ranked partners to the lowest ranked partners. We also find, in the context of this game, that subjects are correct in their expectations of partners ranked high in Agreeableness, but not correct in their expectations of partners ranked high in Openness to Experience. This fact potentially leads subjects to find information about the rank of Agreeableness more valuable by the end of the experiment than the rank of other personality traits.

Our findings suggest that more informal measures of a person's character are used when individuals decide to be cooperative. Personality is more than just a latent characteristic of a person's economic preferences, but also informs others as to their likelihood of forming cooperative equilibria in non-cooperative settings. It is important to remember that standard economic theory, through deductive reasoning, suggests that social information should not be predictive of strategies in social dilemmas. We argue that using personality information of partners can be rational, as players should condition their strategies on predictable regularities of partners. Conditional expectations and characterizations of player types could be important in many settings, where previous play is unobservable, incomplete, or costly to obtain, and pro-social expectations could be important toward the

establishment of cooperation in bi-lateral agreements, negotiations, or coalitions in common pool resources.

There are a number of other implications for conditional expectations based on social information. When cooperative partners are sortable, social information may be influential in how partners are chosen and have implications to the evolutionary performance of groups or network building. In addition, signaling these traits may be used to inform others of the intent to cooperate in non-cooperative situations. This type of social signaling may be used similar to a type of ‘secret hand-shake’ pre-play that is discussed in Anderlini and Sabourian (1995) as players attempt to establish a perception of their ‘type’ to their partners. Further research on how social information and past experiences interact will be useful to more completely ascertain the relationship between social information and the rules and social norms that govern behavior from past play.

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Tables

Table 1: Descriptions of High and Low Ranking Partners

Personality Trait	Description of High Ranking Partner	Description of Low Ranking Partner
Agreeableness	good natured, sympathetic, forgiving, and courteous	critical, rude, harsh, and callous
Openness to Experience	original, creative, curious, and complex	conventional, down to earth, narrow interests, and uncreative
Conscientiousness	reliable, well-organized, self-disciplined, and careful	disorganized, undependable, and negligent
Neuroticism	nervous, high-strung, insecure, and worrying	calm, relaxed, and secure
Extraversion	sociable, friendly, fun loving, and talkative	introverted, reserved, inhibited, and quiet

Table 2: Information Treatments

Treatment	Information Description
A	Rank Order of Partner's Agreeableness
B	Rank Order of Partner's Openness to Experience
C	Rank Order of Partner's Conscientiousness
D	Rank Order of Partner's Neuroticism
E	Rank Order of Partner's Extraversion
F	No Information

Note: In each session a subject will experience all of the treatments and all treatments are for the duration of six rounds. The order of treatment is randomized across sessions. Subjects are not provided with information on the number of rounds or number of treatments.

Table 3: RE Tobit Regression: Continuous Measure of Personality Rankings

	Dependent Variable: Contribution to the Public Good									
	(1)		(2)		(3)		(4)		(5)	
	Agreeableness		Openness		Extraversion		Neuroticism		Conscientiousness	
Partner's rank	-0.276***	(0.099)	-0.190***	(0.074)	-0.045	(0.073)	0.086	(0.087)	-0.060	(0.093)
Personality distance	0.217	(1.328)	0.797	(0.818)	-0.886*	(0.510)	-1.819***	(0.656)	-0.597	(0.857)
Round	-0.688***	(0.213)	-0.276*	(0.168)	-0.441***	(0.161)	-0.670***	(0.198)	-0.079	(0.201)
Extraversion	0.401	(1.100)	0.029	(0.974)	-0.214	(0.854)	0.0168	(0.893)	0.039	(1.027)
Openness	-0.720	(1.757)	-0.747	(1.555)	-1.551	(1.365)	-1.302	(1.422)	0.785	(1.641)
Conscientiousness	-2.870*	(1.622)	-2.411*	(1.442)	-3.194**	(1.268)	-2.072	(1.293)	-3.571**	(1.515)
Neuroticism	-0.998	(1.278)	-0.544	(1.122)	-2.216**	(0.969)	-2.232**	(1.041)	-2.102*	(1.171)
Agreeableness	3.821	(2.455)	3.385	(2.119)	2.160	(1.876)	2.699	(1.950)	1.162	(2.230)
Female	1.605	(1.821)	2.247	(1.619)	2.666*	(1.428)	4.564***	(1.504)	4.916***	(1.772)
# of previous experiments	-0.576	(1.027)	-0.800	(0.918)	0.407	(0.781)	-0.127	(0.813)	0.263	(0.944)
Session FE	Y		Y		Y		Y		Y	
Log-Likelihood	-862.34		-899.76		-832.17		-834.57		-837.49	
Prob > chi squared	0.011		0.154		0.037		0.000		0.225	
Observations	588		588		588		588		588	
Uncensored observations	174		202		188		177		173	
Number of subjects	98		98		98		98		98	

Note: Standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels.

