



Preliminary results for an economic exchange game designed to measure of an aspect of antisocial behavior



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ABSTRACT

This study provides preliminary evidence for an economic exchange game (Thieves' Game), to measure the effects of a lack of guilt or remorselessness on behavior. The study examined the relationship between performance in the Thieves' Game, antisocial personality traits, and self-report of guilt. The sample was composed of 169 community volunteers. Points stolen in the Thieves' Game, male gender, Machiavellianism, Neuroticism, lower Agreeableness, lower Conscientiousness, and lower concern over harming others, were all found to correlate with antisocial traits. When these significant associations were entered into a hierarchical linear regression, with gender, Machiavellianism, Neuroticism, Agreeableness, Conscientiousness, and concern over harming others entered in the first step and Thieves' Game performance entered in the second step, the Thieves' Game was a significant predictor and was responsible for a statistically significant *R-squared change*. In a second set of analyses designed to assess the relationship between guilt and stealing behavior in the Thieves' Game, a linear regression using self-report of guilt to predict stealing behavior while controlling for the effects of demographics and personality traits demonstrated that self report of experienced guilt was the only significant predictor of stealing behavior.

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1. Introduction

How do researchers and clinicians accurately assess the behaviors which participants and patients have a reason to conceal? This is likely one of the oldest questions in psychological, personality, forensic and medical research and practice. Certain diagnoses such as substance use disorders, sexual paraphilia, and undesirable personality traits (e.g., antisocial behavior) are universally underreported (Black, 2013; Delaney-Black et al., 2010; Heckert & Gondolf, 2000; Kroner, Mills, & Morgan, 2007; Stockwell, Zhao, & Macdonald, 2014). This underreporting not only skews research findings (Schuler, Lechner, Carter, & Malcolm, 2009), but also makes clinical assessment difficult and treatment complicated. Individuals may be pressured to withhold information for a variety of reasons including the threat of stigma, fear of legal action, and fear over compromised medical care (Inzlicht & Kang, 2010; Shantz & Latham, 2012; Stier & Hinshaw, 2007; Udry, Gaughan, Schwingl, & Van Den Berg, 1996). A variety of measures and techniques have been developed to improve the accuracy of assessment including measures of response validity built into questionnaires (e.g., MMPI-II) measures of social desirability (Marlowe Crown) or the

tendency to deny behaviors of which society disapproves, and modifying interview styles to be less judgmental and more patient empowering. Utilization of biochemical verification to test for drug use and accessing criminal records can improve accuracy of assessment; however, these techniques are intrusive, time consuming, and not always possible or ethical. Developing techniques to more accurately assess unreported behaviors and symptoms is a goal of accurate assessment for both research and clinical purposes.

The utilization of economic exchange games as a means of assessment is one potential avenue for improving the measurement of underreported symptoms. Economic exchange games have been used to study constructs ranging from reciprocity (i.e., Prisoner's Dilemma) to trust (i.e., the Trust Game) to fairness (i.e., the Ultimatum Game). These paradigms represents an advantage over more traditional paper and pencil assessments in terms of ecological validity, meaning that the behavior in these games tends to generalize well outside the laboratory and appear to capture societal norms of behavior (Henrich et al., 2001; Henrich et al., 2010), patterns of decision making associated with culture (Herrmann, Thöni, & Gächter, 2008; Khadjavi & Lange, 2013) and patterns of social cognition which have been linked to both clinical and normal personality (Ben-Ner, Kramer, & Levy, 2008; Clark, Zyambo, Li, & Cropsey, 2016; King-Casas et al., 2008; Sharp, 2012). This greater ecological validity is obtained because economic exchange

