MORE FOR ME OR MORE FOR YOU? THE EFFECTS OF POWER AND RESOURCE ASYMMETRY ON COOPERATION

by

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ABSTRACT

People frequently have interactions where they are interdependent, but differ in the extent to which they have power and resources. Two forms of power are the control one has over the outcomes of others (responsibility) and the extent to which one's outcomes are controlled by others (dependence). With regard to resources, individuals may have more or less resources than others. Prior research on power shows that social dilemmas with higher dependence and higher responsibility illicit more cooperation, but does not show whether dependence or responsibility is the cause of the cooperation. In the first study, participants chose between cooperative and non-cooperative options in a series of Prisoner's Dilemma games (PDG) that varied in dependence and responsibility. It was found that more participants were cooperative in games that had a greater amount of dependence and slightly fewer participants cooperated in games that had a greater amount of responsibility. In Study 2, the games used also varied the amount of resources the participant had relative to the other decision maker. It was found that participants cooperated at the highest rate when they had a resource advantage, less when they had equal resources, and least when they had a resource disadvantage. In both studies the effects of dependence and resources were moderated by Social Value Orientation (SVO): the effects were strongest for people with a joint gain maximizing orientation (Js), weaker for those with an own gain maximizing orientation (Os), and non-significant for people with a relative gain maximizing orientation (Rs).

Chapter 1

INTRODUCTION

Would you like a large slice out of a small pie (leaving very little for others) or a smaller slice out of a larger pie that can adequately feed everyone? This question is the essence of what researchers call a social dilemma: at least two people are faced with alternatives that conflict in the extent that they provide greater outcomes for the self or greater outcomes for a social unit (Axelrod, 1967; Komorita & Parks, 1994; Van Lange, Balliet, Parks, & Van Vugt, 2013). From a game theoretic perspective, rational actors should selfishly choose the larger piece with no regard for the size of the whole pie except perhaps to benefit oneself strategically in the long term (Hardin, 1968; Van Lange, Balliet, & Parks, 2013; Van Lange, De Cremer, Van Dijk, & Van Vugt, 2007). However, there is a great deal of evidence demonstrating that people faced with these dilemmas frequently cooperate (choosing the smaller piece from the larger pie) and that their cooperation is influenced by situational factors and individual differences (e.g., Balliet, Parks, & Joireman, 2009; Bogaert, Boone, & DeClerck, 2008; Fischer 2009; Kuhlman & Marshello, 1975; Messick & McClintock, 1968; Murphy & Ackermann, 2014).

For simplicity, most research on social dilemmas uses a symmetric configuration of outcomes. Symmetry of outcomes has two features that are important for the current research. First, the decision makers have an equal amount of power over each other's outcomes. In a social dilemma, each decision maker (DM) depends on the choices of others to the same extent that they are responsible for the outcomes of the other DM(s). This means that each DM has the same amount of power to influence the outcomes of others. Second, each DM has an equal amount of resources available to them when the outcomes are symmetrical. This does not mean that they will necessarily receive equal outcomes, but it does mean that any outcome available to one DM is available to all other DMs. This requirement makes it so that the total or average of all possible outcomes for one DM is equal to the total or average of outcomes for any other DM.

But how often are individuals' outcomes symmetrically arranged outside of the laboratory? It is likely that natural social interactions differ in the extent to which individuals have power and resources in a socially interdependent situation. Do people alter their choices based on their position in the social dilemma? When deciding whether to cooperate, do people care about their dependence on others, responsibility for others, and resources relative to others they are interacting with? An over-reliance on the symmetrical social dilemma limits our ability to address these questions. This dissertation is an attempt to provide a systematic approach to answering these questions by manipulating different parameters in the asymmetric Prisoner's Dilemma Game (PDG). This endeavor contributes to research methodology by advancing a system to quantify asymmetries. Furthermore, theory on social dilemmas is advanced by providing a novel examination of social motives and individual differences in cooperation in the context of asymmetry.

1.1 Overview

This dissertation consists of 4 chapters: 1) a general introduction, 2) an experiment testing power asymmetry, 3) a second experiment that provides tests of both power and resource asymmetry, and 4) a general discussion of the conclusions from this research and potential extensions of the paradigm used.

The general introduction will first provide an applied example illustrating the importance of asymmetric decisions in the context of scientific research practices. Next, readers will be introduced to the symmetric PDG. A rationale will be provided for exclusively using the PDG in the current research. The final section of the general introduction is a brief review of prior literature examining the psychological underpinnings of the PDG with a focus on social motives promoting goals of joint gain maximization, own gain maximization, and relative gain maximization.

The first study is an examination of asymmetries in power using social interdependence theory as a theoretical and mathematical framework (Kelley & Thibaut, 1978; Kelley et al., 2003). For two DMs to be socially interdependent each must have some control over the outcomes of the others. Social interdependence can be split into 2 components. Dependence is the amount of control others have over the DM and responsibility is the amount of control the DM has over others. When the amount of dependence and responsibility differ, the social dilemma (PDG in this case) has a power asymmetry. I will demonstrate in separate subsections how dependence and responsibility can be quantified for any matrix game and then provide a review of the limited past research on this topic. The first study of this dissertation was designed to address whether dependence and responsibility each uniquely affect cooperation. Participants were asked to choose between cooperative and non-cooperative options in 3 sets of games where dependence and responsibility were systematically manipulated in a within-subjects design. This study makes a unique contribution by demonstrating that dependence and responsibility can each be manipulated while holding the other constant. While the overall effect of social interdependence has been widely researched, this is the first systematic test of the relative impact of dependence and responsibility on cooperation.

