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The Influence of Opponent Strategy and Psychopathic Traits on Point Gains and Cooperation in the Iterated Prisoner's Dilemma

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THE INFLUENCE OF OPPONENT STRATEGY AND PSYCHOPATHIC TRAITS ON POINT GAINS AND COOPERATION IN THE ITERATED PRISONER'S DILEMMA

By

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Abstract

The Prisoner's Dilemma game is a paradigm used to model and measure social cooperation. Uncooperative behavior may be one manifestation of the unstable interpersonal functioning in psychopathy. I investigated the effect of opponent strategy as well as psychopathic traits of fearless dominance (FD) and impulsive antisociality (IA) on cooperation rates and total and competitive point gains in a sample of 177 undergraduates playing long, finitely iterated Prisoner's Dilemma games against computerized opponents who varied in their interpersonal styles from very harsh to very lenient. I analyzed rates of cooperation during each game, participants' total points gained, and the difference in points earned between participant and opponent (competitive point gain). These variables were analyzed across the experiment overall and across trials after either participant or computer cooperation or defection on the previous trial. Across the experiment overall, there was significantly less cooperation and total and competitive point gains in the second half compared to the first half of each opponent block of trials, there was a positive association with leniency of opponent strategy and cooperation and total and competitive point gains, and there was a negative association with inconsistent opponent conditions and total and competitive point gains. However, opposing patterns emerged for each when comparing after cooperation and defection on the previous trial. For psychopathy, there were no effects of computer opponent's strategy on these three variables. In the second half of each block of trials, those higher in FD tended to score more total points. Implications and future directions are discussed.

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Chapter 1: Introduction

The Influence of Opponent Strategy and Psychopathic Traits on Point Gains and Cooperation in the Iterated Prisoner's Dilemma

The Prisoner's Dilemma (PD; Luce & Raiffa, 1957) game is a social dilemma paradigm that is used to model and measure social cooperation. In a traditional PD, Player A is given the scenario in which they and a partner (Player B) were arrested for a crime. They are taken into separate rooms for interrogation without the possibility of communication and are given an opportunity to remain silent (cooperate) or testify against their partner (defect). A payoff matrix (see Figure 1) is given such that if both Player A and Player B remain silent (mutual cooperation), then each receives one year in prison. If both Player A and Player B testify against their partner (mutual defection), each receives three years in prison. If Player A testifies (defection) and Player B remains silent (cooperation), Player A receives zero years in prison and Player B receives five years in prison. If Player A remains silent (cooperation) and Player B testifies (defection), then Player A receives five years and Player B receives zero years in prison.

Traditional PD Game Payoff Matrix

Player $A_{(A)}$ / Player $B_{(B)}$	**Cooperation**	**Defection**
Cooperation	(R_A: 1, R_B: 1)	(T_A: 0, S_B: 5)
Defection	(S_A: 5, T_B: 0)	(P_A: 3, P_B: 3)

Figure 1. Payoff matrix of the traditional PD game framed as avoiding jail time.

However, because administering meaningful punishments to participants is difficult to do in ethical laboratory settings, PD games often involve gaining points or some other reward. Fortunately, results for PD games seem similar whether framed as rewards or punishments (de Heus, Hoogervorst, & Dijk, 2010). A true PD game requires that the greatest reward is for defection while the opponent cooperates (*T*), the second greatest reward is for mutual cooperation (*R*), the second smallest reward is for mutual defection (*P*), and the smallest reward is for cooperation while the opponent defects (*S*). This array of rewards ensures that defection is the most potentially rewarding option for an individual player. Iterated PD games must also have the points distributed such that $2*R > T + S$ to ensure that the most points allotted across participants is *R*, mutual cooperation.

Interdependence theory proposes that interdependent interactions are a combined function of three major influences: structural influences (e.g., the PD game, one-shot vs. iterated, finite vs. infinite iterated, gain-loss framing, payoff matrix, etc.), interpersonal influences (e.g., social dynamics, use of or reaction to an employed strategy, etc.) and individual difference influences (e.g., player motives, affect, personality, etc.; Van Lange, Joireman, Parks, & Van Dijk, 2013). This theory considers the transformation of the given structure by the players into a matrix of subjective outcomes that accounts for these influences and is more closely linked to real-world behavior. The "given matrix" is the short-term self-interest based on the given structure as well as the individual's needs and skills. The "effective matrix" accounts for interpersonal (i.e., weighing individual vs. mutual interests) and temporal (i.e., weighing short-term vs. long-term interest) concerns, long-term consequences of actions, individual differences, and cognitive/affective states (e.g., priming, mood, etc.). Features of the situation, interpersonal dynamics and demands, as well as the individual player differences can promote an array of behavioral motivations and outcomes (e.g., self-control, concern with future consequences, encouraging cooperation/defection, forgiveness, etc.; Van Lange et al., 2013). Players in PD games consistently battle the tension between the shorter-term competitive incentive of defection and long-term gains of cooperation.

Structural Influences

One-shot versus iterated PD. PD games can be either one-shot or iterated. In one-shot games, there is only one trial played against an opponent in a game paradigm. In a one-shot PD game, defection is the dominant strategy as it carries the highest reward whether the opponent cooperates or defects (Jurišić, Kermek, & Konecki, 2012). This structure could be used to investigate behavior when a relationship is brief and the opponent need not concern themselves with consequences of their actions in any continued interpersonal interactions. In iterated games, there is more than one trial with an opponent; thus, one's interactions on any trial besides the final one will theoretically affect the social interaction that occurs on subsequent trials. Iterated games better approximate real-world social situations such as interpersonal relationships, emotional responses to behavior, and manipulative or naïve strategies (Press & Dyson, 2012).

In an infinitely repeated iterated PD games, cooperative strategies are more successful (Jurišić et al., 2012) as mutual cooperation tends to develop over time (Barlow & Tsang, 2015) due to the contribution of several contextual mechanisms (e.g., direct reciprocity, indirect reciprocity, spatial selection, multilevel selection, kin selection; Rand & Nowak, 2013). In finitely repeated iterated PD games (i.e., set number of rounds with a known end) the dominant response is to always defect (Barlow & Tsang, 2015). There will eventually be a round without the possibility of retribution for defection and backwards induction unravels trials before it. Cooperation could afford a significant reward (e.g., R_A, R_B, see Figure 1) but carries with it risk (e.g., S_A, T_B) of the least rewarding outcome and does not allow for the possibility of the greatest individual reward (e.g., T_A, S_B). Given these risks and the potential benefit of a round without the possibility of retribution, defection is the dominant response even in these finitely repeated iterated PD games. Even so, individuals appear to perceive longer finite iterated PD games as infinite in games between 25-50 iterations (Barlow & Tsang, 2015) in which the most adaptive strategy is again cooperation given the reward potential for mutual cooperation and the contextual pressures that promote it.

Human versus computer interactions. Many researchers fail to address potential differences between human-human and human-computer interactions. However, recent experimental literature has shown that in a finitely repeated PD game participants tended to cooperate more with human opponents compared to robots yet they showed no significant difference in the amount of reciprocity between human and robot opponents (Sandoval, Brandstetter, Obaid, & Bartneck, 2016). This suggests that while human-human interactions may elicit more cooperation, the norm of reciprocity appears to be consistent across human-human and human-robot interactions supporting the valid use of human-computer interactions in finitely repeated PD games.

Interpersonal Influences

Strategy: Tit-for-tat. There is a vast literature on iterated PD games and a variety of ways to characterize strategy in such games. In Axelrod's (1980a, 1980b) classic studies, he conducted two round-robin style tournaments with leaders in game theory research from several disciplines who each entered a programmed strategy in an attempt to find the most successful one in the iterated PD. The winner (i.e., highest average score across rounds) of the tournaments was tit-for-tat (TFT; cooperates on the first trial then always copies the opponent’s move on the previous trial), which was subsequently considered the strategy that was most robustly successful in promoting social cooperation and represents the social norm of reciprocity. However, Axelrod emphasizes that TFT cannot be considered the most superior strategy as no rule can be considered best independent of the environment. Instead, he suggested that TFT appeared to be a robustly successful strategy across environments. Sandoval et al. (2016) also found that participants reciprocated and cooperated more with a TFT strategy compared to a random strategy in both human-human and human-computer interactions, further supporting Axelrod's assumption that TFT represents the social norm of reciprocity and can be applied to human-computer interactions as well. Additionally, this norm of reciprocity is often considered culturally universal though it has been shown to be stronger in some cultures (e.g., collectivistic cultures) than others (e.g., individualistic cultures; Brett & Kopelman, 2004; Shen, Wan, & Wyer, 2011).

Properties of successful strategies. Axelrod (1980a, 1980b) also proposed several properties of successful (i.e., based on most points earned) strategies in iterated PD games. First, *niceness* alone was found to distinguish between the high scoring from the low scoring strategies. A strategy is considered "nice" if it will not be the first to defect, or at least not before the last few moves. Additionally, nice strategies avoid unnecessary conflict by cooperating as long as the other player does (Axelrod, 1984). Another key property is *forgiveness*, which is defined as the strategy's tendency to cooperate in the trials after their opponent has defected. For example, TFT can be characterized as punishing for one move but then forgiving of an isolated defection as it returns to cooperation immediately after the opponent does. In other words, it forgives a single defection instead of punishing by continuing to defect. Another property is *provocability* which is defined as a strategy that immediately defects after their opponent defects when it is considered “uncalled for,” otherwise risking being taken advantage of. TFT is an example of a provocable strategy such that it will defect immediately following an opponent’s defection. Finally, *clarity* is another property of successful strategy such that the strategy’s behavior must be clear to allow the other player to adapt to that strategic pattern (Axelrod, 1984). If a strategy lacks clarity or is inconsistent, it is possible that the opponent will not be able to properly adjust their own strategy which may lead to unideal outcomes (e.g., defection spirals) for both players. In addition, Axelrod proposes that “the effectiveness of a particular strategy depends not only on its own characteristics, but also on the nature of the other strategies with which it must interact” (1980a, p. 21) and that an effective strategy must take into account of the entire dyadic history of interactions as they have developed from the beginning.

Criticisms of Axelrod’s tournaments and TFT. A recent review of iterated PD strategies (Jurišić et al., 2012) suggests that Axelrod’s basic properties for successful strategies appear to remain valid. However, recent literature has also criticized the findings regarding TFT as the most robust and successful iterated PD strategy such that it ignores past game history beyond the last trial, it can never “win” in any particular iterated PD game or gain a positive point difference, and is likely only successful when faced with a particular set of success criteria, payoff matrix, and tournament format (Rapoport, Seale, & Colman, 2015). Additionally, while TFT has been lauded as important for the evolution of cooperation, it does not necessarily appear to be an evolutionarily stable strategy in long-term iterations such that it is not immune to invasion by an initially rare alternative strategy (Lorberbaum, Bohning, Shastri, & Sine, 2002). In human interactions, noise/error and boredom (e.g., human participants achieving mutual cooperation for an extended period and then defecting to “see what happens”; Axelrod, 2012) come into play and game theorists have long proposed generosity (i.e., allowing some amount of opponent defections to go unpunished) as a successful way to cope with noise and prevent defection spirals (Wu & Axelrod, 1995). Generous strategies counter Axelrod's proposed property of provocability.

Stochastic strategies reflect an agent's tendency to decide based upon previous interactions as well as incorporate randomness and chance. Axelrod's tournaments used deterministic rules with a choice of cooperation or defection in every trial as a function only of the history of interactions in a maximum of the three trials prior. Deterministic rules are not necessarily the best approximation of real human behavior such that humans are prone to error, short memories, and/or uncertain motives, interpretations, and decisions (Nowak & Sigmund, 1992). Instead, stochastic (not deterministic) strategies reflect a better simulation of human behavior. Additionally, Axelrod suggested that TFT is the best strategy for eliciting cooperation from his tournament results using a homogeneous sample of game-theoretic experts.

One study using stochastic strategies as well as a more representative, heterogeneous sample of implemented strategies ($n = 100$) than was used in Axelrod's tournaments found that TFT is not robust once errors occur and can give rise to defection spirals (Nowak & Sigmund, 1992). They concede that TFT can still promote the emergence of reciprocation but appears most successful when it paves the way for more generous strategies in iterated PD games. They found that a "generous TFT" (GTFT; equivalent to TFT except it cooperates with a probability of q when opponent defects; in Nowak & Sigmund, 1992, $q = ⅓$) was optimal such that it afforded the highest payoff and was immune to inciting defection spirals by less cooperative opponent strategies. Other studies have additionally found that more biologically successful and robust strategies are more generous (Grim, 1996; Nowak, 1990) or more forgiving (Beaufils, Jean-Paul,

& Mathieu, 1996; O' Riordan, 2000) than TFT, as well as other strategies such as Pavlov win-stay lose-shift (Nowak & Sigmund, 1993).

A review of the effect of preprogrammed strategies on cooperation in PD games highlights the fact that the effect of computerized strategies do not exist in a vacuum by suggesting that "programmed strategies often interact with other variables, such as trials, length of initial strategies, matrix values, and subjects' diagnostic classification to produce delayed effects on cooperation" (Oskamp, 1971, p. 256). Thus, given the intricacies of the particular set of success criteria, payoff matrix, tournament format, and other criteria, the question of what strategies will most effectively elicit social cooperation in iterated PD games remains inconclusive (Rapoport et al., 2015).