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games do not rely on self-report of past behaviors which are generally effective (Darke, 1998; Meyer et al., 2001), but can be problematic when complicated constructs (e.g., personality and substance abuse) are being measured or when accurate self-report exposes individuals to unnecessary risk or stigma (Clark et al., 2016; Ganellen, 2007; Klonsky, Oltmanns, & Turkheimer, 2002). Economic exchange games (e.g., the Public Goods Game, the Prisoner's Dilemma, the Ultimatum Game, the Dictator Game) require participants to solve social dilemmas involving other participants (e.g., to punish a non-cooperator or not punish a non-cooperator) in exchange for real money. The participants interact via a computer with a person (or a computer program they are lead to believe is another person) that they cannot see, and the choices they make are reflected in the money they earn for participating. Thus, both the social dilemma they face and the resulting consequences are real as opposed to hypothetical. When a participant donates money to another participant during an experiment they are in fact giving real money to that person. The data produced by these paradigms is not a self-report of what someone believes they would do, but rather these data indicate a choice which has actually been made. These paradigms have demonstrated their validity in the assessment of social behavior within mental disorders such as depression and anxiety disorders (Harlé, Allen, & Sanfey, 2010; Scheele, Mihov, Schwederski, Maier, & Hurlmann, 2013; Sripada et al., 2009; McClure et al., 2007). These paradigms have also been used to assess patterns of social cognition associated with antisocial personality traits in adults and adolescents with externalizing problems, which makes them of interest to our current article, because antisocial traits are typically considered socially undesirable and are often more difficult to assess through self-report measures (Koenigs, Kruepke, & Newman, 2010; Rilling et al., 2007; Sharp, Ha, & Fonagy, 2011; Sharp, 2012).

Antisocial Personality is characterized by heightened levels of uncooperative behavior, a lack of inhibition, a low concern for the wellbeing of others, impulsivity, a lack of empathy, and a diminished capacity to feel guilt and shame (American Psychiatric Association, 2013; Black, 2013; Simonoff et al., 2004). In addition to heightened levels of impulsiveness, and decreased levels of inhibition the social impairment is broad and often linked to incidence initiating incarceration, conflicts, and peer rejection (Black, 2013; Simonoff et al., 2004). Evidence of social impairment is demonstrated by a diminished concern for the wellbeing of others, a diminished concern for harming others, less concern over whether others are treated fairly, an inability to empathize with others' suffering, and high levels of neuroticism (Aharoni, Antonenko, & Kiehl, 2011; Glenn, Iyer, Graham, Koleva, & Haidt, 2009; Miller & Eisenberg, 1988). Additionally, the construct of Machiavellianism or tendency to use others for one's own gain has been linked to antisocial personality (McHoskey, 2001; McHoskey, Worzel, & Szyarto, 1998) and due to this studies focus on social decision this construct may be of great importance. Not only are these traits socially undesirable, but their very nature (e.g., the desire to manipulate and deceive others) impeded accurate assessment of social behavior.

As previously indicated, because economic exchange games do not require self-report, but instead take samples of behavior during interactions with others, they would seem a logical tool for the assessment of antisocial behavior, and the literature has confirmed their ability to measure the expected deficits associated with antisocial behavior in both clinical adult samples (Koenigs et al., 2010; Mokros et al., 2008; Rada, De Lucas Taracena, & Rodriguez, 2003; Rilling et al., 2007) and non-clinical adult samples (Gillespie, Mitchell, Johnson, Dawson, and Beech, 2013; Vieira et al., 2013). Economic exchange games have recently been used to assess many of the aspects of antisocial behavior. For example, the Prisoner's Dilemma has been used to study reciprocity, and this data has generally confirmed that individuals exhibiting antisocial traits have a tendency towards defection (Mokros et al., 2008; Rada et al., 2003; Rilling et al., 2007; Curry, Chesters, Viding, and 2011). The Ultimatum Game has been used to study fairness and demonstrated greater acceptance of unfairness (Osumi & Ohira, 2010; Vieira et al.,

2013). The Dictator Game has been used to study generosity and shown that antisocial traits are associated with less generous offers (Koenigs et al., 2010). The Trust Game has been used to assess trust levels in adolescents with externalizing behaviors (e.g., frequent fighting, rule violations, acting out, aggression, poor relationships) and the results have demonstrated that these youth are less trustworthy than their peers (Sharp et al., 2011). Finally, delayed discounting has been used to study impulsivity and demonstrated a diminished capacity to delay social gratification (Sharp et al., 2012). Thus, economic exchange games seem to be a valid measure of many of the social aspects of antisocial traits as the results of experiments that utilize these paradigms fit with the general literature on this personality construct. Antisocial personality is multidimensional and there exist economic exchange games to study many of the aspects of antisocial behavior, there are still other aspects of antisocial behavior for which no economic exchange games have been designed to measure.