Table 4: RE Tobit Regression: Non-continuous Personality Rankings

	Dependent Variable: Contribution to the Public Good									
	(1) Agreeableness		(2) Openness		(3) Extraversion		(4) Neuroticism		(5) Conscientiousness	
Group 2 (Ranks: 6-9)	-0.496	(0.974)	0.063	(0.767)	-1.299*	(0.749)	-0.055	(0.919)	0.039	(0.914)
Group 3 (Ranks: 10-14)	-2.753***	(0.953)	-1.951***	(0.707)	-0.470	(0.680)	0.735	(0.821)	-0.540	(0.884)
Personality distance	0.515	(1.375)	1.167	(0.846)	-1.100**	(0.523)	-1.940***	(0.696)	-0.523	(0.885)
Round	-0.687***	(0.213)	-0.279*	(0.167)	-0.434***	(0.160)	-0.669***	(0.198)	-0.076	(0.201)
Extraversion	0.442	(1.102)	0.035	(0.980)	-0.212	(0.850)	0.034	(0.894)	0.030	(1.027)
Openness	-0.734	(1.761)	-0.719	(1.564)	-1.608	(1.356)	-1.285	(1.422)	0.792	(1.642)
Conscientiousness	-2.773*	(1.626)	-2.375	(1.452)	-3.209**	(1.260)	-2.091	(1.293)	-3.554**	(1.516)
Neuroticism	-0.962	(1.280)	-0.437	(1.131)	-2.156**	(0.962)	-2.216**	(1.041)	-2.087*	(1.171)
Agreeableness	3.828	(2.457)	3.295	(2.134)	2.116	(1.862)	2.693	(1.952)	1.174	(2.231)
Female	1.564	(1.822)	2.197	(1.629)	2.655*	(1.418)	4.498***	(1.506)	4.905***	(1.772)
# of previous experiments	-0.590	(1.030)	-0.782	(0.924)	0.415	(0.775)	-0.135	(0.813)	0.252	(0.945)
Session FE	Y		Y		Y		Y		Y	
Log-Likelihood	-861.64		-898.17		-830.85		-834.52		-837.45	
Prob > chi squared	0.012		0.109		0.026		0.000		0.275	
Observations	588		588		588		588		588	
Uncensored observations	174		202		188		177		173	
Number of subjects	98		98		98		98		98	

Note: Standard errors are in parentheses. ***,**,* denotes statistical significance at the 1%,5%, and 10% levels.

Table 5: RE Tobit Regression: Predictors of Cooperative Behavior

	Dependent Variable: Contribution to the Public Good					
	(1)		(2)		(3)	
<i>Personality Measures</i>						
Extraversion	0.239	(0.895)	0.407	(0.861)	0.418	(0.795)
Openness	-1.203	(1.425)	-1.146	(1.371)	-1.001	(1.266)
Conscientiousness	-3.029**	(1.325)	-3.171**	(1.285)	-2.995**	(1.185)
Neuroticism	-1.567	(1.023)	-1.527	(0.983)	-1.507*	(0.908)
Agreeableness	3.533*	(1.969)	3.440*	(1.901)	3.249*	(1.755)
<i>Strategy</i>						
1 period lag (Public good)	-	-	-0.168***	(0.035)	-0.152***	(0.035)
2 period lag (Public good)	-	-	-	-	-0.215***	(0.035)
<i>Expectations</i>						
Treatment A • partner's rank	-0.217***	(0.085)	-0.203**	(0.087)	-0.215**	(0.087)
Treatment B • partner's rank	-0.244***	(0.082)	-0.232***	(0.083)	-0.225***	(0.083)
Treatment C • partner's rank	-0.011	(0.085)	-0.009	(0.086)	-0.031	(0.086)
Treatment D • partner's rank	0.109	(0.086)	0.130	(0.088)	0.097	(0.088)
Treatment E • partner's rank	-0.131	(0.086)	-0.103	(0.087)	-0.096	(0.087)
<i>Personality Distance</i>						
Treatment A • personality distance	-0.026	(0.977)	-0.193	(1.032)	0.085	(1.083)
Treatment B • personality distance	0.922	(0.845)	0.890	(0.854)	0.742	(0.854)
Treatment C • personality distance	-1.142**	(0.571)	-0.920	(0.577)	-0.918	(0.572)
Treatment D • personality distance	-1.902***	(0.594)	-1.825***	(0.600)	-1.646***	(0.596)
Treatment E • personality distance	0.208	(0.659)	0.132	(0.665)	-0.168	(0.656)
<i>Other Controls</i>						
Round	-0.432***	(0.088)	-0.429***	(0.092)	-0.441***	(0.093)
Female	3.691**	(1.479)	3.865***	(1.430)	3.760***	(1.322)
# of previous experiments	-0.265	(0.827)	-0.268	(0.798)	-0.265	(0.737)
Treatment FE	Y		Y		Y	
Ordering FE	Y		Y		Y	
Session FE	Y		Y		Y	
Log-Likelihood	-4,183		-4,013		-3,853	
Prob > chi squared	0		0		0	
Observations	2,940		2,856		2,772	
Uncensored observations	914		878		852	
Number of subjects	98		98		98	