Evolution of cooperation in humans. Several mechanisms have been proposed that promote the development of cooperation in humans (Rand & Nowak, 2013) one of which is direct reciprocity. Direct reciprocity results from repeated encounters between individuals, as is seen in a two-agent iterated PD game, where behavior both depends on previous trials and affects future trials. This suggests that patterns of behavior can emerge based upon behaviors in previous trials. Furthermore, a review of experimental data from four papers using stochastic game theoretic models suggests that dyadic cooperation is significantly predicted by the extent to which the probability of future interactions outweighs the riskiness of the interaction and payoff (Rand & Nowak, 2013, p. 4). Repeated interactions between individuals promote the evolution of cooperation even in finitely repeated PD games that are longer (Barlow & Tsang, 2015).

Axelrod (1984) highlighted the importance of opponent and participant strategy as a factor that can promote cooperation in iterated PD games, particularly TFT. However, there have been mixed findings regarding the evolution of cooperation when comparing cooperation in the beginning of a set of trials in iterated PD games to later trials. TFT has been experimentally shown to be associated with promoting greater cooperation in later sets of trials compared to beginning sets of trials (Sheldon, 1999) and several studies have highlighted the importance of early cooperation as they found it is associated with later cooperation (Komorita & Mechling, 1967; Pilisuk, Potter, Rapoport, & Winter, 1965; Sermat, 1967; Terhune, 1968). However, other studies found that competitive play, rather than cooperation, in the preliminary trials in iterated PD games was associated with more cooperation in later trials (Bixenstine & Wilson, 1963; Harford & Solomon, 1967; Scodel, 1962; Swingle, 1968; Wilson, 1971). Perhaps it is dependent upon the structural or interpersonal task condition (e.g., payoff matrix, PD format, opponent strategy, etc.) such that early cooperation may be best for facilitating participant cooperation under some conditions, whereas under others, early double-crossing may set the stage for cooperation later (Wilson, 1971).

Individual Difference Influences

Interdependence Theory suggests that individual differences on an array of factors can affect decision making and PD cooperation and game outcomes. Previous studies have found that Big Five Agreeableness (Kagel & McGee, 2014), internal locus of control, high self-monitoring, and high sensation seeking are associated with cooperative behavior in iterated PD games, whereas Type-A behavior tended to decrease the likelihood of cooperation (Boone, De Brabander, & van Witteloostuijn, 1999). Cooperation is also bred over time through repetition and learning as players improve their understanding of the subtle interplay between self-interest and cooperation. Personality features (e.g., internal locus of control) have been associated with quicker such learning in iterated PD games (Boone et al., 2002). Psychopathology and personality disorders are other factors that can influence decision making. Psychopathy is one such personality disorder that has been shown to affect cooperation in PD games (Berg, Lilienfeld, & Waldman, 2013; Gervais, Kline, Ludmer, George, & Manson, 2013; Mokros et al., 2008; Rilling et al., 2007; Yamagishi, Li, Takagishi, Matsumoto, & Kiyonari, 2014).

Psychopathy. Psychopathy is a disorder characterized by antisocial behavior, emotional impairments (e.g., lack of empathy, fearlessness), and interpersonal deficits (e.g., manipulativeness, violation of social norms). One model of psychopathy considers two orthogonal factors derived from the Psychopathic Personality Inventory – Revised (PPI-R; Lilienfeld & Andrews, 1996): fearless dominance (FD) and impulsive antisociality (IA). FD is characterized by an immunity to stress, lack of fear response, and an ability to charm/influence others. IA is characterized by a lack of planfulness or consideration of consequences, inability to take responsibility for one's actions, and a disregard for social norms (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003). These factors have also been shown to have opposing associations with interpersonal constructs (Benning et al., 2003; Patrick, Edens, Poythress, Lilienfeld, & Benning, 2006) including social cooperation.

Studies investigating social cooperation in psychopathy using one-shot PD games have yielded somewhat inconsistent results (Berg et al., 2013; Gervais et al., 2013; Mokros et al., 2008; Rilling et al., 2007; Yamagishi et al., 2014). Men from a relatively wealthy Tokyo suburb who played three distinct one-shot PD games and defected across all three games were defined as exemplars of *Homo economicus*, or people who maximize their self-interest without considering others (Yamagishi et al., 2014). In comparison to other groups of participants, these *Homo economicus* individuals – who *never* cooperated – scored high on FD and low on the carefree nonplanfulness PPI-R subscale (which loads onto IA). This suggests that those high in FD may tend to defect more often overall, whereas the cognitively impulsive portion of IA may be associated with cooperation. In a one-shot PD game with a sample of English female university students, Levenson Self-Report Psychopathy Scale (LSRP; Levenson, Kiehl, & Fitzpatrick, 1995) Factor 2 scores, which measure the aggressive and impulsive characteristics of psychopathy, were associated with greater profit in the game because they were associated with receiving more cooperation from their human opponents (Gervais et al., 2013). Overall, these results suggest that impulsive and antisocial psychopathic traits might paradoxically be associated with both cooperation and successfully eliciting cooperation from other people whereas FD may be associated with defection in one-shot games.

In a sample of male undergraduates playing three distinct one-shot PD games, PPI-R fearlessness scores (which loads onto FD) were related to taking advantage of others' cooperation by defecting while expecting their opponents to cooperate (Curry, Chesters, & Viding, 2011). Additionally, those high in stress immunity (which loads onto FD) were less likely to reciprocate cooperation, which is congruent with the findings of FD indexing *Homo economicus* who never cooperated. Those high in Machiavellian egocentricity (which loads onto IA) also cooperated less and were less likely to initiate or reciprocate cooperation (Curry et al., 2011). However, carefree nonplanfulness and impulsive nonconformity (both load onto IA) were not associated with lower levels of cooperation and those high in blame externalization (which loads onto IA) were more likely to initiate cooperation. These mixed findings regarding subscales related to IA again suggests a potential paradoxical relationship between impulsive and antisocial psychopathic traits and cooperation in one-shot PD games.

Four studies have investigated psychopathy's effects on behavior in an iterated PD game. IA correlated negatively with the number of cooperations across 10 PD trials using a TFT computer opponent, but FD did not (Berg et al., 2013). In a sample of German high-security psychiatric patients playing against a forgiving, generous (tit-for-two tats) computer opponent, PPI-R Machiavellian egocentricity and impulsive nonconformity (both load onto IA) correlated negatively with cooperation (Mokros et al., 2008). In addition, individuals high in psychopathic traits earned a significantly higher reward than did controls. In a community sample playing against a computer opponent using TFT, total and factor 1 scores on the LSRP in men (but not women) correlated negatively with cooperation (Rilling et al., 2007). Additionally, total LSRP scores and LSRP Factor 1 scores for men (but not women) were negatively correlated with cooperation after a mutually cooperative interaction on the previous trial, but there were no significant results for PPI-R total scores or FD.

Finally, in groups of primary and secondary psychopaths from a maximum security hospital in England selected as psychopaths using the works of Cleckley (1941) and Hare (1970), as well as a control group, there were no differences between groups' predispositions to cooperate in an iterated version of PD of 30 trials played against human opponents matched on psychopathy types (Widom, 1976). Widom suggested that over time, psychopaths may tend to cooperate if the stakes are high enough. Also, secondary psychopaths (who evidenced anxiety in their psychodiagnostic files) and controls showed an increase in the probability of cooperation after a trial of mutual cooperation during trials with communication, while primary psychopaths (lacking fear and empathy in their psychodiagnostic profiles) showed a decrease in this probability. Widom (1976) concluded that the behavior of individuals with psychopathic traits may be influenced by situational demands that might impact their motivation. Thus, these psychopathy factors akin to FD and IA appear to relate in opposite directions to social cooperation in PD games with a large number of trials.

Current Study

Overall, there are an array of structural, interpersonal, and individual difference influences that can affect gains and cooperation in PD games. The current study investigates social cooperation and gains in a series of finitely iterated PD games. The structural factors of these PD games remained constant to investigate the effects of interpersonal and individual difference factors. I aimed to investigate human participants' reactive and strategic behavior patterns in response to computerized opponent strategies that were manipulated to represent interpersonal styles ranging from very harsh to very lenient. These opponent strategies are nice (i.e., always cooperate on the first trial) and vary parametrically in their forgivingness (i.e., the degree to which they punish or forgive defections by returning or not returning to cooperation immediately), provocability (i.e., immediately defect or continue to cooperate in the face of a player's defection), and clarity (i.e., consistent or inconsistent employment of strategy). Harsher strategies are provocable and range in their punitiveness, whereas lenient strategies are forgiving and range in their generosity. The current study also aimed to investigate the effect of individual differences in psychopathic traits on reactive and strategic patterns of cooperation and gains in iterated PD games against this range of Harsh-Lenient and Consistent-Inconsistent computerized opponent strategies. Previous studies using iterated PD games and a computerized opponent to study psychopathy have used TFT or forgiving, generous strategies to control for participants' behavior that might represent a reaction to provocation (Mokros et al., 2008).

To investigate if participants' behavior was based on their own strategy and/or in reaction to their opponents' behavior I examined "cooperation" (participant's decision to cooperate or defect on each trial), "total point gain" (participant score on each trial) in the experiment overall, and "competitive point gain" (difference between participant and opponent scores on each trial) in the first and second half of each experimental block (against each opponent). I also investigated these variables on the next trial after participant or computer cooperations and defections along with their association with psychopathic traits. I analyzed data separately from the first and second half of each game block to investigate development of behavior; in particular, whether participants become more strategic in their behavior after probing their opponent's strategy.

Significant effects in the experiment overall were decomposed to examine the influences of previous behavior patterns of gain and behavior on subsequent trials. Effects after participant's own behavior on the previous trial should represent strategic patterns of participant behavior, whereas effects after computer behavior on the previous trial represent patterns of participants' reactions patterns to their opponents' behavior. Though Rilling et al. (2007) investigated the probability that subjects would choose to cooperate after a mutually cooperative outcome on the previous trial, no known studies investigating PD games with psychopathy have reported findings on patterns of behavior based on cooperation or defection of the participants' themselves or their computer opponents on the previous trial.

Hypotheses

The strongest hypotheses for this study (either based on previous literature or the structure of the task itself) are displayed in italics.

Interpersonal.

1. *Following suggestions that more generous (Grim, 1996; Nowak, 1990; Nowak & Sigmund, 1992; Wu & Axelrod, 1995) and more forgiving (Beaufils et al., 1996; O' Riordan, 2000) strategies are more successful in promoting cooperation, there would be a positive linear relationship between leniency of strategies and both a) cooperation and b) total point gain, as diagrammed in Figure 2A.*

Because both mutual cooperation and mutual defection represent a competitive point gain of zero, the expected positive linear relationship between leniency of strategy and cooperation entails that c) there would be a quadratic relationship between competitive point gain and opponent Harshness-Leniency such that extreme strategies have lower competitive point gain than less extreme strategies, as diagrammed in Figure 2A.

2. Given Axelrod's (1984) suggestion that clarity is a necessary property for a successful strategy, less clear (inconsistent) strategies would incite a) less cooperation and b) lower total point gain but c) will have no relationship with competitive point gain, as diagrammed in Figure 2B.
3. Because lenient strategies are defined by always rewarding returning to cooperation, whereas harsh strategies do not always immediately reward returning to cooperation, there would be a positive linear relationship between leniency of strategies and cooperation after participant cooperation on the previous trial, as diagrammed in Figure 2C.
4. Because harsh strategies are defined by always punishing defection, whereas lenient strategies do not always punish defection and are vulnerable to being taken advantage of, there would be a negative linear relationship between leniency of strategies and cooperation after participant defection on the previous trial, as diagrammed in Figure 2C.
5. Given that generous strategies promote cooperation (Grim, 1996; Nowak, 1990; Nowak & Sigmund, 1992; Wu & Axelrod, 1995) but harsh strategies may promote reactive aggression, there would be a positive linear relationship between

leniency of strategy and cooperation after computer cooperation on the previous trial, as diagrammed in Figure 2C.

6. Given that lenient strategies will relatively rarely defect to promote cooperation (Grim, 1996; O' Riordan, 2000) but harsh strategies would defect more often and may promote reactive defection spirals (Nowak & Sigmund, 1992), there would be a positive linear relationship between leniency of strategies and cooperation after computer defection on the previous trial, as diagrammed in Figure 2C.
7. Given the mixed findings regarding the importance of cooperation or competitiveness in early trials in promoting cooperation in later trials, I expect to see an interaction between Block Half and opponent Harshness-Leniency such that lenient strategies would show an greater increase in a) cooperation and b) total point gain in the second half whereas harsh strategies would show a greater decrease in c) cooperation and d) total point gain in the second half, as diagrammed in Figure 2D.