A lack of guilt or remorse is core feature of antisocial personality and there currently exists no game for measuring the effect of guilt on behavior. The goal of the current study was to gather preliminary data validating an economic exchange game, which was designed to assess the impact of guilt on behavior. The authors Battigalli and Dufwenberg (2007) described a game designed to elicit guilt in its players. The authors did not specify a name for this game, but it will be called the Thieves' Game throughout this paper for ease of explanation because it involves stealing points from other players. In the Thieves' Game, points are accumulated as the rounds progress and the individual who is vulnerable to be stolen from rotates each round. The game is anonymous so people do not know who they are stealing from or who is stealing from them. At the end of the game the participants are shown how many points they earned, how many they stole, how many points were stolen from them, and they are given the opportunity to return the points they stole to their owners. The paradigm is designed to assess guilt, with the assumption that individuals who feel more guilt will return the points they stole. The two hypotheses of the study are that, 1) points stolen and kept in the Thieves' Game will be strongly associated with antisocial traits as measured by the Personality Assessment Inventory even when known correlates of antisocial behavior (e.g., race, Machiavellianism, five-factor personality) are controlled for. 2) That higher self-report of guilt during the Thieves' Game will be associated with participant's return of more points to their owners in the Thieves' Game.

2. Method

2.1. Sample

The study sample was composed of 214 participants, recruited from the community via flyers placed throughout the medical and academic campus where the study took place. Participants responded to the flyers and called the study office to be screened and schedule an appointment. They were excluded if they were younger than 19 years old (legal age of consent in the state where the study took place), could not use a computer, could not read English, or could not arrange to come to the session via transportation problems. Participant's data were excluded from analyses if any of their scores for the validity indices of the Personality Assessment Inventory (PAI; Morey, 1991) exceeded two standard deviations from the mean of the PAI's clinical norms (i.e., Inconsistency ≥ 73 Infrequency ≥ 75 , Negative Image Management ≥ 92 , Positive Image Management ≥ 68). Profiles with heightened validity scores at this level are typically not considered valid and are indicative of reading difficulty, random responding, exaggerated responding, under reporting of symptoms or a response pattern that invalidates the profile (Morey, 2003). A total of 45 participants were dropped due to elevated validity scales on the PAI. There were no differences between the two groups in terms of age ($F = 0.000$, $p = 0.988$), antisocial traits ($F = 3.05$, $p = 0.082$) or gender ($X^2 = 0.44$, $p = 0.507$). The group

which provided invalid data was more likely to self-identify as African American ($X^2 = 16.60, p = 0.002$) and report being less educated ($X^2 = 18.12, p = 0.006$). There were also differences in economic game performance for the Thieves' Game ($F = 5.69, p = 0.018$). The group with invalid data kept more points in the Thieves' Game ($M = 5.13, SD = 3.84$ versus $M = 3.28, SD = 4.38$). The sample of 169 individuals used in the current study included 75 (44.4%) White, 83 (49.1%) Black, 2 (1.2%) Hispanic, 5 (3.0%) Asian/Pacific Islander, and 4 (2.4%) Bi-racial participants. The average age of this sample was 39.9 ($SD = 12.0$; $Range = 19$ – 66) years. This sample contained 77 (45.6%) male and 92 (54.4%) female participants.

2.2. Measure

The Personality Assessment Inventory (PAI; Morey, 1991) is a 344-item questionnaire with 22 non-overlapping scales that assess psychopathology as well as personality traits and other constructs relevant to treatment. Responses are indicated on a four-point Likert-type scale with the response options: "false, not at all true", "slightly true", "mainly true", and "very true". The 22 scales included 4 validity scales, 11 clinical scales, 5 treatment scales, and 2 interpersonal scales. The PAI was used to measure antisocial personality traits.

The International Personality Item Pool Big-5 (IPIP Big-5; Johnson, 2014) is based on the NEO Personality Inventory—Revised (NEO PI—R; Costa & McCrae, 1992). The IPIP Big-5 is 120 items long and designed to assess five broad domains of personality: Extroversion, Neuroticism, Agreeableness, Conscientiousness, and Openness. It uses a 5-point Likert-type scale that requires participants to rate how accurately a statement describes their behavior. The scale anchors for the statements are "very inaccurate", to "very accurate". Evidence of measurement validity is an average correlation of 0.82 with the corresponding big five scales of the NEO PI-R (Costa & McCrae, 1992) ranging from 0.76 for Agreeableness to 0.87 for Neuroticism (Johnson, 2014). Alpha reliabilities for the IPIP Big-5 subscales of Neuroticism, Extroversion, Openness, Agreeableness, and Conscientiousness, in the current sample were 0.87, 0.81, 0.73, 0.84, and 0.89 respectively.