The second study will extend the paradigm used in Study 1 to also include asymmetry of resources. The introduction to this study will provide a review of past research and a formula for quantifying the resource advantage or resource disadvantage of each DM. In the procedures for Study 2, participants were asked to make choices in a series of PDG's where dependence, responsibility, and resources were each manipulated independently. This makes it possible to test the 100% unique effect of each variable on cooperation. The second study will provide a replication test of the Study 1 results and extend these findings to provide an understanding of cooperative behavior under conditions of relative advantage and disadvantage with respect to total resources available.

Finally, in the general discussion section some conclusions and several future directions are considered. After summarizing the results of the 2 studies, I will discuss how a third feature of a PDG called 'social risk' can affect choices for each DM (Ng & Au, 2015). When a DM cooperates in the PDG, she hopes to attain mutual cooperation but risks the possibility that the other DM will exploit her cooperation leaving her with a "sucker's" outcome. Each DM has this risk, but the amount of risk for each player can differ asymmetrically. It remains to be seen how asymmetries in risk may affect cooperation. The third section of the general discussion will show how the logic and formulas used in the current research can be extended to any social interaction where the outcomes can be represented in a matrix format. With this in mind, asymmetry will be considered in the context of PDG extensions and other games. Finally, possible applications of this research will be mentioned in a concluding remarks section.

In past research, the asymmetric matrix game has rarely been used, and no systematic, theoretical approach to studying asymmetric games has been developed. Considering the prevalence of asymmetric social interactions and relationships in our daily lives, this undertaking will be important as a method to understand how asymmetry of power and resources affect cooperation and to provide a bridge to apply experimental findings to asymmetries outside of the laboratory.

1.2 The HARKing dilemma

As an example of a social dilemma, consider the scientist who has mixed motives for 1) individual career advancement and 2) the improvement of the scientific field (and society) as a whole. Often, these two motives prescribe the same course of action and there is no dilemma. But, the scientist also may have opportunities to advance their career at some cost to a larger collective. Furthermore, the incentive structures in this social dilemma can be asymmetric such that for different scientists the benefits of these decisions may vary based on the scientist's goals and status in the field.

Recently, a great deal of attention has been devoted to the reproducibility of scientific results (e.g., Open Science Collaboration, 2015) and research practices that may compromise our ability to provide reliable findings (Bohannon, 2015; Kerr, 1998; Simonsohn, Nelson, & Simmons, 2014). One controversial practice involves the reporting of hypotheses in published research. In academic journals, there is a well-documented "publication bias" -- a greater likelihood for publication if the results are consistent with the hypotheses. This consistency makes for a more "clean" story (Kerr, 1998; Sterling, 1959). As Daryl Bem (2004) explains this opens up a potential dilemma for researchers:

> There are two possible articles you can write: (a) the article you planned to write when you designed the study or (b) the article that makes the most sense now that you have seen the results. They are rarely the same, and the correct answer is (b).

Bem seems to be well aware of the bias towards publication of a cleaner story. His advice is likely geared towards helping scientific researchers publish articles and advance their personal careers. One way to apply Bem's advice is to generate or revise the hypotheses after the data has been collected and the results are known. This assures that there will be a "clean" story where the results match the hypotheses. However, if scientists Hypothesize After Results are Known (HARK) this may have adverse consequences for others in the same field of research. Norbert Kerr (1998) warns that HARKing can be deceptive for consumers of scientific research:

> A reader quick, keen, and leery
> Did wonder, ponder, and query
> When results clean and tight
> Fit predictions just right
> If the data preceded the theory
>
> -Anonymous

Kerr's (1998; 2011) call for complete disclosure of a priori hypotheses can be seen as a recommendation for scientists to serve the collective good rather than personal interests. Indeed, Kerr argues that the field is harmed by HARKing practices in a variety of ways including the advancement of Type I errors, omitting useful information about what did not work, presenting an inaccurate model of science to students, and taking unjustified statistical license. This may lead to greater cynicism towards scientific findings with severe consequences for funding streams and public influence available to scientists in general.

The contrasting recommendations offered by Kerr (1998) and Bem (2004) provide a good example of a social dilemma, but it is also easy to imagine that the incentives for advancing one's personal status and improving the field of research have different values for different scientists. To illustrate, imagine two scientists; Jan and Marcia. Each scientist is developing ideas in the same area of research and each is preparing a manuscript. Both are in a circumstance familiar to most scientists: the results of the study are interesting and important, but they were not hypothesized prior to the data collection. Both Jan and Marcia are aware that there is a publication bias in science favoring studies with hypothesized results (Sterling, 1959). Jan is an assistant professor applying for tenure. The decision to HARK (H) is personally beneficial to Jan and she has little vested interest in the field at this early stage in her career. Marcia is a tenured professor. Using HARKing is still personally beneficial to Marcia (the paper has a greater chance of publication and impact) but Marcia already has many publications, so the marginal utility of one added publication is not as great for Marcia as it is for Jan. Marcia also has spent a long career in this area of research, so she has a greater vested interest in the reputation of the field and benefits more from the Disclosure of hypotheses by both herself and others.