Note: Standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5%, and 10% levels. Order fixed effects are used to control for the progression of treatments and are in effect another type of duration control on subject's experience. Personality traits of subjects are measured on a Likert Scale between 0 and 5. The lag in play is defined as the level of public good provided in the previous period. Treatment fixed effects interacted with partner's rank control for the expectations of cooperative behavior based on perceptions of personality

Table 6: Correlation Matrix of Personality Traits

	Agreeableness	Openness to Exp.	Conscientiousness	Extraversion	Neuroticism
Agreeableness	1	-	-	-	-
Openness to Exp.	0.1801	1	-	-	-
Conscientiousness	0.3508	-0.0031	1	-	-
Extraversion	-0.0403	0.0743	0.1858	1	-
Neuroticism	-0.1940	0.0046	-0.3588	-0.1563	1

Table 7: Preferences for Information

Chosen Trait	Frequency	Percentage
Agreeableness	100	40%
Openness to Experience	39	15%
Conscientiousness	50	20%
Extraversion	27	11%
Neuroticism	36	14%
Total	252	100%

Note: These frequencies are taken from the 3rd Stage of the experiment where subjects chose which trait ranking to observe.

Appendix A: Instructions¹¹

Welcome to an experiment about the economics of decision making! Carefully read along with these instructions and feel free to ask the administrator any questions you have. However, please do not communicate with the any other participants at any time in the experiment.

In this experiment you will be paid \$10 for your participation and additional money based on your performance in the game. Any money earned during the experiment will initially be recorded as experimental dollars. At the end of this experiment, we will convert your experimental dollars into actual U.S. dollars that will be given to you as you leave the lab. The more experimental dollars you earn the more actual U.S. dollars you will receive at the end of the experiment. At the end of the experiment, your earnings will be converted at a rate of \$1 US dollars for \$20 experimental dollars. Throughout the game you will be informed about how much money you have made so far. At the end of the experiment, the total amount in this account will be added to the \$10 participation pay and you will be paid the total amount of money upon leaving.

Break:

First, you will complete a brief questionnaire. Your options are “strongly disagree”, “disagree”, “neutral”, “agree”, and “strongly agree”. For instance, a choice of “strongly disagree” means that you disagree a lot with the statement, while a choice of “strongly agree” means that you agree a lot with the statement.

After they finish the Big Five Inventory:

You are about to engage in an economic decision making experiment. In each round you will be paired with another, anonymous participant, which changes randomly every round. How much money you earn depends on your own choice and on the choice your partner.

You will participate in a number of rounds in this experiment. Each round is independent, meaning that decisions during a round do not affect the future rounds in any way. The only value that gets carried over across rounds is your cumulative profit, which will be used to calculate your cash earnings at the end of the experiment.

Break:

In this game you will have the option to remove money from a common fund and place that money in an individual fund. The common fund starts out with 20 units in it. You can take up to 10 units out of the common fund and into your individual fund. The individual fund will return money to you at a rate of \$0.75 for each unit deposited into it. However, units left in the common fund by you and your partner

¹¹ All text in bold and italics are for the reader to follow when the experiment moved forward to a different screen or a handout was provided to subjects. The information that was handed out for reference is indented.

will return money to **both** you and your partner at \$0.50 per unit in the common fund.

Once you have made your decision, neither of you will ever be able to affect each other's payouts in later parts of the experiment.

After each decision, you will be assigned a new partner and you will repeat the decision with the new partner.

Once you have completed all of the rounds, you will be debriefed about the experiment. As you leave the lab you will be paid based on the experimental dollars you earned in the experiment.

On their own sheet:

We will now give you some examples of the game. If any of them are confusing please raise your hand and ask for clarification.

Ex. 1. Say you remove 10 units from the common fund and your partner removes 0 units from the common fund.

You would earn \$7.50 in your individual fund and \$5 from the common fund, earning a total of \$12.50. Your partner would earn \$5 during this round. In total \$17.50 is earned by you and your partner

Ex. 2. If you removed 0 units from the common fund and your opponent removed 0 units from the common fund you would both earn \$10. In total \$20 is earned by you and your partner.