The Moral Foundations Questionnaire (MFQ; Graham et al., 2011) was designed to study the five foundations of moral foundations theory: harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, and purity/sanctity. In this questionnaire, participants were required to rate how relevant a statement is to decisions of morality (16 items), and their agreement of the statements (16 items) using a Likert-scale ranging from zero to five. The first 16 questions used a 6-point scale anchored at "not at all relevant" and "extremely relevant". The last 16 use a 6-point scale anchored at "strongly disagree" to "strongly agree". Scores represent the average rating for each Foundation. Evidence of measurement validity comes from correlations with other measures of morality (Baril & Wright, 2012) and prediction of political orientation as well as stance on socially relevant moral issues (Graham, Haidt, & Nosek, 2009; Koleva, Graham, Iyer, Ditto, & Haidt, 2012). Alpha reliabilities for the MFQ subscales of harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, and purity/sanctity in the current sample were 0.76, 0.74, 0.49, 0.71 and 0.79 respectively.

The Short Dark Triad (SD3; Jones & Paulhus, 2014) is a 27-item self-report questionnaire measuring Narcissism, Machiavellianism, and Psychopathy. Narcissism best predicts ego-promoting outcomes; Machiavellianism best predicts outcomes predicted by a strategic orientation; Psychopathy best predicts reckless anti-social behavior (Jones & Paulhus, 2014). Participants were required to rate their agreement of each statement using a 5-point Likert-type scale, with response options anchored at "strongly disagree", and "strongly agree". Evidence of measurement validity comes from correlations with other self-report measures of these traits as well as correlations with observer reports of personality (Jones & Paulhus, 2014). Alpha reliabilities for the SD3 subscales of narcissism, Machiavellianism, and psychopathy in the current sample were 0.73, 0.61, and 0.79 respectively.

2.3. Economic exchange game

The Thieves' Game (Battigalli & Dufwenberg, 2007) was modified from the author's original human versus human design so that it could be administered in a computerized format and fit with the cover story of playing against anonymous online opponents who were also involved in research studies. The participant was in fact playing against a computer. The instructions were included in the tutorial presented before the game, and the tutorial walked the participant through the rules of the game. The tutorial could be repeated as many times as the participant wanted and a research assistant was available in the room (but not in a place where she could see the screen or participant's actions), in case the participant still had questions. The game is a four player, four round game where players automatically accumulate three points per round (see Fig. 1 for screenshots of the Thieves' Game). Each round three of the players can steal points and one of the players is vulnerable to have points stolen from him. The player who is vulnerable to be stolen from rotates each round. If no one steals from the participant, he will accumulate 12 points automatically. If multiple players chose to steal from the vulnerable player during the same round then the points earned that round are divided between the thieves equally. For example, if all three players who have the opportunity to steal chose to steal from the vulnerable player, since every player (including the vulnerable player) earns three points every round, then each thief will receive one of the vulnerable player's points. The participant can steal a total of 9 points if he chose to steal every round in which he was eligible to steal and no one else chose to steal. Therefore, a participant can have a total of 21 points if they steal every round and no one else steals at all. During the game there is no indication if the participant has been stolen from or if another participant stole in one of the same rounds in which he stole. After the game a screen is presented indicating how many points the participant stole and how many points the participant had stolen from him. The participant is then given the option of returning some, all, or none of the points he stole to the other players. Since our protocol was intended to test the effects of guilt on behavior none of the computer confederates stole any points. As a result, when the participant came to the last screen if they had stolen points they would realize that they had been the only one stealing points. The variable of interest was the amount of points that were stolen and not returned.

2.4. Procedure

After giving consent to participate in the study and given an overview of what the study would entail, the participants were seated at a computer and took the PAI online through the Pearson website. The PAI was given first so that the research assistant would be able to examine the results while the participant was completing the rest of the study. Specifically, the research assistant examined the PAI results for evidence of current suicide risk, and in cases where evidence of current ideation was found, a licensed psychologist was alerted, and intervened. The current study was part of a larger study assessing mental health and performance in economic exchange games. The participants then played the economic exchange games. Before playing the games, a research assistant read a brief instructions and informed the participants that were read they were playing against other individuals via an online network. The participants had recently completed the PAI online and the authors of the experiment did their best to design the software to look like an online game. There was also a brief tutorial built into each game that explained how the game worked, what the rules were, and how points were earned. The participant clicked a continue button to advance through the tutorial and the participant could choose to repeat the tutorial if they wished. Both the instructions and the tutorial explained to the participant they were playing online with other people. They were in fact playing against a computer based strategy. Playing against a computer was necessary to elicit guilt in the Thieves' Game. Deception is not used in the tradition literature on economic exchange



Note: This figure shows 3 screen shots from the Thieves' Game. The first image is the introductory screen. The second image is a screen showing the option to steal from a vulnerable player. The third image is a screen that allowed the participant to return stolen points. There are multiple other images including a loading screen and a feedback screen.