The decision for Marcia and Jan is between HARKing (H) or Disclosing (D) their a priori hypotheses. This is a social dilemma defined by a conflict between a self-interest rationale to HARK versus a collective rationale of cooperative scholarship for the field. In reality, scientists are generally part of larger (N-person) academic communities, but for simplicity I will consider only the decisions and outcomes of

Marcia and Jan relative to one another, as if they are a 2 person scientific field. The same logic can easily be extended to larger groups. When Jan chooses H it is bad for Marcia, and likewise, when Marcia chooses H it is bad for Jan. This is true because both have some vested interest in the reputation of the field which is damaged by HARKing. These 2 features make Jan and Marcia socially interdependent, and the rank order of outcomes available to each of them will constitute a Prisoner's Dilemma. This social dilemma is asymmetric with respect to power because Marcia's dependence on Jan to disclose is strong, and Marcia's responsibility to disclose is less important to Jan.

1.3 The Prisoner's Dilemma Game

Social dilemmas have been represented as games based on choices (or "moves") with different strategic properties (Rapoport & Chammah, 1965). For example, the Chicken Game presents DMs with a dilemma where personal outcomes are maximized by choosing the opposite of the option chosen by the other DM. Conversely, the Assurance Game is structured so that each DM maximizes personal outcomes by choosing the same option as the other DM (Van Lange et al., 2013). While these 2 games present interesting situations, by far the most researched type of social dilemma is known as the Prisoner's Dilemma Game (PDG; Dawes, 1980; Poundstone, 1992; Rapoport & Chammah, 1965). One reason for this is because the PDG is structured so that (unlike the Chicken and Assurance Games) maximization of personal outcomes is attained strictly through non-cooperation, and collective outcomes are maximized through mutual cooperation. This arrangement of outcomes provides a sharp contrast between the mixed motives of selfishness and prosociality. This is possible because the PDG is non-zero-sum: a gain for one DM does not necessitate an equivalent loss to the other DM. This feature allows for variance in the collective welfare based on the combination of both DMs choices. The PDG has been chosen for both of the studies in this paper both because it is the most widely researched matrix game and because the properties of the PDG are most conducive to representing asymmetrical relationships in quantifiable ways (e.g., the “k index”; Rapoport, 1967).

1.3.1 The Prisoner Analogy

The Prisoner’s Dilemma Game was presented by Luce & Raiffa (1957) in the form of a criminal interrogation analogy. In the analogy, 2 prisoners are brought in for questioning for a crime they are suspected of committing together. The goal for the district attorney is to construct a situation where each prisoner is most incentivized to Confess while still ensuring an adequate penalty for the crime. The choice for each prisoner is whether to Confess (C) or remain Silent (S). The combination of choices allows for 4 possible outcomes; both are silent (S_1S_2), only prisoner 1 confesses (C_1S_2), only prisoner 2 confesses (S_1C_2), or both confess (C_1C_2). The district attorney offers the prison terms illustrated in Figure 1 for each of the 4 outcomes.

Figure 1: The Prisoner's Dilemma Game Matrix (Luce and Raiffa, 1957)

		Prisoner 2	
		Silent$_2$	Confess$_2$
Prisoner 1	S$_1$	1yr 1yr	0.25yr 10yr
	C$_1$	10yr 0.25yr	8yr 8yr

Note . Each of the 4 cells in the matrix shows a pair of outcomes. Below the diagonal in each cell is an outcome for Prisoner 1. Above the diagonal in each cell is an outcome for Prisoner 2. Prisoner 1 chooses which row the outcome is in by choosing to be Silent or Confess. Prisoner 2 chooses which column the outcome is in. The combined choices of Prisoners 1 and 2 result in the outcomes in one of the four cells.

An S_1S_2 outcome results in a 1 year sentence for both prisoners. A unilateral confession by either player can shorten their own sentence to 3 months but the Silent partner will get the maximum sentence of 10 years. A C_1C_2 outcome has an 8 year sentence for both prisoners. Note that confession is a strictly dominant strategy; each prisoner is better off confessing (3 months or 8 years) than remaining silent (1 year or 10 years), regardless of what the other prisoner does.

However, as Hardin (1968) illustrated in the Tragedy of the Commons analogy, the PDG is a situation where the pursuit of self-interest results in collective ruin. This can be seen by adding together the joint outcome in each cell (both prison terms added together). The worst collective outcome occurs when both prisoner's Confess (16 total years) and the best collective outcome occurs when both remain Silent (2 total years). This forms a dilemma where opposite actions are prescribed to promote individual welfare (Confess) and the collective welfare (Silent) of the dyad.

1.3.2 The PDG as a Research Tool

The social conflict between individual and collective interests became particularly interesting to researchers in the 1950's to develop solutions to prevent global conflict. For the RAND Corporation, game theory was an important tool to help understand these situations. As part of their work with RAND, Merrill Flood and Melvin Drescher (for a review, see Poundstone, 1992) formalized the PDG to provide a framework for understanding the Cold War arms race between the United States (US) and the Soviet Union (USSR). In this application, the PDG is scaled up so that each of the prisoners is replaced by an entire country. While there were many countries with a stake in the Cold War, the US and USSR were the primary agents and are used to represent the 2 "players" in a PDG. In figure 2, the decision for each country is to produce more weapons (Arm) or to cease weapons production (Disarm). If the USSR Disarms, the US has an incentive to Arm and exert hegemony. If the USSR Arms, the US still has an incentive to Arm, because Cold War is preferable to the USSR domination for the US. The same incentives exist for USSR, locking the two powers in a cycle of proliferation that is necessitated by a desire for global power. Unfortunately, this cycle is sub-optimal for the 2 nations: both are better off in a world with less weapons (Peace). It is also quite likely that the outcomes available to the US and the USSR were asymmetrical. Historically, the countries both consistently chose to Arm and the outcomes for this mutual non-cooperation seem to have been more favorable for the US. The USSR ultimately dissolved in 1991, possibly due to the economic pressure of an inflated defense budget used to "Arm".