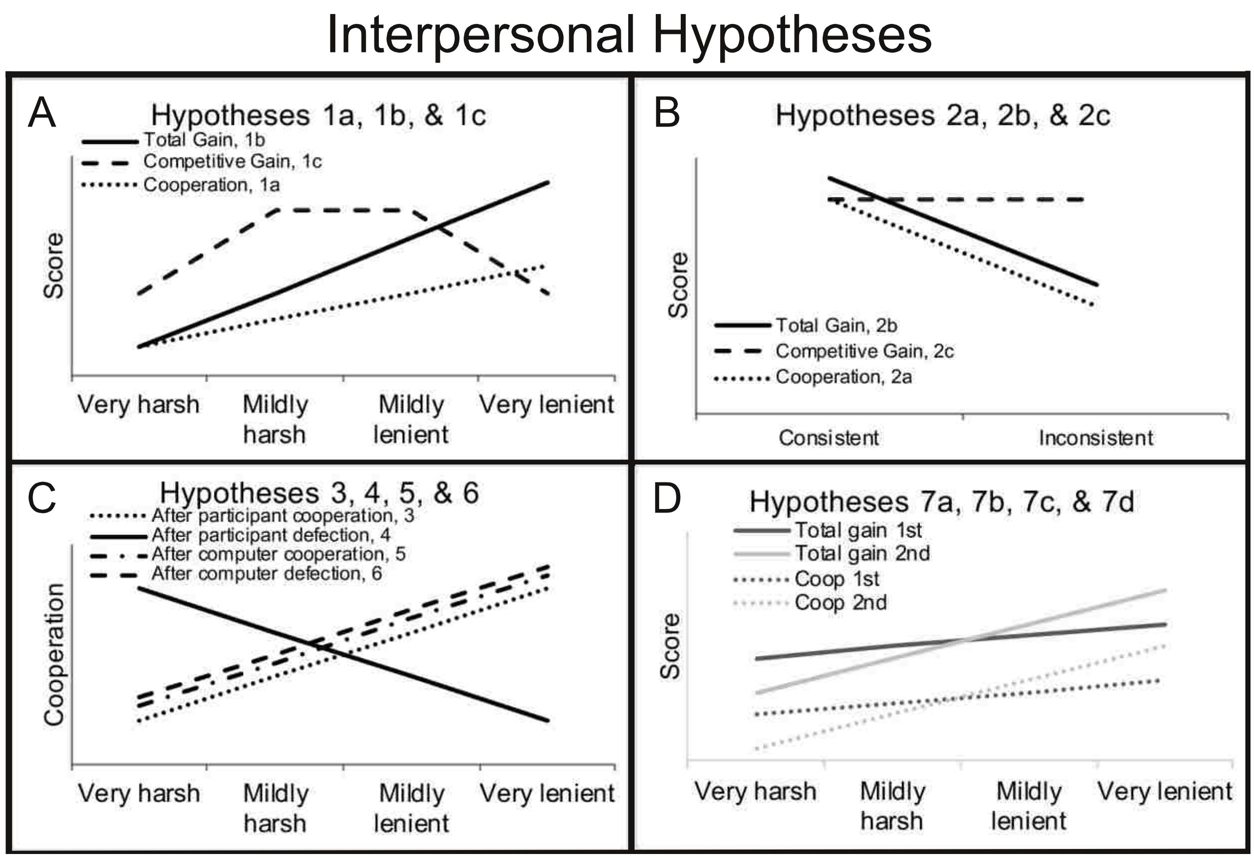

Figure 2. Diagrammed interpersonal hypotheses (e.g., Hypotheses 1-7).

Individual differences.

8. *Across the entire experiment a) following Berg et al. (2013), Mokros et al. (2008), and Yamagishi et al. (2014), FD and IA would correlate negatively with participant cooperation; b) consistent with Curry et al. (2011), FD would correlate positively with competitive point gain, but IA would not; c) consistent with Gervais et al., (2013), IA would correlated positively with total point gain; (as diagrammed in Figure 3A)* and d) because the most extreme conditions may promote defection (that is, more lenient opponents would continue cooperating after defections and more harsh opponents would engender defection spirals) for

FD and IA, they would be more negatively correlated with cooperation in very harsh and very lenient strategy conditions (as diagrammed in Figure 3B).

9. After participant cooperation on the previous trial, a) building on Rilling et al. (2007)'s results for LSRP Factor 1, FD would correlate negatively with cooperation after the participant cooperated on the previous trial and b) consistent with Widom (1976)'s findings for secondary psychopathy, IA would correlate positively with cooperation, as diagrammed in Figure 3C.

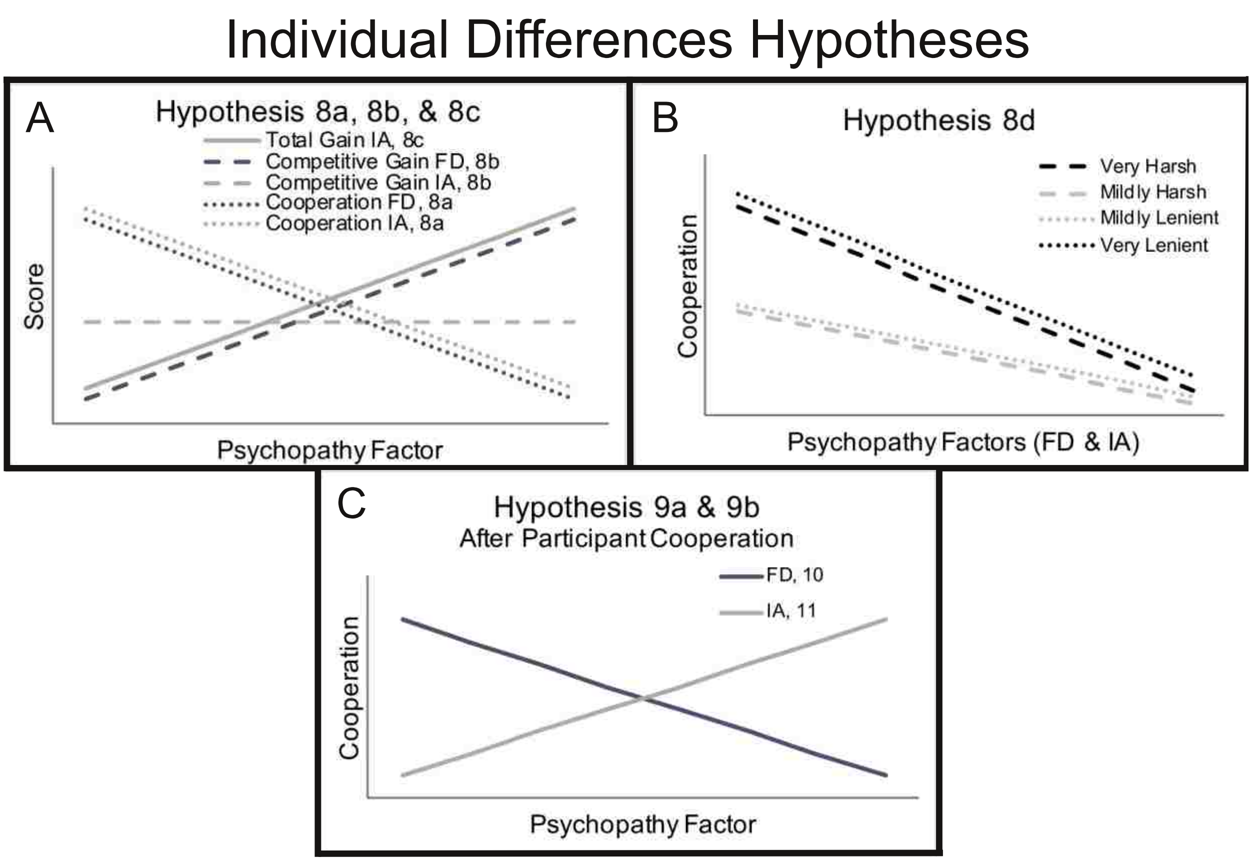

Figure 3. Diagrammed individual differences hypotheses (e.g., Hypotheses 8-9).

Chapter 2: Method

Participants

Participants were 177 undergraduate students from Vanderbilt University who participated for course credit. Participants were excluded from the analyses if they were unable to complete the experiment due to computer malfunction (*n* = 11) or if their personality data were incomplete (*n* = 3) or invalid due to random or acquiescent responding (Benning & Freeman, 2017; *n* = 2). Thus, 161 participants were included in all analyses. The mean age was 19.8 years (*SD* = 2.41). The sample was 50.9% female, 38.7% male, and 10.4% did not respond. They were 62.6% Caucasian, 11.0% Black/African American, 1.2% American Indian/Alaska Native, 11.7% Asian/Pacific Islander, 6.1% Spanish/Hispanic/Latino, and 10.4% did not respond.

Prisoner's Dilemma Task.

Participants played nine PD game "blocks" against different randomized computer opponents. Each PD game block consisted of 30 trials, though the participants were unaware of how many trials were in each block. They were shown one of 10 forward-facing neutral faces from the Karolinska Directed Emotional Faces (actors AF06, AF07, AM08, AM10, AM13, AF11, AF17, AF19, AM14, and AM18) that depicted their opponent at the beginning of each block. They were told that they would play against a computer who would behave based on the strategies used by previous human players. At the beginning of the task, participants were told to both a) win as many points as they could and b) win more points than each opponent. Within participants, a different actor was presented for each opponent strategy condition; across participants, actors were paired randomly with opponent strategy conditions. Each block used one opponent strategy condition.

Participants were told that they were being paired against various opponents in a traditional "prisoner's dilemma" scenario and may choose to either cooperate or defect on each trial. They were informed of the payout matrix (see Figure 4) for each combination of participant-opponent behavior. If the participant defected and the opponent cooperated, the participant earned five points ($T_P = 5$) and the opponent earned zero points ($S_O = 0$). If both participant and opponent mutually cooperated, they both earned three points ($R_P = 3$; $R_O = 3$). If both participant and opponent mutually defected, they both earned one point ($P_P = 1$; $P_O = 1$). If the participant cooperated and the opponent defected, the participant earned zero points ($S_P = 0$) and the opponent earned five points ($T_O = 5$).

Current Study PD Game Payoff Matrix

Participant$_{(P)}$ / Opponent$_{(O)}$	**Cooperation**	**Defection**
Cooperation	(R_P: 3, R_O: 3)	(T_P: 5, S_O: 0)
Defection	(S_P: 0, T_O: 5)	(P_P: 1, P_O: 1)

Figure 4. Payoff matrix of PD task.

Each computer opponent condition used one of nine strategies, each assigned to a block in random order. Strategies varied parametrically on both forgivingness and provocability to create a dimension of interpersonal Harshness-Leniency that would maximize the psychological effect of the manipulation. They also varied in clarity to investigate the effect of strategy consistency-inconsistency. The strategies were consistent very harsh (three tits-for-tat; once the participant defects, the computer will also continue to defect until the participant cooperates three times in a row), inconsistently very harsh (two to three tits-for-tat; once the participant defects, the computer will also continue to defect until the participant cooperates two to three times in a row), consistent mildly harsh (two tits-for-tat; once the participant defects, the computer will also continue to defect until the participant cooperates two times in a row), inconsistently mildly harsh (one to two tits-for-tat; once the participant defects, the computer will also continue to defect until the participant cooperates one to two times in a row), inconsistently mildly lenient (tit-for-one to two tats; the computer will continue to cooperate until the participant defects one to two times and will switch back to cooperation if the participant cooperates), consistent mildly lenient (tit-for-two tats; the computer will continue to cooperate until the participant defects two times and will switch back to cooperation if the participant cooperates), inconsistently very lenient (tit-for-two to three tats; the computer will continue to cooperate until the participant defects two to three to two times and will switch back to cooperation if the participant cooperates), and consistent very lenient (tit-for-three tats; the computer will continue to cooperate until the participant defects three times and will switch back to cooperation if the participant cooperates). TFT (computer decision on each trial copies the participant's decision on the previous trial) were excluded from analyses, as it was neither harsh nor lenient and so did not fit within the analytic strategy or aim of the study.

After completing each condition, participants were asked to rate their emotional valence and arousal from 1 (lowest valence or arousal) to 9 (highest valence or arousal) using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). At the end of the experiment, participants reported what fraction of the time they used a strategy to win the most points and to defeat their opponents by most points possible.

Measures

Demographics. Participants reported on their age, gender, race/ethnicity, medical/physical and psychiatric difficulties, medications, marital status, family history, educational status, and employment status.

Multidimensional Personality Questionnaire – Brief Form (MPQ-BF; Patrick, Curtin, & Tellegen, 2002). The MPQ-BF is a 155 self-report measure of normal-range personality with 11 primary trait scales (i.e., Wellbeing, Social Potency, Achievement, Social Closeness, Stress Reaction, Alienation, Aggression, Control, Harm Avoidance, Traditionalism, and Absorption) which was used to estimate FD (primarily from Social Potency, Stress Reaction, and Harm Avoidance) and IA (primarily from Social Closeness, Alienation, Aggression, Control, and Traditionalism) using regression equations from Benning et al. (2003). The MPQ-BF estimates PPI factors with good precision (multiple *R*s > .7; Benning et al., 2003) with essentially identical correlation patterns (Benning, Patrick, Blonigen, Hicks, & Iacono, 2005) and information levels about psychopathy (Walton, Roberts, Krueger, Blonigen, & Hicks, 2008) as the PPI. Cronbach αs in the current sample ranged from .74 (Traditionalism) to .86 (Stress Reaction) for the primary trait scales. This sample had higher scores on FD and IA compared to the MPQ normative sample. Their FD and IA scores were relatively similar to those of federal inmates; compared to a state inmate sample, their FD scores were higher, but their IA scores were lower (see Benning et al., in press, for further details).