Fig. 1. Screen shots of Thieves' Game.

games and economic research; however, deception is commonly used to standardize the assessment procedures when psychological researchers use economic exchange games in an effort to assess personality traits or psychopathology (Betz, 1991; Eiser & Bhavnani, 1974; Harlé et al., 2010; Leite, 2011; Osumi & Ohira, 2010). All participants were debriefed immediately following participation and it was explained to them that they were playing against a computer.

After completing the PAI and the economic exchange games the participants then filled out the International Personality Item Pool Big-5, the Moral Foundations Questionnaire, and the Short Dark Triad. The participants also filled out a basic demographics form, and a questionnaire developed by the authors specifically for this study to assess the participants' emotional reactions to the games. The questionnaire was titled, "Reaction to Games," and utilized a 7-point Likert-type response format, using options ranging from "very little" to "a lot" when asking about the extent of emotion experienced. The questionnaire required participants to rate their own and their partner's performance in the games using choices ranging from "not very well" to "very well." The questionnaire provided a brief description of the Thieves' game referring to it as "Game 8." The number 8 was a randomly chosen number, which was believe to a more neutral label than the Thieves' Game. This was done because non-neutral labels of games serve as cooperation/competition ques. which exert an influence performance (Lieberman, Samuels, & Ross, 2004). The question of interest for current study was, "After playing game 8 how guilty did you feel?" The completed all the questionnaires in the lobby of the floor where the study took place and returned to meet with the research assistant when they were finished. Each participant was paid according to their performance (points earned) in the games. The pay ranged from \$30.00–\$40.00. A minimum of \$30.00 was given to satisfy departmental expectations for payment allocated to research participants when mental health variables (i.e., antisocial traits) are studied. This study was approved by the presiding institutional review board; informed consent was obtained from each participant prior to the experiment.

2.5. Analysis

Antisocial personality was measured via the antisocial traits scale of the Personality Assessment Inventory. It should be noted this this scale provides a continuous measure of Antisocial Personality as opposed to a diagnosis of Antisocial Personality Disorder. Univariate correlations between antisocial personality and known correlates of antisocial personality were determined via Pearson Correlations. The correlation between antisocial traits and stealing in the Thieves' Game was also calculated. The variables demonstrating a significant univariate correlation were then entered into a hierarchical linier regression with the known

demographic and personality constructs entered in step one and the Thieves' Game results entered in step two.

The second set of analyses sought to determine if self-report of guilt was linked to keeping points in the Thieves' Game. Guilt was entered into a regression to control for the effects of both demographics (i.e., age, race, and gender) and personality variables which have been empirically linked to antisocial behavior (i.e., Machiavellianism, psychopathy and the five factor traits).

3. Results

The correlations between antisocial traits as measured by the PAI and known associations of antisocial behavior can be seen in Table 1. The significant correlations included male gender, Machiavellianism, less concern over harming others, Neuroticism, lower levels of Agreeableness, and lower levels of Conscientiousness. Age, race, concern over fairness, and the personality traits of extroversion and openness were not associated with antisocial traits. The number points stolen and kept in the Thieves' Game was positively correlated with antisocial traits.

When the significant associations were entered into a hierarchical linier regression with antisocial traits as the criterion variable (the results are shown in Table 2, the results for all of the participants including those with invalid data are shown in the Appendix A). The first step produced a significant *R-Squared* of 0.41 ($p < 0.001$). The significant associations included gender, agreeableness, and conscientiousness. Machiavellianism, Harm and Neuroticism were non-significant. The Thieves' Game was force entered into the second step of the model. The inclusion of the Thieves' Game produced a new *R-Squared* of 0.43 indicating a significant *R-Square Change* ($R\text{-squared change} = 0.02, F$

Table 1
Descriptive statistics of the sample univariate associations between antisocial personality and predictor variables.