Figure 2: The Cold War represented as a social dilemma.

		USSR	
		Disarm	Arm
USA	D	Peace	USSR Wins
	A	USA Wins	Cold War

Note. Each cell in the matrix represents the outcomes of a joint decision between the US and USSR during the Cold War. It is assumed that for each country Win > Peace > Cold War > Loss.

Since the seminal work of Flood and Drescher, research on the PDG has expanded to address a wide range of social problems and is used as a framework to understand psychological processes, social exchange, and our evolutionary history (Bowles & Gintis, 2011; Dawes, 1980; Komorita & Parks, 1986; Nowak, 2011; Poundstone, 1992; Van Lange et al., 2013). The two features that define a PDG in relation to other games/situations are 1) Non-cooperative decisions (HARK, Confess, Arm) always provide the best outcome for each DM, regardless of the decisions made by others in the PDG, and 2) Mutual cooperation (Disclose, Silent, Disarm) provides the best joint outcome for all DMs. Taken together, the contrast between these two statements shows that the PDG presents the DM with a dilemma between individual rationality (non-cooperation) and collective rationality (mutual cooperation). This configuration exists for the social dilemmas of academic honesty, prisoner interrogations, and the Cold War arms race.

This dissertation will focus on restricted forms of the PDG that can represent the asymmetries in question while controlling for other factors by erring towards simplicity. Specifically, the PDGs will be restricted to a 2 player version with binary choices (cooperation vs. non-cooperation). Additionally the interactions between the 2 players will be considered as a one-shot interaction with simultaneous decisions. However, these restrictions are not methodologically or theoretically necessary. In the conclusion section, some examples will be provided to show how the measurement instruments and social motives described here can be applied to more complex adaptations of the PDG and even expanded to games other than the PDG.

This work is intended to provide a framework for categorizing the types of possible asymmetry to 1) test the relative importance of each form of asymmetry, 2) understand how asymmetry affects cooperation in social dilemmas, and 3) examine whether the social motives of individuals moderate the effects of power and resource asymmetry. Future research may apply this knowledge to enhance our understanding of cooperation in non-laboratory settings where decision situations typically comprise some form of asymmetry.

1.4 Psychology of the PDG

Economists have traditionally been interested in developing normative mathematical models for how "rational" actors should behave in interdependent relationships. As social psychologists and researchers from other disciplines adopted the gaming paradigm, the normative game theoretic prescriptions for rational actors became a comparison point for the behavior of real DMs (Camerer, 2003).

As research on the PDG grew from its game theoretic roots, it was applied to a variety of issues in biology, anthropology, political science, economics, and social psychology. In biology and anthropology, the PDG is an important research tool to understand the organization of primitive societies and evolution: a social dilemma between individual reproductive fitness and group survival (Bowles & Gintis, 2011).

Voting behavior (Van Lange et al., 2013) and collective action (Messick, 1973) are structured as social dilemmas of interest to political scientists and students of organizational behavior.

The traditional game theoretic prescriptions for rational choice is a normative issue that can be (and is) addressed mathematically. How DMs actually behave is a descriptive question that requires empirical testing. The discrepancies observed between normatively rational and "real" human behavior led social psychologists to insights concerning the psychological processes involved with interdependent decision making. These include differences in social values (Kuhlman & Marshello; Liebrand, 1984; Messick & McClintock, 1968; Van Lange, et al., 1997), expectations of partner behavior (Dawes, 1980; Kelley & Stahelski, 1970; Kuhlman & Wimberley, 1976; Murphy & Ackermann, 2015; Yamagishi, 1998), and risk preferences (Ng & Au, 2015).

1.4.1 Social Values

In game theory, there is a fundamental assumption that DMs are rational actors that calculate and maximize their own outcomes based on probabilistic strategies (Rapoport & Chammah, 1965). Indeed, Flood and Drescher were interested in a mathematical solution to the PDG that could justify rational actors behaving cooperatively. Such a solution remains elusive, but people do frequently cooperate in the PDG and researchers have developed a much better understanding of why this happens. Cooperative behavior in the PDG can be better understood by expanding the time horizon of interactions and by redefining rationality in terms of utilities for things other than outcomes for self. With a longer time horizon, theories of reciprocity can help to explain cooperation as an act designed to facilitate cooperation in return. But theoretically, cooperation should dissolve once an endpoint to the interaction is known in a process of backward induction (Nowak, 2011). Theories of direct reciprocity, strong reciprocity, and indirect reciprocity seek to explain cooperative behavior in terms of people's construal of the likelihood of future interaction (Rand et al., 2014).

More traditionally, psychological researchers place an emphasis on whether rationality should be defined strictly in terms of own outcomes. Theories of Social Value Orientation (SVO) propose that individuals differ not only in the extent to which they value outcomes for self, but also in the extent to which they are concerned with the outcomes of others (Messick & McClintock, 1968).