Procedures

Each participant completed the experiment in a single session. After completing an informed consent, participants were asked to answer the demographics questionnaire and the

MPQ-BF through E-Prime. They then completed the PD task. They were then debriefed and awarded participation credit for an undergraduate course.

Data Analytic Plan

For each participant, cooperation, total point gain, and competitive point gain were averaged across each half of each block. Total point gain acts as a measure of the PD game's first instructed goal (i.e., win as many points as they could) and competitive point gain acts as a measure of the second instructed goal (i.e., win more points than their opponent). To investigate the main effects and interactions of opponent condition, psychopathy factors, and first and second half of opponent condition blocks across the entire experiment, analyses of covariance (ANCOVAs) were run on participants' cooperation, total point gain, and competitive point gain using Huynh-Feldt corrections for non-sphericity. Any main effects or interactions that were not statistically significant in the experiment as a whole were not included when analyzing results after particular behavior by the participant or computer. For each level of opponent Harshness-Leniency, I collapsed across Consistent-Inconsistent conditions in analyses involving psychopathy as I did not find any significant differences between these conditions regarding psychopathy factors. I evaluated post hoc pairwise comparisons involving Harshness-Leniency against a Sidak-corrected α level of .0085.

Significant main effects involving psychopathy were followed-up with partial correlations to determine the sign of the effect, and significant interactions involving psychopathy were decomposed with Steiger's (1980) *t* tests for dependent correlations across conditions. Post-hoc bootstrapped mediational analyses (Preacher & Hayes, 2008) were conducted with 5000 resamples to examine if participant cooperation mediated significant relationships between psychopathy factors and total point gain or competitive point gain.

To examine how participants' gains and cooperation were affected by both their own behavior (strategic trials) and their opponent's behavior (reactive trials) on the previous trial, participants' cooperation, total point gain, and competitive point gain on the next trial after participant cooperation or defection and computer opponent cooperation or defection were computed. For each, ANCOVAs, partial correlations, and Steiger's *t*s (1980) were run as described above for the cooperation, total point gain, and competitive point gain across the experiment. I used a Sidak-corrected α level of .013 to control for the four different sets of comparisons. Some participants never cooperated ($n = 2$ in harsh conditions; $n = 6$ in lenient conditions) or defected ($n = 2$ in harsh conditions; $n = 3$ in lenient conditions) in a given condition, leading to missing data. To retain all participants in these analyses, each participant's mean total point gain, competitive point gain, and cooperation across all other conditions for those missing cells were imputed. Also, the relationships were examined between psychopathy and self-reported strategies through partial correlations between FD/IA and participants' ratings at the end of the experiment of a) how much they sought to gain the most points possible and b) win by as large a margin as possible.

Chapter 3: Results

Across Entire Experiment

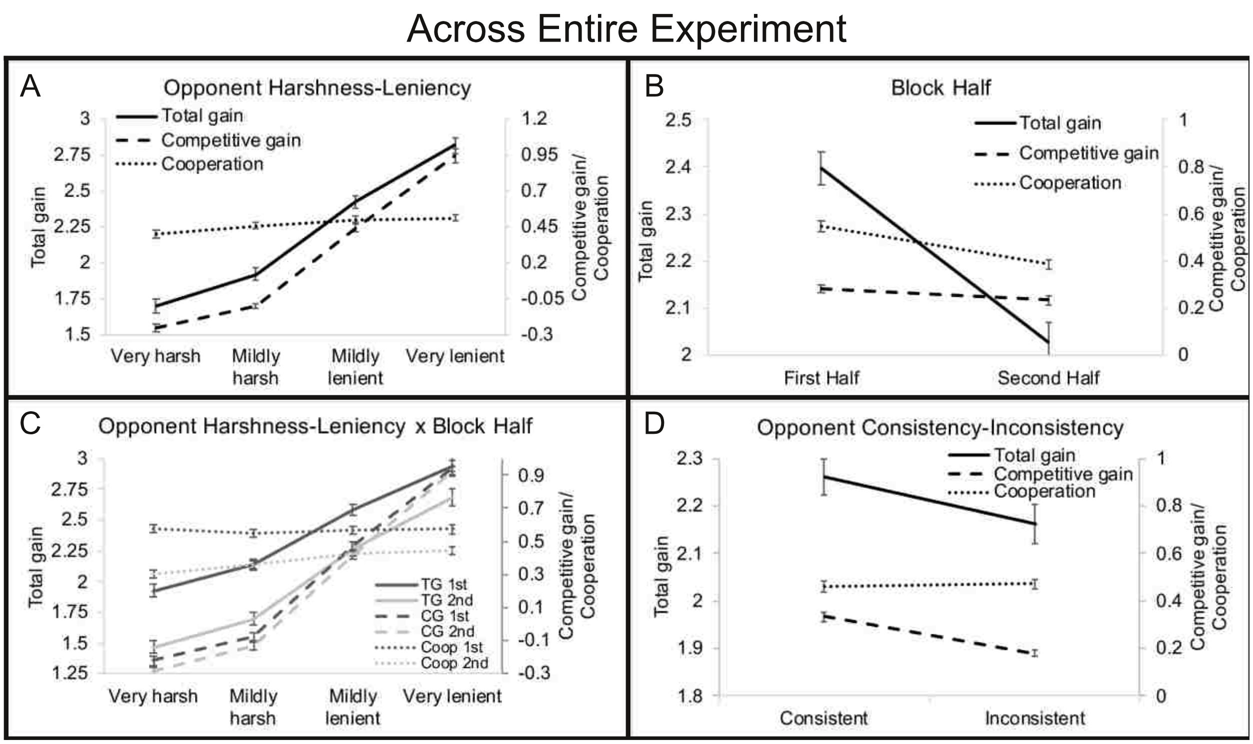

Figure 5. Effects of strategy and Block Half on cooperation, total point gain, and competitive point gain across the entire experiment. TG 1st = Total point gain first half; TG 2nd = Total point gain second half; Coop 1st = Cooperation first half; Coop 2nd = Cooperation second half.

Cooperation.

Strategy. As diagrammed in Figure 5A, there was a significant main effect of opponent Harshness-Leniency, $F(2.99,473) = 16.4$, $p < .001$, $\eta_p^2 = .09$. There was an overall positive linear relationship (linear $F(1,158) = 37.3$, $p < .001$, $\eta_p^2 = .19$) between cooperation and leniency of opponent strategy, though the difference between very and mildly lenient conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 4.13$, $p = .044$,

$\eta_p^2 = .03$). Pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 3.00, ps < .02, except for between the mildly lenient and both mildly harsh, $t(160) = 2.39$, $p = .104$, and very lenient conditions, $t(160) = -0.08$, $p = .972$.

There was significantly more cooperation in the first half of each block compared to the second, $F(1,158) = 194$, $p < .001$, $\eta_p^2 = .55$, as diagrammed in Figure 5B. One sample *t*-tests revealed that means rates of cooperation in both the first, $t(160) = 2.09$, $p = .039$, $d = .165$, and second, $t(160) = -5.70$, $p < .001$, $d = -.449$, half of each block were significantly different from .50, the rate expected if participants chose to cooperate or defect randomly on each trial.

There was a significant interaction of opponent Harshness-Leniency x Block Half, $F(3,474) = 6.01$, $p = .001$, $\eta_p^2 = .04$. As diagrammed in Figure 5C, there was a difference between block halves in the positive linear relationship of cooperation with strategic leniency (linear opponent Harshness-Leniency x Block Half $F(1,158) = 15.3$, $p < .001$, $\eta_p^2 = .09$) in which the linear effect of opponent Harshness-Leniency was greater in the second half of each block, $F(1,158) = 47.6$, $p < .001$, $\eta_p^2 = .23$, than in the first block, $F(1,158) = 15.1$, $p < .001$, $\eta_p^2 = .09$.

There was no significant main effect of Consistent-Inconsistent opponent strategy, $F(1,158) = 0.62$, $p = .432$, $\eta_p^2 < .01$, as diagrammed in Figure 5D. Therefore, in subsequent analyses involving cooperation, I did not investigate Consistent-Inconsistent opponent strategy.

Psychopathy. There were no main effects or interactions (i.e., FD, IA, Block Half, opponent Harshness-Leniency) involving with psychopathy with cooperation in the experiment overall, Fs < 1.2, ps > .27, η_p^2s < .01. Therefore, I only analyzed cooperation further to clarify significant FD x Block Half effects on total point gain or FD x opponent Harshness-Leniency effects on competitive point gain below.

Total point gain.

Strategy. As diagrammed in Figure 5A, there was a significant main effect of opponent Harshness-Leniency, $F(2.29,364) = 228$, $p < .001$, $\eta_p^2 = .59$. There was an overall positive linear relationship (linear $F(1,158) = 374$, $p < .001$, $\eta_p^2 = .70$) between total point gain and leniency of opponent strategy, though the difference between very harsh and mildly harsh conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 11.1$, $p = .001$, $\eta_p^2 = .07$). Nevertheless, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 6.00 , ps < .001.

There was significantly more total point gain in the first half of each block compared to the second, $F(1,158) = 275$, $p < .001$, $\eta_p^2 = .64$, as diagrammed in Figure 5B.

There was a significant interaction of opponent Harshness-Leniency x Block Half, $F(2.69,424) = 8.97$, $p < .001$, $\eta_p^2 = .05$. As diagrammed in Figure 5C, there was a difference between block halves in the positive linear relationship of total point gain with strategic leniency (linear opponent Harshness-Leniency x Block Half $F(1,158) = 17.5$, $p < .001$, $\eta_p^2 = .10$) in which the linear effect of opponent Harshness-Leniency was greater in the second half of each block, $F(1,158) = 321$, $p < .001$, $\eta_p^2 = .67$, than in the first half, $F(1,158) = 313$, $p < .001$, $\eta_p^2 = .67$.

Finally, as diagrammed in Figure 5D, participants had significantly lower total point gain in the inconsistent conditions than the consistent conditions, $F(1,158) = 14.75$, $p < .001$, $\eta_p^2 = .09$.

Psychopathy. There was a significant FD x Block Half effect on participants' total point gain, $F(1,158) = 4.49$, $p = .036$, $\eta_p^2 = .03$. Though no partial correlations were significant between FD and total point gain in the first or second half of blocks, they further revealed that the first half of blocks, $r_p(158) = -.090$, $p = .255$, had a more negative partial correlation than did the second half of blocks, $r_p(158) = .013$, $p = .871$, largely due to the high correlation between the first and second half of blocks, $r(159) = .853$, $p < .001$. No other main effects or interactions (e.g., IA, Block Half, opponent Harshness-Leniency) involving psychopathy with total point gain in the experiment overall were significant, Fs < 2.8, ps $> .05$, η_p^2s $< .02$. Therefore, in subsequent analyses involving total point gain, I only investigated the FD x Block Half interaction.

Competitive point gain.

Strategy. As diagrammed in Figure 5A, there was a significant main effect of opponent Harshness-Leniency, $F(1.42,225) = 263$, $p < .001$, $\eta_p^2 = .63$. There was an overall positive linear relationship (linear $F(1,158) = 314$, $p < .001$, $\eta_p^2 = .70$) between competitive point gain and leniency of opponent strategy, though the difference between very harsh and mildly harsh conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 70.5$, $p = .001$, $\eta_p^2 = .07$). Nevertheless, pairwise comparisons revealed significant differences between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 6.70, ps $< .001$.

There was a significantly larger competitive point gain in the first half of each block compared to the second, as diagrammed in Figure 5B, $F(1,158) = 4.99$, $p = .027$, $\eta_p^2 = .03$.

Participants also had significantly lower competitive point gain in the inconsistent conditions than the consistent conditions, as diagrammed in Figure 5D, $F(1,158) = 57.9$, $p < .001$, $\eta_p^2 = .27$.

There was no significant interaction of opponent Harshness-Leniency x Block Half, $F(2.31,366) = 0.22$, $p = .837$, $\eta_p^2 < .01$, as shown in Figure 5C. Therefore, in subsequent analyses involving competitive point gain, I did not investigate this interaction.

Psychopathy. There was a significant interaction of FD x opponent Harshness-Leniency, $F(1.42,225) = 3.48$, $p = .048$, $\eta_p^2 = .02$. Though Steiger's (1980) t tests revealed no significant difference between each level of opponent Harshness-Leniency, $|t(160)|$s < 1.9, *p*s > .06, there was a significant partial correlation between FD and the very lenient condition, $r(158) = .181$, $p = .022$, but no other conditions, $|r(158)|$s < .10. No other main effects or interactions (e.g., IA, Block Half) involving psychopathy with competitive point gain in the experiment overall were significant, *F*s < 3.9, *p*s > .06, η_p^2s < .03. Therefore, in subsequent analyses involving competitive point gain, I only investigated the effects of FD x opponent Harshness-Leniency.