Ex. 3. If you both remove 10 units from the common fund then you would both earn \$7.50. In total \$15 is earned by you and your partner.

Break:

Now you're going to play 4 practice rounds just to become familiar with the game. Your results in these rounds will not affect how much money you receive at the end of the experiment.

When they finish the practice rounds:

The practice rounds are now over. The decisions you make now WILL affect the payout you receive at the end of the experiment.

Once they finish the practice rounds:

At the beginning of this experiment you took a questionnaire which rates your responses based on personality traits. One of those traits was Agreeableness.

We ranked everyone in the experiment in terms of how they scored on agreeableness and have provided the ranking of your partner(s) to you in the next rounds. For example: if your partner has a rank of "1", they received the highest score in terms of agreeableness out of everyone taking the experiment now.

These rankings are determined by the responses to the questionnaire and not your decisions during this experiment.

To interpret the rankings of Agreeableness: 1 is the highest rank, 14 is the lowest rank.

High ranking individuals tend to more be good natured, sympathetic, forgiving, and courteous.

Low ranking individuals tend to more be critical, rude, harsh, and callous.

High scorers in openness tend to be original, creative, curious, complex.
Low scorers tend to be conventional, down to earth, narrow interests, uncreative.

Your partner's openness rank out of everyone in the experiment now: 2
There are this many subjects in the experiment right now: 2
How much you can invest in your individual fund: 10
How much you will invest in your individual fund:

OK

Screenshot of decision screen. This is an example- in the actual experiment there were 14 subjects. The text reads: line 1: “Your partner’s openness rank out of everyone in the experiment now:” line 2: “There are this many subjects in the experiment right now:” line 3: “How much you can invest in you individual fund:” line 4: “How much you will invest in your individual fund:”

Next treatment:

Extraversion Definition:

We also ranked everyone in the experiment in terms of how they scored on extraversion and have provided the ranking of your partner(s) to you in the next rounds. To interpret the rankings of Extraversion: 1 is the highest rank, 14 is the lowest rank.

High ranking individuals tend to be more sociable, friendly, fun loving, and talkative.

Low ranking individuals tend to be more introverted, reserved, inhibited, and quiet.

Next treatment:

Neuroticism Definition:

We ranked everyone in the experiment in terms of how they scored on neuroticism and have provided the ranking of your partner(s) to you in the next rounds.

To interpret the rankings of Neuroticism: 1 is the highest rank, 14 is the lowest rank.

High ranking individuals tend to be more nervous, high-strung, insecure, and worrying.

Low ranking individuals tend to be more calm, relaxed, secure, and hardy.

Next treatment:

Openness Definition:

We ranked everyone in the experiment in terms of how they scored on openness and have provided the ranking of your partner(s) to you in the next rounds.

To interpret the rankings of Openness: 1 is the highest rank, 14 is the lowest rank.

High ranking individuals tend to be more original, creative, curious, and complex.

Low ranking individuals tend to be more conventional, down to earth, narrow interests, and uncreative.

Next treatment:

Conscientiousness Definition:

We ranked everyone in the experiment in terms of how they scored on conscientiousness and have provided the ranking of your partner(s) to you in the next rounds.

To interpret the rankings of Conscientiousness: 1 is the highest rank, 14 is the lowest rank.

High ranking individuals tend to be more reliable, well-organized, self-disciplined, and careful.

Low ranking individuals tend to be more disorganized, undependable, and negligent.

Stage 3:

In this part of the experiment you are going to have access to one of the five indicators of your partner. You will get to choose which indicator you want to see for each round. These indicators are:

Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.



Screenshot of option to choose the personality trait ranking.

Here are the definitions of the indicators:¹²

Openness to Experience/Intellect-High ranking individuals tend to be more original, creative, curious, and complex; Low ranking individuals tend to be more conventional, down to earth, narrow interests, and uncreative.

Conscientiousness- High ranking individuals tend to be more reliable, well-organized, self-disciplined, and careful; Low ranking individuals tend to be more disorganized, undependable, and negligent.

Extraversion-High ranking individuals tend to be more sociable, friendly, fun loving, and talkative; Low ranking individuals tend to be more introverted, reserved, inhibited, and quiet.

Agreeableness-High ranking individuals tend to be more good natured, sympathetic, forgiving, and courteous; Low ranking individuals tend to be more critical, rude, harsh, and callous.

Neuroticism-High ranking individuals tend to be more nervous, high-strung, insecure, and worrying; Low ranking individuals tend to be more calm, relaxed, and secure

¹² A handout was also provided with these definitions for reference.