Based on consistent choices in allocations for "self" and "other", individuals are usually classified into one of the 3 most common SVO's (Bogaert, Boone, & Declerck, 2008; Kuhlman & Marshello, 1975; Liebrand, 1984; Murphy & Ackermann, 2014; Van Lange et al., 1997). Joint gain maximizers (Js, cooperators, prosocials) prefer options that have the best combined outcomes for self and others. This means they generally have a positive utility for outcomes to self and also a positive utility for the other's outcomes. By common estimates, the joint maximizing SVO is quite prevalent, making up about 50-60% of the population (Au & Kwong, 2004). Own gain maximizers (Os, individualists, proselfs) are most like the rational actor model used in traditional game theory. Making up about 25-30% of the population, the own gain maximizer has a positive utility only for their own outcomes and indifference to the outcomes of others. Finally, relative gain maximizers (Rs, competitors, proselfs) typically make up less than 10% of the population and choose outcomes that provide them with the greatest advantage over others. They have a positive utility for outcomes to self and a negative utility for outcomes to others. There are also many less common SVO's including altruism and aggression which are both indifferent to outcomes for self but have either a positive (altruism) or negative (aggression) regard for others.

The PDG provides an important test of SVO because preferences for joint gain maximization and own gain maximization (the 2 most common SVOs) unambiguously predict opposite choices in the PDG. Own gain is always maximized through non-cooperation and joint gain is always maximized through mutual cooperation. As a classic example of this dynamic, Kuhlman & Marshello (1975) measured the SVO of participants who engaged in a repeated PDG with ostensible partners. Overall, Js had a higher rate of cooperation (67%) than Os (35%) and Rs (12%). This is important because it validates the PDG as an instrument that can be used to understand psychological motives. These motives are quite consistent (Murphy, Ackermann, & Handgraaf, 2011), but the social preferences expressed by individuals with a given SVO depend on situational constraints and the behavior of socially independent others.

Social motives categorized by SVO are stable orientations toward a particular type of outcome. Social preferences represent the choices expressed by an individual from a range of alternatives in a given situation. While the two often go hand in hand, the distinction between social motives and social preferences is an important one. In the work of Kuhlman and Marshello (1975), it is important to note that the PDG was repeated over 30 trials. The results demonstrated that the expression of SVO can be influenced by the behavior of others. The ostensible partner in the games was manipulated to employ one of 3 strategies; 1) 100 cooperation, 2) a "tit for tat" strategy, or 3) 100% cooperation. Js generally chose the cooperative option in a PDG at rates of 92% and 80% in the first 2 conditions. However, consistent with the "sucker effect" (Kerr, 1983), Js were not willing to be taken advantage of: they responded to non-cooperation with only 29% cooperation. Os showed a different pattern, tending to choose the non-cooperative option when the other DM used an unshifting strategy. They only chose cooperation 13% of the time with the 100% defecting other and 31% of the time with the 100% cooperating other. The later finding may provide some evidence of reciprocity concerns. When the other DM used a tit for tat strategy, the other DM was initially cooperative but always responded to non-cooperation in kind. The Os were remarkably responsive to the tit for tat strategy, cooperating 63% of the time. It is likely that the Os adapted their behavior to generate reciprocity. With the other DM using a tit for tat strategy, the benefit of reciprocity makes cooperation the best strategy to enhance one's own gain in the long term. Rs were consistently low in cooperation across all 3 conditions (14%, 15%, and 8%). This makes sense because PDG cooperation offers no chance of gaining a relative gain in the immediate trial or future trials. This provides clear evidence that the social motives measured as SVO are related to social preferences expressed in the PDG, but also that situational variation (in this case the behavior of the other DM) can influence the expression of social preferences.

Another type of situational variation in the PDG is an asymmetry of outcomes. Very little is known about the relationship between SVO and asymmetric PDGs. One prediction is that more cooperative SVO's will express more cooperative preferences in the PDG (a main effect). Since we know that situations can influence the expression of SVO, it is also possible that power and resource asymmetries may have different effects for Js, Os, and Rs. The proposed studies explore these possibilities by measuring the SVO of participants who then play PDG games that asymmetrically vary in dependence, responsibility, and resources.

1.4.2 Social Value Orientation and Goals

As described above, the three major SVO's can be described by the different goals they have for social interactions. It is tempting to assume that Js should behave more cooperatively than Os who should behave more cooperatively than Rs. However, it is important to note that SVO's prescribe goals for the outcomes of social interactions rather than a course of action for the DM. It can be seen from Kuhlman and Marshello (1975) that both Js and Os are willing to make different decisions in order to achieve the goals that are most valued based on their SVO. In particular, for a J, the goal is not to cooperate (a decision), but rather to pursue mutual cooperation (a goal). If a DM with a cooperative goal expects others to choose non-cooperation, they may have little incentive to cooperate.

Pruitt and Kimmel (1977) reasoned that both the goal of cooperation and an expectation that the other DM shares that goal are both necessary in order to observe cooperative behavior. SVO research shows that individual variation in goals can help us to understand psychological processes. Dawes (1980) referred to an individual's goals as the morality component of cooperation in social dilemmas. More recent research has demonstrated links between social preferences and brain activation in fMRI experiments (Haruno & Frith, 2010). Declerck, Boone, and Edmonds (2013) review neuroscience research on SVO as evidence for a "social rationality" that is distinct from "economic rationality" in terms of the patterns of neural activation. They show that economically rational (selfish) decisions are accompanied by increased activity in a cognitive control network comprised of the lateral prefrontal cortex, dorsolateral prefrontal cortex, lateral orbital prefrontal cortex, and dorsal anterior cingulate cortex. In contrast, socially rational decisions are marked by activity in the medial prefrontal cortex, temporal-parietal junction, and amygdala. The brain system corresponding to economic rationality is more responsive to changes in extrinsic incentives (payoffs), whereas the brain system corresponding to social rationality is more responsive to whether others violate trust. This provides evidence that our brains are structured to differentially process prosocial (J) goals and proself (O and R) goals.