Emotion and arousal ratings after each block. For valence ratings, there was a significant main effect of opponent Harshness-Leniency, $F(2.56,405) = 25.4$, $p < .001$, $\eta_p^2 = .14$. The means and standard errors for each Harshness-Leniency condition were as follows: very harsh $M = 5.46$, $SE = 0.14$, mildly harsh $M = 5.74$, $SE = 0.13$, mildly lenient $M = 6.05$, $SE = 0.13$, very lenient $M = 6.27$, $SE = 0.13$. Thus, there was a positive linear relationship of leniency of strategy, $F(1,158) = 47.5$, $p < .001$, $\eta_p^2 = .21$, and significant differences between all conditions, $|t(160)|$s > 2.4, $p < .02$, with mean values ranging from neutral to slightly positive valence. There was no significant main effect of Consistent-Inconsistent opponent strategy, $F(1,158) = 0.37$, $p = .545$, $\eta_p^2 < .01$. There was a significant main effect of FD, $F(1,158) = 4.66$, $p = .032$, $\eta_p^2 = .03$, but not IA, $F(1,158) = 0.11$, $p = .744$, $\eta_p^2 < .01$. FD correlated with valence ratings across all conditions, $r_p(158) = .169$, $p = .032$, but IA did not, $r_p(158) = -.026$, $p = .744$.

For arousal ratings, there were no significant main effects of opponent Harshness-Leniency, $F(2.84,449) = 0.69$, $p = .552$, $\eta_p^2 < .01$, Consistent-Inconsistent opponent strategy, $F(1,158) = 0.84$, $p = .362$, $\eta_p^2 < .01$, FD, $F(1,158) = 0.57$, $p = .453$, $\eta_p^2 < .01$, or IA $F(1,158) = 1.54$, $p = .217$, $\eta_p^2 < .02$, and there were no significant partial correlations with arousal ratings for FD, $r(158) = .060$, $p = .453$, or IA, $r(158) = .098$, $p = .217$.

Strategy ratings after entire experiment. There was no significant difference between means of self-reported strategies of "gain the most points possible," *M* = 5.29, *SE* = 0.19, and "gain as many more points than your opponent as possible," *M* = 5.67, *SE* = 0.18, *t*(160) = 1.41, *p* = .160. There were no significant partial correlations of self-reported strategy with FD, $|r_p(160)|$s < .13, *p*s > .11, or IA, $|r_p(160)|$s < .14, *p*s > .07.

Behavior after Participant's Cooperation

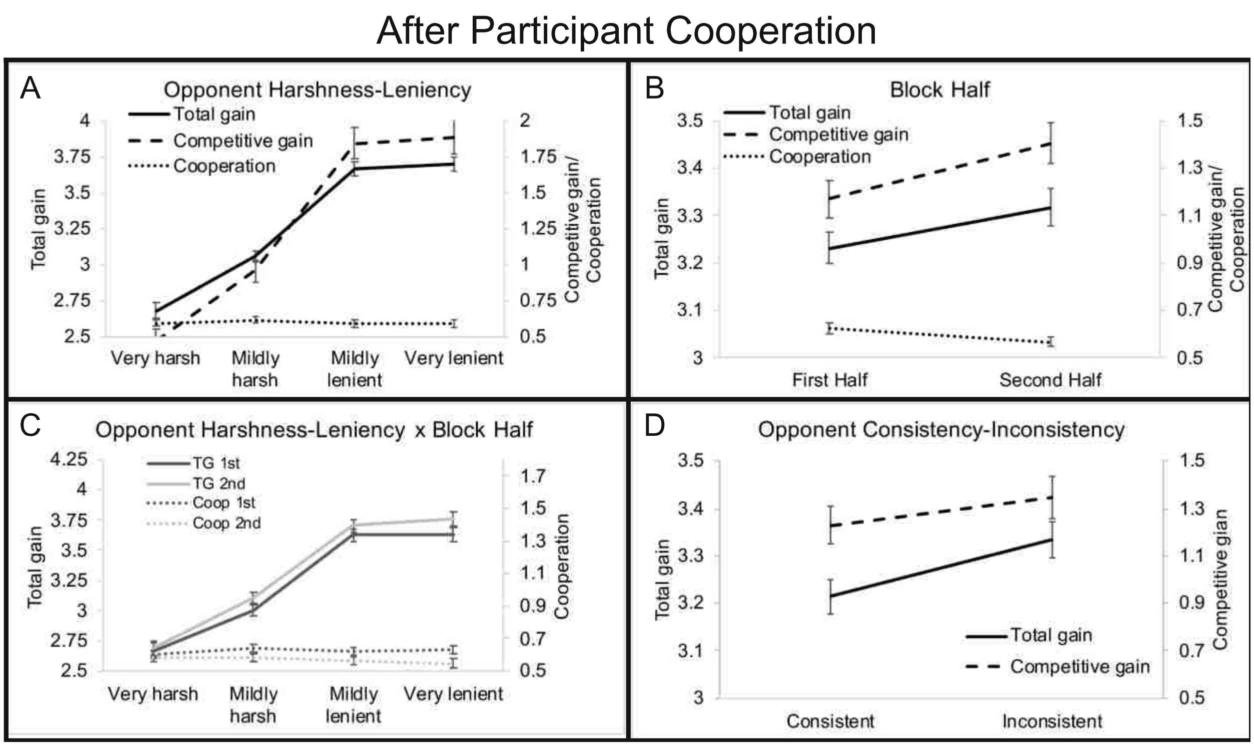

Figure 6. Effects of strategy and Block Half on cooperation, total point gain, and competitive point gain after participant cooperation on the previous trial. TG 1st = Total point gain first half; TG 2nd = Total point gain second half; Coop 1st = Cooperation first half; Coop 2nd = Cooperation second half.

Cooperation.

*Strategy***.** There was significantly more cooperation in the first half of each block compared to the second half, $F(1,157) = 41.5$, $p < .001$, $\eta_p^2 = .21$, as diagrammed in Figure 6B. One sample *t*-tests revealed that means rates of cooperation in both the first, $t(159) = 5.61$, $p < .001$, $d = .444$, and second, $t(159) = 3.16$, $p = .002$, $d = .250$, half of each block were significantly greater than .50.

There was no significant main effect of opponent Harshness-Leniency, $F(2.82,443) = 1.17$, $p = .321$, $\eta_p^2 < .01$, and no significant interaction of opponent Harshness-Leniency x Block Half, $F(2.91,458) = 2.05$, $p = .109$, $\eta_p^2 = .01$, as shown in Figures 6A and 6C, respectively.

Total point gain.

*Strategy***.** As diagrammed in Figure 6A, there was a significant main effect of opponent Harshness-Leniency, $F(1.93,303) = 158$, $p < .001$, $\eta_p^2 = .50$. There was an overall positive linear relationship (linear $F(1,157) = 225$, $p < .001$, $\eta_p^2 = .59$) between total point gain and leniency of strategy, though the difference between mildly lenient and very lenient conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,157) = 32.7$, $p < .001$, $\eta_p^2 = .17$). Specifically, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(159)|\text{s} > 7.5$, *p*s < .001, except for between the mildly lenient and very lenient conditions, $t(159) = -0.99$, $p = .907$.

Participants gained significantly fewer total points in the first half of each block compared to the second half, $F(1,157) = 8.94$, $p = .003$, $\eta_p^2 = .05$, as diagrammed in Figure 6B.

There was no significant interaction of opponent harness-leniency x Block Half, $F(2.44,383) = 1.04$, $p = .367$, $\eta_p^2 < .01$, as diagrammed in Figure 6C.

Participants also significantly more total points in the inconsistent conditions than the consistent conditions, $F(1,157) = 17.4$, $p < .001$, $\eta_p^2 = .10$, as shown in Figure 6D.

Psychopathy. When correcting for multiple comparisons, the FD x Block Half effect on participants' total point gain was not significant after participants cooperated on the previous trial, $F(1,157) = 4.56$, $p = .034$, $\eta_p^2 = .03$.

Competitive point gain.

*Strategy***.** As diagrammed in Figure 6A, there was a significant main effect of opponent Harshness-Leniency, $F(2.13,334) = 113$, $p < .001$, $\eta_p^2 = .42$. There was an overall positive linear relationship (linear $F(1,157) = 165$, $p < .001$, $\eta_p^2 = .51$) between competitive point gain and leniency of opponent strategy, though the difference between mildly lenient and very lenient conditions was less than that between all other conditions (quadratic $F(1,157) = 18.8$, $p < .001$, $\eta_p^2 = .11$). In particular, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(159)|$s > 7.40, *p*s $< .001$, except for between the mildly lenient and very lenient conditions, $t(159) = -0.59$, $p = .992$.

There was a significant main effect of Block Half, $F(1,157) = 26.38$, $p < .001$, $\eta_p^2 = .14$, such that there was a significantly smaller competitive point gain in the first half of each block compared to the second half, as diagrammed in Figure 6B.

When correcting for multiple comparisons the main effect of Consistent-Inconsistent opponent strategy was not significant, $F(1,157) = 4.93$, $p = .028$, $\eta_p^2 = .03$, as diagrammed in Figure 6D.

Psychopathy. There was no significant interaction of FD x opponent Harshness-Leniency, $F(2.82,443) = 0.81$, $p = .485$, $\eta_p^2 < .01$.

Behavior after Participant's Defection

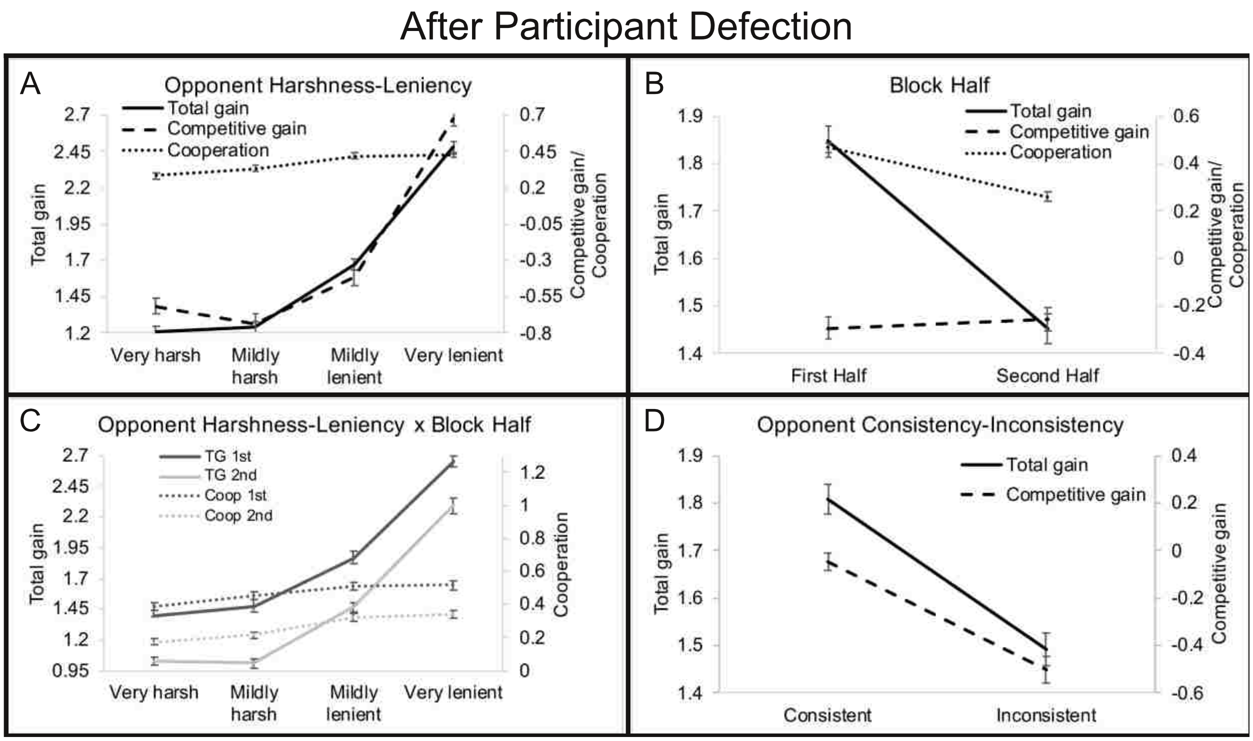

Figure 7. Effects of strategy and Block Half on cooperation, total point gain, and competitive point gain after participant defection on the previous trial. TG 1st = Total point gain first half; TG 2nd = Total point gain second half; Coop 1st = Cooperation first half; Coop 2nd = Cooperation second half.

Cooperation.

*Strategy***.** As diagrammed in Figure 7A, there was a significant main effect of opponent Harshness-Leniency, $F(2.71,428) = 37.3$, $p < .001$, $\eta_p^2 = .20$. There was an overall positive linear relationship (linear $F(1,158) = 78.6$, $p < .001$, $\eta_p^2 = .33$) between cooperation and leniency of opponent strategy, though the difference between mildly and very lenient conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 5.11$, $p = .025$, $\eta_p^2 = .03$). Indeed, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient strategies, $|t(160)|$s > 3.90, ps < .01, except for between the mildly lenient and very lenient conditions, $t(160) = -0.60$, $p = .993$.

There was significantly more cooperation in the first half of each block compared to the second half, $F(1,158) = 144$, $p < .001$, $\eta_p^2 = .48$, as diagrammed in Figure 7B. One sample *t*-tests revealed that means rates of cooperation in the second half of each block, $t(160) = -13.6$, $p < .001$, $d = -1.07$, were significantly lower than .50, but not the first half, $t(160) = -1.61$, $p = .109$, $d = -.127$.