	Mean (SD) or N (%)	Pearson correlation	Sig. (2-tailed)
Gender (female)	92 (54.4%)	−0.39	<0.001
Race (white)	83 (49.1%)	0.14	0.071
Age	39.9 (12.0)	−0.10	0.213
Harm	3.8 (0.96)	−0.21	0.006
Fairness	3.7 (0.89)	−0.12	0.116
Machiavellianism	2.7 (0.68)	0.39	<0.001
Neuroticism	15.5 (3.7)	0.38	<0.001
Extroversion	20.2 (3.5)	0.13	0.093
Openness	19.5 (2.6)	0.10	0.185
Agreeableness	23.2 (2.9)	−0.55	<0.001
Conscientiousness	23.1 (3.4)	−0.53	<0.001
Thieves' Game	3.3 (4.4)	0.20	0.015

Note: This table includes the data for the 169 participants included in this study.

Table 2
Stepwise regression analysis predicting antisocial personality traits.

	<i>t</i>	<i>p</i>	β	<i>F</i>	<i>df</i>	<i>p</i>	<i>adj.R</i> ²
Model 1				17.21	6147	<0.001	0.39
Gender (female)	−3.3	<0.001	−0.22				
Machiavellianism	1.4	0.001	0.10				
Harm	0.12	0.159	0.01				
Neuroticism	0.57	0.905	0.05				
Agreeableness	−2.92	0.004	−0.26				
Conscientiousness	−2.81	0.006	−0.26				
Model 2				15.87	7146	<0.001	0.41
Gender (female)	−3.33	0.001	−0.22				
Machiavellianism	1.26	0.211	0.09				
Harm	0.14	0.892	0.01				
Neuroticism	0.55	0.587	0.05				
Agreeableness	−2.62	0.010	−0.23				
Conscientiousness	−3.08	0.003	−0.28				
Thieves' Game	2.23	0.027	0.14				

Note: The *N* = 169, *F* Change = 4.98, *R*² Change = 0.02.

Change = 4.98, *p* = 0.027). The significant associations in this new model included gender, agreeableness, conscientiousness, and points stolen in the Thieves' Game. Machiavellianism, Harm and Neuroticism remained non-significant.

Additionally we assessed the relationship between self-reported guilt following the Thieves' Game and returning points during the game in a linear regression controlling for age, gender, race, Machiavellianism, and five factor personality traits. The results of the significant regression ($F(10, 143) = 2.44, p = .010$) are shown in Table 3. When entered into a regression to control for demographics and personality traits, self-report of guilt was the only variable significantly associated with returning points. Thus, guilt appears to be a potential mechanism leading people to return points.

4. Discussion

Both hypotheses were supported by the data and these results provide promising preliminary evidence for economic exchange game that can be used to assess the lack of guilt which is characteristic of antisocial personality traits. A lack of guilt and other antisocial traits can be difficult to assess, because they are typically considered undesirable (Black, 2013; Heckert & Gondolf, 2000; Kroner et al., 2007). Economic exchange games offer several advantages over traditional self-report measures (Sharp et al., 2012) and may provide a paradigm to indirectly assess antisocial and other traits which participants may be inclined to underreport. Specifically, remorselessness or feeling a lack of guilt is one such trait, and the Thieves' Game developed by Battigalli and Dufwenberg (2007) may be a means of assessing the influence of guilt on behavior. In our study the Thieves' Game demonstrated an effect size comparable to other variables with a pre-established associations to antisocial traits, including: five factor personality variables, Machiavellianism, beliefs about harm and fairness, and gender. This was a

Table 3
Linear regression predicting points returned in the Thieves' game.

	<i>B</i>	<i>St. Error</i>	β	<i>t</i>	<i>p</i>
Gender (female)	0.53	0.52	0.08	1.02	0.311
Race (white)	−0.37	0.53	−0.06	−0.69	0.491
Age	0.01	0.02	0.02	0.24	0.815
Machiavellianism	0.12	0.40	0.03	0.29	0.776
Neuroticism	0.05	0.09	0.06	0.53	0.600
Extroversion	−0.10	0.09	−0.11	−1.14	0.255
Openness	0.07	0.11	0.06	0.69	0.490
Agreeableness	0.23	0.12	0.21	1.97	0.051
Conscientiousness	−0.02	0.10	−0.03	−0.22	0.824
Self-reported guilt	0.42	0.12	0.29	3.59	<0.001