1.4.3 Expectations of Other's Cooperation

Dawes (1980) further associated expectations with trust as an important predictor of cooperation. A belief that others have positive intentions for your well-being can make cooperation more likely (Yamagishi, 1998; Yamagishi & Yamagishi, 1994). But, just as goals alone are not enough to produce cooperation, trust is not enough either. Remember that Os and Rs are both motivated by gains for self. When another DM is trusted to cooperate, gains to self in the PDG are still maximized through non-cooperation. Based on the involvement of morality and trust in social dilemmas, asymmetric versions of the PDG can help to provide us insights into how power and resources influence an individual's perception of who is trustworthy, and whether power and resource asymmetries interact with trust to predict cooperative behavior. The trust element of asymmetric games is an interesting topic, but is not directly addressed with the procedures in the current research.

1.4.4 Knowledge of the Outcome Structure

Finally, along with morality and trust, Dawes (1980) argued that knowledge is necessary for cooperation in social dilemmas. However, he was not referring to just any knowledge, but specifically an understanding of the outcomes and contingencies involved in the game. A critical assumption of game theory is that all players have perfect knowledge in this regard. However, in a world where humans have imperfect knowledge, this assumption is problematic in determining whether people cooperate. For example, if a scientist is unaware that HARKing has any negative consequences, disclosure of hypotheses would not be a sensible course of action. In this case, it would not matter how much that researcher values the well-being of her peers and the field of research. The asymmetric game may have a higher threshold for the knowledge required to cooperate. The participant in an asymmetric social dilemma will need to fully consider at least 2 different sets of outcomes (own and others) in order to understand that the collective can benefit most through cooperation of each actor. The added complexity of asymmetric games may provide important insights into how well participants understand social dilemmas as they are presented in laboratory settings.

1.4.5 Situational Influences on Psychological Processes

The PDG and other social dilemmas provide valuable tools for understanding psychological processes (Van Lange et al., 2013). In the present research, Social Value Orientation will be measured as a predictor of cooperation. Tests of interactions will be used to determine whether Js, Os, and Rs differ in their response to situational variation in terms of dependence (Study 1), responsibility (Study 1), and resources

(Study 2). Future research may be used to examine the influence of asymmetry on expectations and knowledge of the PDG.

Chapter 2

STUDY 1: DEPENDENCE AND RESPONSIBILITY

In Study 1, the relationship between social interdependence and cooperation in the PDG was explored. Based on prior research, it was expected that cooperation rates would be higher in situations with more interdependence between the DMs. However, greater social interdependence entails both a greater dependence on the other DM and also a greater responsibility for the other DM. The use of asymmetric PDGs allows for a quantification and isolation of the effects of dependence from those of responsibility and vice versa. This study was the first attempt to systematically address the questions of whether dependence and/or responsibility uniquely influence cooperation.

2.1 Introduction

In the HARKing example, Jan and Marcia are both faced with conflicting motives to HARK (individual rationality) or Disclose (collective rationality). If Jan and Marcia's decisions have a greater impact on one another, the dilemma is milder and less severe. Prior research shows that DMs are less cooperative in dilemmas where there is a more severe conflict of interests. In a symmetric PDG, more mild dilemmas have both greater dependence and greater responsibility. The severity of dependence is altered with changes to one's own outcomes and responsibility is manipulated with changes to the other's outcomes. In an asymmetric game, severity can be reduced with greater dependence and/or greater responsibility. In the HARKing example, Marcia is more dependent on Jan (Marcia's concern for the field) and has less responsibility for Jan (Jan's career is less affected by Marcia HARKing). Jan has the opposite configuration: she is less dependent and more responsible for the outcomes of Marcia. The dilemma is milder for Marcia in terms of dependence, but it is milder for Jan in terms of responsibility. Who is more likely to cooperate, the more dependent Marcia or the more responsible Jan?

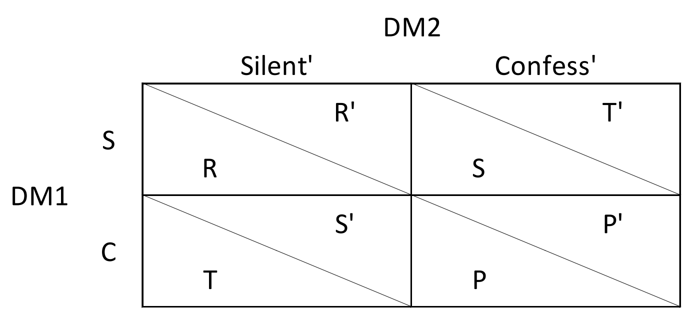
The main goal of the first study is to understand the relative influence of dependence and responsibility on cooperation in the PDG. To provide a background for this undertaking, the next 2 subsections will provide 1) an explanation of how manipulations of outcomes in the PDG can affect decision making, 2) a framework for how these differences can be understood in terms of Social Interdependence Theory, 3) a section that demonstrates how dependence can be quantified and manipulated asymmetrically, 4) a section for the quantification and isolation of responsibility, and 5) a brief review of prior literature pertaining to asymmetry in social interdependence.