There was no significant interaction of opponent harness-leniency x Block Half, $F(2.93,463) = 2.33$, $p = .075$, $\eta_p^2 = .02$, as shown in Figure 7C.

Total point gain.

*Strategy***.** As diagrammed in Figure 7A, there was a significant main effect of opponent Harshness-Leniency, $F(1.90,299) = 339$, $p < .001$, $\eta_p^2 = .68$. There was an overall positive linear relationship (linear $F(1,158) = 494$, $p < .001$, $\eta_p^2 = .76$) between total point gain and leniency of opponent strategy, though the difference between very and mildly harsh conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 190$, $p < .001$, $\eta_p^2 = .55$). Indeed, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 11.6, *p*s $< .001$, except for between the very harsh and mildly harsh conditions, $t(160) = 2.39$, $p = .809$.

There was a significant main effect of Block Half, $F(1,158) = 246$, $p < .001$, $\eta_p^2 = .61$. Specifically, there was significantly more total point gain in the first half of each block compared to the second half as shown in Figure 7B.

There was no significant interaction of opponent Harshness-Leniency x Block Half, $F(2.44,386) = 1.20$, $p = .306$, $\eta_p^2 < .01$, as diagrammed in Figure 7C.

There was a significantly lower total point gain in the inconsistent conditions than the consistent conditions, $F(1,158) = 138$, $p < .001$, $\eta_p^2 = .47$, as diagrammed in Figure 7D.

Psychopathy. There was no FD x Block Half interaction, $F(1,158) = 1.60$, $p = .208$, $\eta_p^2 = .01$.

Competitive point gain.

Strategy. As shown in Figure 7A, there was a significant main effect of opponent Harshness-Leniency, $F(2.37,375) = 206$, $p < .001$, $\eta_p^2 = .57$, with an overall positive linear relationship (linear $F(1,158) = 341$, $p < .001$, $\eta_p^2 = .68$) between competitive point gain and leniency of opponent strategy, though the slope of the difference between very and mildly harsh conditions was slightly negative (quadratic $F(1,158) = 178$, $p < .001$, $\eta_p^2 = .53$). Nevertheless, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 3.90, ps $< .002$, except for between the very harsh and mildly harsh conditions, $t(160) = 2.53$, $p = .075$.

There was no significant main effect of Block Half, $F(1,158) = 0.83$, $p = .363$, $\eta_p^2 < .01$, as diagrammed in Figure 7B.

There was a significant main effect of Consistent-Inconsistent opponent strategy, $F(1,158) = 101$, $p < .001$, $\eta_p^2 = .40$, with a significantly more negative competitive point gain in the inconsistent conditions than the consistent conditions, as diagrammed in Figure 7D.

Psychopathy. There was no significant interaction of FD x opponent Harshness-Leniency, $F(2.37,374) = 0.37$, $p = .728$, $\eta_p^2 < .01$.

Behavior after Computer's Cooperation

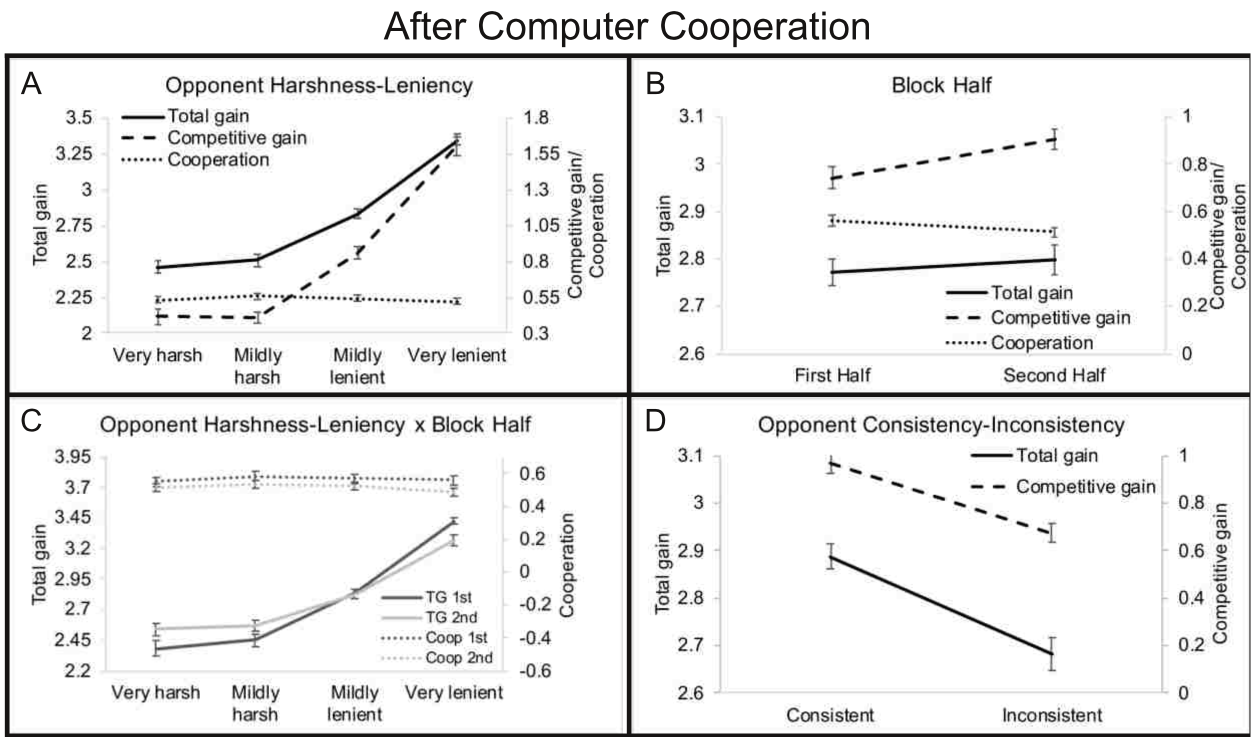

Figure 8. Effects of strategy and Block Half on cooperation, total point gain, and competitive point gain after computer opponent cooperation on the previous trial. TG 1st = Total point gain first half; TG 2nd = Total point gain second half; Coop 1st = Cooperation first half; Coop 2nd = Cooperation second half.

Cooperation.

*Strategy***.** There was significantly more cooperation in the first half of each block compared to the second half, $F(1,158) = 24.5$, $p < .001$, $\eta_p^2 = .13$, as diagrammed in Figure 8B. One sample *t*-tests revealed that means rates of cooperation the first half of each block, $t(160) = 2.75$, $p = .007$, $d = .217$, were significantly greater than .50, but not the second half, $t(160) = 0.60$, $p = .553$, $d = .047$.

There was no significant main effect of opponent Harshness-Leniency, $F(3,473) = 2.11$, $p = .098$, $\eta_p^2 = .01$, or interaction of opponent harness-leniency x Block Half, $F(3,480) = 1.09$, $p = .353$, $\eta_p^2 < .01$, as diagrammed in Figure 8A and 8C respectively.

Total point gain.

Strategy. As diagrammed in Figure 8A, there was a significant main effect of opponent Harshness-Leniency, $F(2.5,395) = 201$, $p < .001$, $\eta_p^2 = .56$. There was an overall positive linear relationship (linear $F(1,158) = 349$, $p < .001$, $\eta_p^2 = .69$) between total point gain and leniency of opponent strategy, though the difference between very and mildly harsh conditions was less than between all other pairs of conditions in this factor (quadratic $F(1,158) = 77.0$, $p < .001$, $\eta_p^2 = .33$). Indeed, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 9.69, ps $< .001$, except for between the very harsh and mildly harsh conditions, $t(160) = 1.21$, $p = .785$.

There was no significant main effect of Block Half, $F(1,158) = 1.56$, $p = .214$, $\eta_p^2 = .01$, as diagrammed in Figure 8B.

However, there was a significant interaction of opponent Harshness-Leniency x Block Half, $F(2.56,404) = 8.19$, $p < .001$, $\eta_p^2 = .05$. As diagrammed in Figure 8C, there was a difference between halves in the positive linear relationship of total point gain with strategic leniency (linear opponent Harshness-Leniency x Block $F(1,158) = 15.0$, $p < .001$, $\eta_p^2 = .09$) in which the linear effect of opponent Harshness-Leniency was greater in the first half of each block, $F(1,158) = 233$, $p < .001$, $\eta_p^2 = .60$, than in the second half, $F(1,158) = 173$, $p < .001$, $\eta_p^2 = .52$.

Participants gained significantly fewer total points in the inconsistent conditions than the consistent conditions, $F(1,158) = 73.5$, $p < .001$, $\eta_p^2 < .32$, as diagrammed in Figure 8D.

Psychopathy. There was no FD x Block Half interaction, $F(1,158) = 0.34$, $p = .564$, $\eta_p^2 < .01$.

Competitive point gain.

*Strategy***.** As diagrammed in Figure 8A, there was a significant main effect of opponent Harshness-Leniency, $F(2.47,391) = 157$, $p < .001$, $\eta_p^2 = .50$. There was an overall generally positive linear relationship (linear $F(1,158) = 272$, $p < .001$, $\eta_p^2 = .63$) between competitive point gain and leniency of opponent strategy, though the difference between very and mildly harsh conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,158) = 69.8$, $p < .001$, $\eta_p^2 = .31$). Indeed, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(160)|$s > 7.70, ps $< .001$, except for between the very harsh and mildly harsh conditions, $t(160) = 0.11$, $p > .99$.

There was a significantly smaller competitive point gain in the first half of each block compared to the second, $F(1,158) = 19.9$, $p < .001$, $\eta_p^2 = .11$, as diagrammed in Figure 8B.

Participants also earned significantly fewer points than their opponents in the inconsistent conditions than the consistent conditions, $F(1,158) = 65.0$, $p < .001$, $\eta_p^2 = .29$, as diagrammed in Figure 8D.

Psychopathy. There was no main interaction of FD x opponent Harshness-Leniency, $F(2.47,391) = 1.22$, $p = .301$, $\eta_p^2 < .01$.

Behavior after Computer's Defection

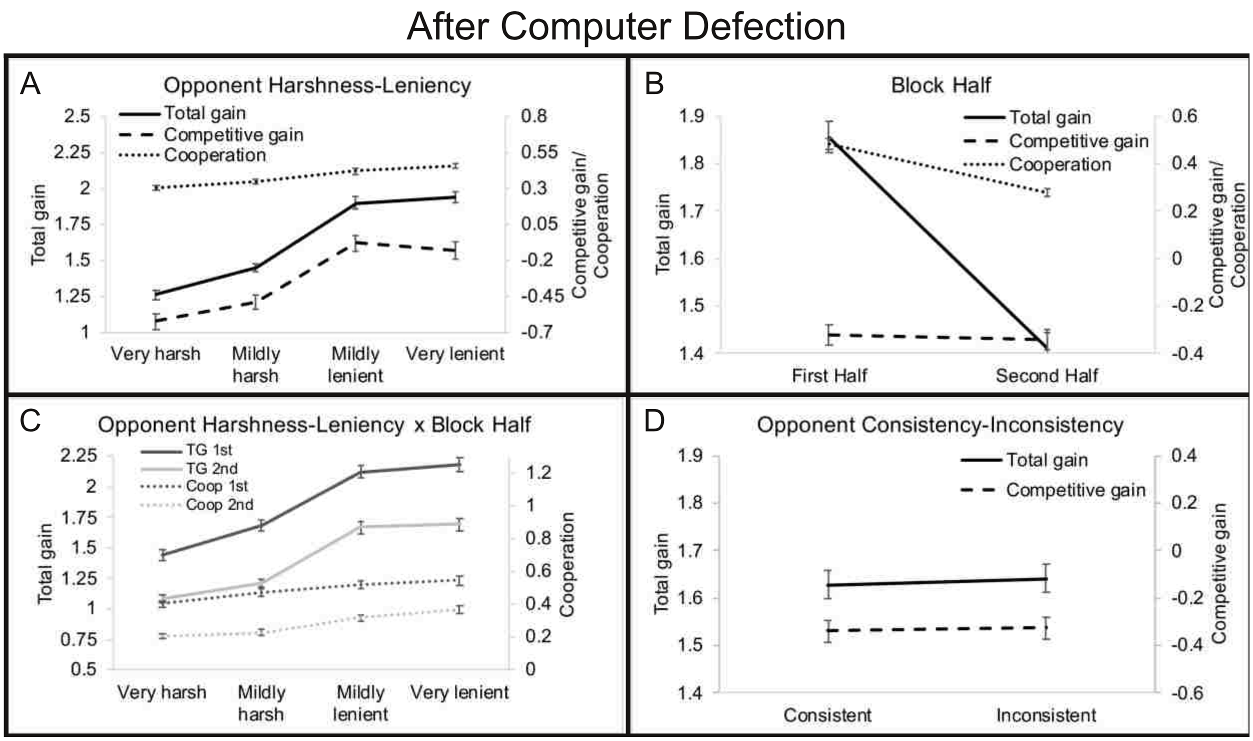

Figure 9. Effects of strategy and Block Half on cooperation, total point gain, and competitive point gain after computer opponent defection on the previous trial. TG 1st = Total point gain first half; TG 2nd = Total point gain second half; Coop 1st = Cooperation first half; Coop 2nd = Cooperation second half.