Note: the *R*² = 146, *F* = 2.44, these results indicate the self-report of guilt was the only significant predictor of points returned in the Thieves' Game.

preliminary study of the game's capacity to measure the impact of guilt on performance. While there exist economic exchange games to assess a variety of other antisocial traits, guilt is an aspect of antisocial personality for which there is no current means of assessment via an economic exchange game. It needs to be recognized that while the Thieves' Game demonstrated a decent effect-size, and the *R-squared change* gained resulting from the addition of the Thieves' game was statistically significant, but represented a minimal change in effect-size. This likely is not an indictment of the utility of the Thieves' Game because we were not trying to directly predict antisocial traits with the Thieves' Game. We were assessing guilt, which is only an aspect of antisocial traits. The fact that the Thieves' Games was able to increase the explanatory power of the analysis above traditional measures of self-report assessment at a significant level speaks to its utility and its potential for future research.

Self-report of guilt following the Thieves' Game was the only significant predictor of returning points during the Thieves' Game. This finding suggests guilt as the mechanism of action leading people not to return the points they stole. This is finding is in alignment with the predictions of Battigalli and Dufwenberg (2007), who developed the Thieves' Game as a potential measure of the effect of guilt on behavior. Identifying guilt as a possible mechanism of action is crucial understanding the game's utility and establishing its usefulness as a measure of behavior. Guilt is certainly only one aspect of antisocial personality, antisocial personality has a myriad of components many of which are related and overlapping (Black, 2013). Further research is certainly needed, but the possibility that the game may help tease about these aspects of antisocial personality by isolating the impact of guilt on decision making speaks to its utility and represents a meaningful step forward in personality assessment.

There were several limitations to this study. First, while a significant literature speaks to the value of assessing personality traits on a continuous basis in normal populations, testing the validity of the Thieves' Game in a purely clinical population or comparing performance in a clinical population to that of a nonclinical population is necessary to further its value as an assessment tool. Second, one of the advantages of economic exchange games is this paradigm's capacity to assess physiological processes during the moment that a social decision is made. Examining skin conductance, testosterone levels, the effect of oxytocin or another mechanism of physiological change during the moment the participants make the decision to not return points is an opportunity better understand the process of guilt that was not utilized in this study. Third, it was the hypothesis of both the authors of this study and the developers of the Thieves' Game that the game measures the effects of guilt. While self-report of not feeling guilt was linked to keeping returning points, we did not assess for the effects guilt or explore other mechanisms of change as in-depth as we could have done. We relied on self-report to assess guilt which was not ideal given antisocial personality's association with deceptiveness. Future work should use a multimethod assessment approach to the measure of guilt.

In conclusion, this study provides the first preliminary evidence of an economic exchange game for the assessment of the effects of guilt on behavior. Performance in the Thieves' Game appears to measure remorselessness or a lack of guilt, which is an aspect of antisocial personality that is difficult to assess due to social desirability. Greater self-report of guilt was linked to returning a greater number of points in the Thieves' Game, and the Thieves' Game was shown to statistically provide incremental explanatory power in the identification of antisocial personality traits over what was captured by self-report measures. Thus, the Thieves' Game has shown potential as an assessment paradigm and merits further research in the study of guilt and antisocial behavior.

Conflict of interest

The authors have no conflicts of interest to declare.

Appendix A. Stepwise regression analysis predicting antisocial personality traits with valid and invalid PAI data

	<i>t</i>	<i>p</i>	β	<i>F</i>	<i>df</i>	<i>p</i>	adj. <i>R</i> ²
Model 1				23.74	6185	<0.001	0.42
Gender (female)	−3.89	<0.001	−0.23				
Machiavellianism	3.09	0.002	0.21				
Harm	0.27	0.791	0.02				
Neuroticism	0.12	0.132	0.12				
Agreeableness	−2.15	0.033	−0.18				
Conscientiousness	−2.49	0.014	−0.22				
Model 2				22.56	7184	<0.001	0.44
Gender (Female)	−3.90	<0.001	−0.23				
Machiavellianism	2.66	0.009	0.18				
Harm	0.42	0.672	0.03				
Neuroticism	1.42	0.157	0.11				
Agreeableness	−1.91	0.058	−0.15				
Conscientiousness	−2.99	0.003	−0.26				
Thieves' Game	3.03	0.003	0.17				

Note: The *N* = 214, this table presents the data for participants who provided both valid and invalid PAI profiles.

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