2.1.1 Severity of the PDG

The PDG always involves a conflict between choices that promote individual and collective outcomes, but not all PDG's are created equal. One way to differentiate PDG games is based on how "severe" or "mild" the conflict between the individual outcomes and collective outcomes is. The severity of the PDG can be quantified and compared with other PDG's using the 4 outcomes available to each player in the game. Rapoport and Chammah (1965) used the 4 payoffs in symmetric games to predict a rank ordering of different PDG's in terms of cooperation based on the severity of the game.

Each of the 4 outcomes available to a DM in the PDG are shown in Figure 3. The Reward outcome is obtained when both DMs choose cooperatively. But, when the other DM is cooperative, there is also a Temptation to choose unilateral non-cooperation and attain an even higher outcome than R. The exploited DM then receives the Sucker's payoff, the worst possible personal outcome. When both DMs fail to cooperate, the outcome is a Punishment. The PDG game is defined by an arrangement of outcomes where T > R > P > S. For a one-shot game, if these inequalities are satisfied, the game can be classified as a PDG. An iterated PDG must also satisfy the inequality 2R > T + S. This inequality prevents the possibility that players can coordinate an alternating strategy of T and S to maximize collective outcomes (Murnighan, 1991; Rapoport & Chammah, 1965). When both DMs have the same values for T, R, P, and S, the game is symmetrical.

Figure 3: Outcome Structure of Rapoport and Chammah's (1965) PDG



Note. The letters in the matrix are used to represent the outcomes for each player. "T" is the Temptation payoff to exploit a cooperative partner through defection. "R" is the Reward payoff for mutual cooperation. "P" is the Penalty payoff for mutual non-cooperation. "S" is the Sucker payoff for cooperating with a non-cooperative partner. In all PDGs, T > R > P > S.

To measure the severity of a game, Rapoport & Chammah (1965) derived 30 possible linear functions of the 4 outcomes. Reasoning that most of the equations were functionally related to one another, the authors demonstrated the need for only the indices r_1 and r_2. The r_1 index was later named the k index (Rapoport, 1967) and the r_2

index has become obsolete because it was a poor predictor of cooperation and fails to take into account variation of all 4 payoffs. The r_2 index will not be considered further in this proposal. The k index for any PDG can be calculated using the following formula:

$$k = \frac{R-P}{T-S} \qquad 1$$

The potential outcomes of cooperation are R and S. Higher values of these outcomes makes the k index higher. Correspondingly, higher values of T and P (outcomes of non-cooperation) make the k index lower. Based on the inequality T > R > P > S and the mathematical properties of the k function, it can be demonstrated that for the PDG, 0 < k < 1 (Rapoport, 1967; Rapoport & Chammah, 1965). A k index of 0 could only occur if R = P or if T = S, either of these conditions would violate the T > R > P > S rule. A k index of 1 or more would mean that either R ≥ T and/or S ≥ P. These are both violations of the PDG rule because non-cooperation would cease to be the strictly dominant strategy in game theoretic terms.

It is a robust finding that PDG's with a higher k index (more mild) elicit higher rates of cooperation (Camac, 1986; Kuhlman & Marshello, 1975; Rapoport & Chammah, 1965; Steele & Tedeschi, 1967). A higher k index means that the conflict between individual rationality and collective rationality is less severe. Put in another way, the higher values of R and S make cooperation more attractive and lower values of T and P make non-cooperation less attractive. Thus, there is not as much conflict of interest in mild dilemmas (Axelrod, 1967; Oskamp & Perlman, 1965). It can be seen from the k index equation that increases to R and S (holding T and P constant) make the k index larger, while increases to T and P (while holding R and S constant) make the k index smaller. However, most of this research has been conducted on symmetric

PDGs where DM1 and DM2 both have the same k index. It remains to be observed whether the k index for self and the k index for the other DM uniquely influence cooperation.

2.1.2 Social Interdependence

Social interdependence theory (Kelley & Thibaut, 1978) explains the relationship between the k index and cooperation based on how much each of the DMs depend on the choices of the other player. When both DMs differentially value potential outcomes that are (at least partially) determined by the other DM, they are socially interdependent. This is the case in all versions of the PDG. However, PDG's can differ in at least 3 ways: 1) the extent to which the two players are interdependent, 2) the magnitude and valence of the outcomes, and 3) the amount of risk involved with a cooperative decision. Study 1 will address the first of these dimensions.

In the framework of Social Interdependence Theory, we can differentiate between 2 features of dyadic interdependence for each decision maker (DM1 and DM2). In such a social situation DM1 is both dependent on the choices of DM2 and responsible for the outcomes of DM2. In contrast, if DM1 is independent if their outcomes are outside the influence of the DM2. Likewise, when DM1 has no responsibility, DM2 is independent. When DM1 and DM2 are completely independent, they are not faced with a PDG or even a social dilemma because there is no collective interest at stake: each DMs choice affects only their own outcomes. While this type of situation certainly occurs, it is of little interest to social psychologists because the decisions are unrelated and the situation is essentially asocial. In the other extreme, when DM1 and DM2 are completely interdependent, DM1 has no control (0%) over their own outcomes and complete control (100%) over the outcomes of DM2. This situation also does not classify as a PDG because DM1s outcomes depend completely on the choice of the DM2. This decision has no selfish option, and thus, no conflict of interest. A PDG involves a combination where there is at least some independence (both DMs choices affect their own outcomes) and also at least some interdependence (both DMs choices affect each other's outcomes; Kelley et al., 2003).