Cooperation.

*Strategy***.** As diagrammed in Figure 9A, there was a significant main effect of opponent Harshness-Leniency, $F(2.95,461) = 34.8$, $p < .001$, $\eta_p^2 = .18$. There was an overall positive linear relationship (linear $F(1,156) = 83.8$, $p < .001$, $\eta_p^2 = .35$) between cooperation and leniency of opponent strategy. Pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(158)|$s > 3.10, *p*s < .02, except for between the mildly lenient and very lenient conditions, $t(158) = -2.12$, $p = .167$.

There was significantly more cooperation in the first half of each block than the second half, $F(1,156) = 183$, $p < .001$, $\eta_p^2 = .54$, as diagrammed in Figure 9B. One sample *t*-tests revealed that mean rates of cooperation in the second half of each block, $t(158) = -13.1$, $p < .001$, $d = -1.04$, were significantly less than .50, but not in the first half, $t(158) = -0.85$, $p = .396$, $d = -.067$.

There was no significant interaction of opponent Harness-Leniency x Block Half, $F(2.96,462) = 2.09$, $p = .101$, $\eta_p^2 = .01$, as diagrammed in Figure 9C.

Total point gain.

Strategy. As diagrammed in Figure 9A, there was a significant main effect of opponent Harshness-Leniency, $F(2.38,371) = 128$, $p < .001$, $\eta_p^2 = .45$. There was an overall positive linear relationship (linear $F(1,156) = 244$, $p < .001$, $\eta_p^2 = .61$, between total point gain and leniency of opponent strategy, though the difference between mildly and very lenient conditions was less than that between all other pairs of conditions in this factor (quadratic $F(1,156) = 7.64$, $p = .006$, $\eta_p^2 = .05$). Specifically, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(158)|$s > 7.40, *p*s < .001, except for between the mildly lenient and very lenient conditions, $t(158) = -1.05$, $p = .878$.

There was significantly more total point gain in the first half of each block compared to the second half, $F(1,156) = 190$, $p < .001$, $\eta_p^2 = .55$, as diagrammed in Figure 9B.

There was no significant interaction of opponent Harshness-Leniency x Block Half, $F(2.49,389) = 1.66$, $p = .185$, $\eta_p^2 = .01$, as diagrammed in Figure 9C.

There was no significant main effect of Consistent-Inconsistent opponent strategy, $F(1,156) = 0.25$, $p = .615$, $\eta_p^2 < .01$, as diagrammed in Figure 9D.

Psychopathy. There was no FD x Block Half interaction, $F(1,156) = 1.89$, $p = .171$, $\eta_p^2 = .01$.

Competitive point gain.

Strategy. As diagrammed in Figure 9A, there was a significant main effect of opponent Harshness-Leniency, $F(2.74,428) = 38.2$, $p < .001$, $\eta_p^2 = .20$. There was an overall positive linear relationship (linear $F(1,156) = 79.5$, $p < .001$, $\eta_p^2 = .34$) between competitive point gain and leniency of opponent strategy, though the slope of the difference between mildly and very lenient conditions was slightly negative (quadratic $F(1,156) = 5.24$, $p = .023$, $\eta_p^2 = .03$). Specifically, pairwise comparisons revealed a significant difference between all levels of Harsh-Lenient opponent strategies, $|t(158)|$s > 2.90, ps $< .02$, except between the mildly lenient and very lenient conditions, $t(158) = 0.79$, $p = .965$.

There was no significant main effect of Block Half, $F(1,156) = 0.37$, $p = .542$, $\eta_p^2 < .01$, or of Consistent-Inconsistent opponent strategy, $F(1,156) = 0.12$, $p = .728$, $\eta_p^2 < .01$, as diagrammed in Figure 9B.

Psychopathy. There was no main interaction of FD x opponent Harshness-Leniency, $F(2.74,427) = 1.71$, $p = .168$, $\eta_p^2 < .02$.

Chapter 4: Discussion

In an undergraduate sample playing iterated PD games against a variety of opponents ranging from very harsh to very lenient in their interpersonal style, cooperation and point gains showed various associations with opponent strategy, first versus second half of each block comparisons, and psychopathy factors.

Strategy

Basic patterns. Across the experiment overall, cooperation decreased (with a large effect size) from the first to the second half of each block, resulting in reduced total and competitive point gains. This pattern is contrary to previous research that suggests the development of cooperation is promoted through repeated interactions among players (Axelrod, 1984; Rand & Nowak, 2013) particularly in longer finitely iterated PD games (Barlow & Tsang, 2015). However, the rates of cooperation and subsequent gains are quite different when comparing patterns of behavior after cooperation or after defection on the previous trial. Cooperation by either the participant or the computer opponent seems to promote participant cooperation overall, which supports previous findings that early cooperative game play promotes later cooperation (Komorita & Mechling, 1967; Pilisuk et al., 1965; Sermat, 1967; Terhune, 1968). After participant cooperation on the previous trial, participants cooperated significantly more than 50% of the time in both halves. In contrast, after computer cooperation on the previous trial, participants cooperated significantly more than 50% of the time in the first half of each block but only about 50% of the time in the second half. Furthermore, they had greater more total point gain (after participant cooperation on the previous trial) and more competitive point gain (after both participant and computer cooperation on the previous trial). Thus, participants may have selectively taken advantage of the elevated rates of cooperation to their benefit on the next trial.

In comparison, defection by either the participant or the computer opponent appears to promote participant defection. After both participant and computer defection on the previous trial, participants cooperated less in the second half of each block. More specifically, participants' mean cooperation in the first half of each block was not substantially different than 50%, but in the second half of each block, their mean cooperation was significantly less than 50% (with large effect sizes). Additionally, along with cooperating less, participants earned less total point gain (after participant defection on the previous trial) in the second half of each block. Although there was no significant effect of Block Half for competitive point gain after participant or computer defection, these were the only conditions in which competitive mean gains in both halves were negative (i.e., computers earned more points than participants), indicating that participants' behavior after defection did not further their objectives in the PD.

Overall, these patterns of results suggest that the presence of cooperation or defection, regardless of who (e.g., participant themselves or their computer opponent), promotes higher rates of that behavior subsequently. However, effects across the experiment overall still suggest there is still a reduction in cooperation in the second half of each when these patterns are combined. Still, it appears that in trials after cooperation, participants are more likely to benefit (e.g., earn more total or competitive point gains in the second half of each block) however, in trails after defection the increase in defection is to their detriment (e.g., less total point gain in the second half or no difference). Finally, when comparing cooperation rates between patterns after participant and after computer behavior, it appears that participants are slightly more likely to cooperate after their own cooperation than after computer's and are slightly more likely to defect after their own defection than after computer's. However, given the similarities in the patterns seen after participant and after computer behavior, it does not appear that participants overall are acting particularly strategically to their own behavior or in reaction to their opponent's behavior per se, but instead are more reactive to the general environment of cooperation or defection while defecting more overall over time – sometimes beneficially, sometimes not.

Evaluating hypotheses. In the experiment overall, opponent leniency of strategy was associated with increased participant cooperation and total and competitive point gains supporting Hypotheses 1a and 1b and in contrast to Hypothesis 1c. This is in support of previous research that highlighted the importance of opponent strategy to the development of cooperation (Axelrod, 1984) and that more generous (Grim, 1996; Nowak, 1990; Nowak & Sigmund, 1993; Wu & Axelrod, 1995) and more forgiving (Beaufils et al., 1996; O' Riordan, 2000) strategies are more successful in promoting cooperation. Additionally, participants' feelings of pleasantness during the experiment increased with the leniency of their opponents' strategies, indicating they may enjoy the interpersonal environment that more lenient opponents provided.

However, patterns again emerge when comparing effects after cooperation and after defection. After both participant and computer defection, increased participant cooperation and total and competitive point gains were all associated with opponent leniency in opposition to Hypotheses 4 and in support of Hypothesis 5, respectively. In contrast, after both participant and computer cooperation, there was no effect of opponent Harshness-Leniency on rates of cooperation, in opposition to Hypotheses 3 and 6 respectively, yet more lenient opponents are associated with increased total and competitive point gains. This pattern suggests that it is, indeed, more likely that one will obtain greater gains against a more lenient opponent overall. However, opponents who are more lenient will promote returning to cooperation on trials after both participant and opponent defection, whereas after both participant and computer cooperation, opponent Harshness-Leniency promotes neither cooperation nor defection.

Interestingly, these patterns of results suggest that while leniency of opponent strategy (e.g., lenient opponents cooperate more often by definition) promotes cooperation, it is moderated by the general tendency of increased defection over time.

Additionally, across the experiment overall, inconsistent opponent conditions were associated with lower total (consistent with Hypothesis 2b) and competitive point gains (in opposition to Hypothesis 2c), though it was not associated with cooperation (in contrast to Hypothesis 2a and previous research; Axelrod, 1980a, 1980b). Inconsistent opponent strategies were also associated with lower total and competitive point gains after participant defection and after computer cooperation, but were associated with greater total point gain after participant cooperation, whereas there was no effect for after computer defection. In all, these results suggest that strategic clarity is less important than other features of opponent strategies in its effects on PD behavior and outcomes.

Psychopathy

Across the experiment as a whole, FD and IA were not associated with increased cooperation or defection, thus not supporting Hypothesis 8a. This is in contrast to previous findings (Berg et al., 2013; Yamagishi et al., 2014; Mokros et al. 2008) of significant positive associations between psychopathic traits and defection when played against generous computerized or human opponents. Additionally, there were no consistent decreases in cooperation across extreme conditions overall, which did not support Hypothesis 8d. In general, there were no significant effects of opponent Harshness-Leniency, except with FD for competitive point gain across the experiment overall, though Steiger's (1980) *t*s did not further reveal any significant differences between conditions and only one significant partial correlation with FD (e.g., very lenient). These results suggests that effects with those high in psychopathic traits playing PD games across a variety of interpersonal styles may be relatively robust against opponents' behavioral patterns. Indeed, contrary to theoretical expectations, psychopathic traits may neither confer a particular sensitivity to interpersonal behavior patterns nor allow consistent exploitation of lenient behavior patterns.

Hypothesis 8b was also not supported as neither FD nor IA were associated with competitive point gain across the experiment as expected. Additionally, the null results of IA and total point gain indicate that Hypothesis 8c was not supported. However, FD had a significantly less negative association with total point gain in the second half of each block across the experiment overall, suggesting that they became more strategic as time went on. This contrasts the Block Half trend seen in the results during the experiment overall, as participants tended to earn fewer total points in the second half of each block. However, Hypotheses 9a and 9b were also not supported, as there were no significant associations with FD or IA after participant cooperation on the previous trial. There was a significant correlation between FD and self-reported valence ratings, but not IA, hinting that FD may be associated with an enjoyment of competitive social interaction, even when performed against automated opponents.

Limitations and Future Directions

These results contrast the literature suggesting that longer iterated PD games promote the development of cooperation (Barlow & Tsang, 2015) perhaps due to the differences in subjects, as they used a computer simulation and the current study uses human participants playing against computerized opponents. Future studies may investigate if even longer games would promote cooperation over time or if these results would replicate in human participants playing against other live human opponents.

Further research should also vary the length of the iterated PD games to examine when individuals high in FD or IA shift in their behavior. Additionally, the longer iterated game used in the current study allowed us to look at more strategic patterns of behavior than either one-shot or short iterated PD games, though both versions of these games have yet to be compared in the same study with psychopathy. Future studies may also further investigate the effect of different opponent strategies on the association between psychopathic traits and cooperation/gains given the surprising small and nonspecific effect of strategy seen in the current study, perhaps using different operationalizations of Harsh-Lenient interpersonal styles or different strategies altogether (e.g., stochastic strategies).

A limitation to the current study was the use of an undergraduate sample from a private university. Future research should use a similar iterated PD game in a clinical or criminal population to both investigate if this is unique to non-criminal populations and to consider if these implications could benefit a clinical population. Though the magnitudes of the effect sizes were consistent with the broader literature, they were still small, making premature any practical or clinical implications of this work. Additionally, previous studies have used a mix of real versus computerized opponents. While computerized opponents were necessary to investigate the role that opponent harshness played in this paradigm, future studies should investigate if harshness of human opponents has an effect on participant gains or cooperation in a PD game. Furthermore, other games (e.g., the Ultimatum Game) may further elucidate the effects that psychopathy factors have on multistep social interactions (Press & Dyson, 2012).

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Widom, C. S. (1976). Interpersonal conflict and cooperation in psychopaths. *Journal of Abnormal Psychology*, *85*(3), 330–334. https://doi.org/10.1037/0021-843X.85.3.330

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Wu, J., & Axelrod, R. (1995). How to cope with noise in the iterated prisoner's dilemma. *Journal of Conflict Resolution*, *39*(1), 183–189. https://doi.org/10.1177/0022002795039001008

Yamagishi, T., Li, Y., Takagishi, H., Matsumoto, Y., & Kiyonari, T. (2014). In Search of Homo economicus. *Psychological Science*, *25*(9), 1699–1711. https://doi.org/10.1177/0956797614538065

Curriculum Vitae

Mary Baggio

Department of Psychology
University of Nevada, Las Vegas
4505 S. Maryland Pkwy.
Las Vegas, NV 89154
baggiomary@gmail.com

EDUCATION

University of Nevada, Las Vegas, Las Vegas, NV
Ph.D. in Clinical Psychology in Progress, expected May 2021
Thesis: The Influence of Opponent Strategy and Psychopathic Traits on Point Gains and Cooperation in the Iterated Prisoner's Dilemma
Advisor: Dr. Stephen Benning

Northern Illinois University, DeKalb, IL
B.A. in Psychology
Psychology Departmental Honors, University Honors, Summa cum laude
Senior Thesis: Trauma and alcohol abuse moderated by interpersonal social support in experienced 9-1-1 telecommunicators
Cumulative GPA: 4.0/4.0
Degree Awarded: May 2014

RESEARCH EXPERIENCE

Psychophysiology of Emotion and Personality Lab, University of Nevada, Las Vegas, Las Vegas, NV
Principal Investigator: Dr. Stephen Benning, Ph.D.

- **Graduate Assistant,** *August 2015-Present*
    - Collect psychophysiological (i.e., EEG, saliva), behavioral, and questionnaire data from participants as part of a study investigating psychopathy, social support, and psychophysiology and psychopathy, aggression, and behavioral game theory
    - Analyze behavioral and psychophysiological data in SPSS and R
    - Program/code behavioral tasks in PsychoPy
    - Prepare documents for submission to the UNLV IRB
    - Manage research participant SONA system credit
    - Train incoming research assistants on psychophysiological and behavioral lab procedures
    - Prepare poster presentations and manuscripts for submission

Emotion Regulation and Temperament Lab, Northern Illinois University, DeKalb, IL
Principal Investigator: Dr. David J. Bridgett, Ph.D.

- **Lab Coordinator,** *May 2014-July 2015*

  - Collected data from mother-infant (4 month-12 month old) dyads as part of a longitudinal study investigating infant temperament, emotion regulation, and the effects of parenting
  - Administered and scored subtests of the WAIS-IV, D-KEFS, the WASI, and the depression and anxiety modules of the SCID
  - Collected physiological data (e.g., RSA, blood pressure, cortisol levels through saliva samples)
  - Cleaned respiratory sinus arrhythmia (RSA) data
  - Led a behavioral video coding project analyzing college students' parenting practices during a stressful simulated infant-care task, trained RAs on the code, kept track of their progress, and checked for their coding reliability
  - Assisted in the planning and development of the lab's college student project
- **Research Assistant,** *January 2013-July 2015*
  - Aided with data collection sessions for children from 4 months through 32 months of age
  - Behaviorally coded videos of infants for struggle, facial, and vocal frustration with a team and independently
  - Collected data from adolescents at a middle school over a 2 week period, distributing informed consents and assents then collecting data from a large group

Trauma, Mental Health, and Recovery Lab, Northern Illinois University, DeKalb, IL
Principal Investigator: Dr. Michelle M. Lilly, Ph.D.

- **Research Assistant,** *July 2013-May 2014*
  - Maintained an extensive participant database for multiple longitudinal and cross-sectional projects investigating the effects of duty-related trauma on the mental health of 9-1-1 telecommunicators from all over the United States
  - Contacted interested participants, screened them via phone or e-mail for eligibility and distributed online questionnaires, sending reminder e-mails when necessary
- **Senior Honors Thesis,** *August 2013-April 2014*
  - Title: Trauma and alcohol abuse moderated by interpersonal social support in experienced 9-1-1 telecommunicators
  - Worked with a recruitment team to collect data from 700 participants from all over the United States and analyzed questionnaire data in SPSS

Anxiety and Personality Lab, Northern Illinois University, DeKalb, IL
Principal Investigator: Dr. Kevin Wu, Ph.D.

- **Research Assistant,** *January 2014-May 2014*
  - Collected data for a project investigating Obsessive Compulsive Disorder and Obsessive Compulsive Personality Disorder and a project investigating hoarding behaviors in college students

    - Administered subtests of the WAIS-IV, D-KEFS, computerized N-back and Wisconsin Card Sorting tasks, and a task to measure hoarding symptoms

TEACHING EXPERIENCE

University of Nevada, Las Vegas, Las Vegas, NV

- **Teaching Assistant,** *Fall 2017, Spring 2018*
    - Teach two sections of undergraduate Introduction to Psychology per semester
    - Create and implement syllabi and lectures
    - Create and administer exams and other assignments

CLINICAL EXPERIENCE

Sandstone Psychological Practice, Las Vegas, NV
Director: Dr. Janell Mihelic, Ph.D. and Dr. Christina Aranda, Ph.D.
Direct Supervisor: Dr. Janell Mihelic, Ph.D.

- **Practicum Student,** *August 2017-Present*
    - Provide supervised individual psychotherapy, particularly from an psychodynamic, client-centered orientation integrating mindfulness, DBT, and CBT skills as appropriate
    - Complete intakes for incoming individual and group patients
    - Co-facilitate interpersonal process group psychotherapy for adolescents, young adults, and adults
    - Coordinate the implementation of two new process groups for adults with depression and adolescents
    - Participate in individual and group supervision as a supervisee
    - Administer and interpret psychodiagnostic interviews and neuropsychological assessments

The Partnership for Research, Assessment, Counseling, Therapy, and Innovative Clinical Education (The PRACTICE), University of Nevada, Las Vegas, Las Vegas, NV
Director: Dr. Michelle Paul, Ph.D.
Direct Supervisors: Dr. Noelle Lefforge, Ph.D.; Dr. Michelle Paul, Ph.D., Dr. Stephanie McLaughlin, Ph.D., Dr. Jeremy Gallas, Psy.D.

- **Practicum Student,** *June 2016-August 2017*
    - Provide supervised individual psychotherapy, particularly from an integrative interpersonal process orientation
    - Co-facilitate interpersonal process and didactic psychotherapy groups
    - Complete intake sessions for incoming patients
    - Participate in individual and group supervision and case rounds as a supervisee
    - Provide on-call crisis counseling services in the wake of the Route 91 Festival shooting

    - Administer and interpret psychodiagnostic interviews and neuropsychological assessments and provide feedback to patients
- **Graduate Assistant,** *August 2015- August 2016; January 2017-August 2017*
    - General administrative and front desk duties
    - Assist in coordinating orientation for incoming clinicians
    - Audit patient billing
    - Completed phone intakes for incoming patients
    - Participate in and present at case rounds meetings
    - Assist with patient psychotherapy sessions (e.g., exposures) upon request

Assessments administered/interpreted:

- Achenbach System of Empirically Based Assessment (ASEBA): Adult Self-Report Checklist
- ADHD Current Symptoms Scale-Self Report Form
- ADHD Childhood Symptoms Scale – Self-Report Form
- Adult DSM-5 Symptom Checklist
- Conner’s Continuous Performance Test 3 (CPT 3)
- Delis-Kaplan Executive Function System (D-KEFS)
- Employment and Social History Questionnaire
- Millon Adolescent Clinical Inventory (MACI)
- Personal History Questionnaire
- Personality Assessment Inventory (PAI)
- Personality Inventory for DSM-5 Brief Form (PID-5-BF)
- Rey-Osterrieth Complex Figure (ROCF)
- Structured Clinical Interview for DSM-5 (SCID-5)
- Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV)
- Wechsler Intelligence Scale for Children (WISC-5)
- Wechsler Memory Scale – Fourth Edition (WMS-IV)
- Woodcock-Johnson Tests of Achievement - Fourth Edition (WJ-IV-ACH)
- Woodcock-Johnson Tests of Cognitive Abilities – Fourth Edition (WJ-IV-COG)
- Woodcock-Johnson Tests of Oral Language (WJ-IV-OL)

SPECIALIZED TRAINING/WORKSHOPS

Interprofessional Education and Practice Workshop *(March 2017 and March 2018)*
Integrated care workshop including student psychologists, physicians, dentists, social workers, and nurse practitioners.
University of Nevada, Las Vegas

Seminar on Integrated Practice in Primary Care *(Fall 2017, 36 hours)*
Presenters: Dr. Sara Hunt, PhD and Dr. Michelle Paul, PhD
University of Nevada, Las Vegas

Screening, Brief Intervention, and Referral to Treatment (SBIRT) Training *(October 2017)*

Presenter: Professor Oscar Sida
Presented by the Southern Nevada Substance Use Disorder Training Project of The Lincy Institute

Doing Business as a Psychologist: The Graduate Course You Never Had *(September 2017)*
Presenter: Dr. Larry Waldman, PhD
Presented by the Nevada Psychological Association

Why People Die By Suicide *(October 2016)*
Presenter: Dr. Thomas Joiner, PhD
Presented by the Nevada Psychological Association

LEADERSHIP EXPERIENCE

Student Committee, Society for the Scientific Study of Psychopathy

- **PhD Day Coordinator,** August 2017-August 2019
    - Attend bi-monthly meetings with other Student Committee members of SSSP, an international society focused on the study of psychopathy
    - Plan and coordinate the PhD Day program working with the local host of the 2019 biennial meeting of SSSP
    - Collect data from student members regarding interest in activities

Outreach Undergraduate Mentoring Program, University of Nevada, Las Vegas, Las Vegas, NV

- **Graduate Student Mentor,** *September 2015-Present*
    - Offer mentorship and guidance to undergraduate students who are interested in pursuing a graduate degree in Psychology, targeting undergraduates from diverse backgrounds traditionally underrepresented in the field

PUBLICATIONS

Baggio, M. C. & Benning, S. D. (Submitted – Under Review 2018). *The influence of psychopathic traits on gains and behavior in the prisoner's dilemma.* Submitted to Journal of Personality Disorders, under review.

CONFERENCE POSTER PRESENTATIONS

Baggio, M.C. & Benning, S. D. (2017, January). *The Influence of Psychopathic Traits on Scores and Behavior in the Prisoner's Dilemma.* Poster presented at the biennial meeting of the Society for the Scientific Study of Psychopathy, Antwerp, Belgium.

Baggio, M. C. & Benning, S. D. (2016, September). *Event-Related Potentials During Face Processing of Interpersonal Psychopathy Factors.* Poster presented at the annual meeting of the Society for Psychophysiological Research, Minneapolis, MN.

Burt, N. M., Rosinski, L., Lowery, B., Ckuj, N., **Baggio, M.,** Kanya, M., & Bridgett, D. J. (2015). *Infant Frustration and Fearfulness as Contributors to Toddler Externalizing Problems: Unique, Additive, or Interactive Effects?* Poster presented at the biennial meeting of the Society for Research in Child Development, Philadelphia, PN.

Baggio, M., Allen, C., & Lilly, M. M. (2014, May). *Emotional Processing and PTSD Among 9-1-1 Telecommunicators.* Poster presented at the annual meeting of the Midwestern Psychological Association, Chicago, IL.

Kanya, M., **Baggio, M.,** Luka, S., Koegel, T., Deater-Deckard, K., & Bridgett, D. J. (2014, May). *Maternal Working Memory and Inhibition Differentially Predict Later Maternal Negative Parenting Behaviors.* Poster presented at the annual meeting of the Association for Psychological Science, San Francisco, CA.

Edwards, E. S., Beshansky, E., Rosinski, L., Westberg, E., **Baggio, M.,** Chennault, D., & Bridgett, D. J. (2014, May). *Inter-parental Relationship Adjustment and Infant Fear: The Protective Role of Positive Parenting.* Poster presented at the annual meeting of the Association for Psychological Science, San Francisco, CA.

Allen, C., Krauss, A., **Baggio, M.,** & Lilly, M. M. (2014, May). *Experiential Avoidance and Somatization: Avoidance Coping as a Mediator.* Poster presented at the annual meeting of the Midwestern Psychological Association, Chicago, IL.

AWARDS AND SCHOLARSHIPS

Patricia Sastaunik Scholarship *(2018-2019)*
University of Nevada, Las Vegas

Honorable Mention for Poster Presentation at the GPSA Research Forum *(2017)*
University of Nevada, Las Vegas

Graduate Access Scholarship *(2015-2016; 2016-2017; 2017-2018)*
University of Nevada, Las Vegas

GPSA Travel Funding *(Spring 2016; Summer 2017)*
University of Nevada, Las Vegas

Dean's List *(8/8 semesters: Fall 2008-Spring 2014)*
Northern Illinois University

University Honors Program *(August 2011-May 2014)*
Northern Illinois University

Psychology Departmental Honors *(2014)*
Northern Illinois University Department of Psychology

Conference Travel Award *(Spring 2014)*
Northern Illinois University Department of Psychology

- Scholarship to fund conference expenses

VIP Access Scholarship *(2010)*
Northern Illinois University Office of Admissions

- Scholarship to promising incoming freshman, based on GPA and ACT scores

Maibach Scholarship *(2012)*
Northern Illinois University Honors Program

- Scholarship for honors program members

Woodstock Center Fund Scholarship *(2012)*
Northern Illinois University Honors Program

- Scholarship for students of high academic merit and personal ambitions

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

Society for the Scientific Study of Psychopathy

Nevada Psychological Association

American Psychological Association

American Psychological Association Division 39 - Psychoanalysis

Society for the Teaching of Psychology

Society for Psychophysiological Research