In social interdependence theory, the control over a given DMs outcomes are comprised of three parameters; Actor Control (AC), Partner Control (PC), and Joint Control (JC). All three parameters are defined in terms of which players outcomes are being examined. These parameters operate in the same way as the parameters of an ANOVA factorial design, except that the analysis is based on variation in the outcomes in the matrix rather than on variance in psychological dependent variables. In the analysis of outcomes in the payoff matrix, there are only these 3 parameters and no error term because all of the variance is mathematically accounted for by the values of the outcomes.

Figure 4a shows some values for the outcomes to Marcia and Jan that fit the relationship between the two researchers (as described in section 1.2). In this paper, the subscripts M and J will be used to annotate whether Marcia or Jan's outcomes are the subject of control. To avoid confusion, the subscripts indicate which person's outcomes are being controlled, they are not used to distinguish which person is controlling the outcomes. Returning to the original analogy, we will first examine the outcomes for Marcia (subscript M). Marcia's control over her own outcomes is AC_M. This parameter indicates of how much of the variance in Marcia's outcomes is affected by her own choice. AC_M accounts for all of Marcia's independence.

Figure 4a: The HARKing PDG.

		Jan	
		Disclose	HARK
Marcia	D	60 80	100 0
	H	0 100	40 20

Note. The fictional researchers "Marcia" and "Jan" each have a choice to Disclose hypotheses (D) or HARK (H). Marcia's choice is between the rows and her outcomes (100, 80, 20, 0) are represented below the diagonal. Jan's choice is between columns and her outcomes (100, 60, 40, 0) are represented above the diagonal.

Figure 4b: The HARKing PDG for Marcia.

		Jan		
		Disclose	HARK	
Marcia	D	80	0	$\alpha_1 = 40$
	H	100	20	$\alpha_2 = 60$
		$\beta_1 = 90$	$\beta_2 = 10$	

Note. Only Marcia's outcomes from Figure 4a are displayed. The average outcome for each of Marcia's choices are shown as α_1 and α_2. The average outcome for each of Jan's choices are shown as β_1 and β_2

Figure 4c: The HARKing PDG for Jan.

		Jan		
		Disclose	HARK	
Marcia	D	60	100	$\alpha_1 = 80$
	H	0	40	$\alpha_2 = 20$
		$\beta_1 = 30$	$\beta_2 = 70$	

Note. Only Jan's outcomes from Figure 4a are displayed. The average outcome for each of Marcia's choices are shown as α_1 and α_2. The average outcome for each of Jan's choices are shown as β_1 and β_2.

The second parameter is PC_M, which is the amount of the variance in Marcia's outcomes that is affected by Jan's choice. Represented as a factorial design, AC_M and PC_M are the main effect of the row variable (Marcia's choice) and the main effect of the column variable (Jan's choice). However, PC_M is only part of Marcia's dependence on Jan, there is also JC_M which is the amount of variance in Marcia's outcomes predicted by the interaction between both Marcia and Jan's choices. In ANOVA language, JC_M is the interaction term. In order for a situation to be classified as a PDG, AC and PC must be present (Kelley & Thibaut, 1978). JC may or may not be involved in a PDG. For the current study, JC will be set to 0 in all games so that the focus is on each DM's direct influence on the outcomes for self and other.

Social interdependence theory provides a way to measure AC and PC that can be readily applied to any combination of outcomes in a matrix including the outcomes that define a PDG. We will first examine the outcomes available to Marcia, shown in Figure 4b. The numbers represent utility of the outcomes for Marcia (i.e., the values of T, R, P, and S). She may value the outcomes because they increase her future income, because they elevate her status, or she may prosocially derive some value from Jan and others in the field being better off. In the notation used by Rapoport and

Chammah (1965), this set of outcomes can be described as a PDG because T = 100, R = 80, P = 20, and S = 0.

2.1.3 Quantifying Dependence

Marcia gets to choose between row D and row H. This corresponds to the AC_M in the situation, but how strong is Marcia's AC? To calculate this, the average of the outcomes in row D is designated as α_1, and the average of row H is α_2. The difference between α_1 and α_2 is 20, which is the row effect AC_M. This raw figure gives us some idea of how much control Marcia has in determining her own outcome. But Jan can also influence Marcia's outcome, depending on which column is chosen by Jan. The averages of column D and column H are then calculated as β_1 and β_2. If Jan chooses Disclose rather than HARK, Marcia is better off by an average of 80 units. This corresponds to the Partner Control that Jan has over Marcia's outcomes (PC_M).

In this situation, Jan has more influence over Marcia's outcomes (PC_M) than Marcia (AC_M). The relative importance of these components can be quantified as an index of Marcia's Dependence on Jan. This is done by dividing the effect of Jan's choice on the variance in Marcia's outcomes (PC_M) relative to the total variance in Marcia's outcomes. Similar to the calculation in an ANOVA statistical test, all of the terms are then squared, yielding the formula:

$$DEP_M = \frac{(PC_M)^2}{(AC_M)^2+(PC_M)^2+(JC_M)^2} \qquad 2$$

In this case, the effect of Marcia's Dependence on Jan is 0.94. This is a relatively large effect showing that Marcia has much less power over her own outcome than Jan does. But there is another aspect of this situation; we also need to consider the possible outcomes for Jan. As the example was described, Marcia is to some extent Responsible for the outcomes of Jan.

2.1.4 Quantifying Responsibility

Marcia has a choice between the rows in the matrix and this choice matters to Jan. But how much does it matter? In order to assess Marcia's control over Jan's outcome (PC_J) the outcomes for Jan shown in Figure 4c will need to be considered. Remember that HARKing has a greater utility for Jan. This is reflected by Jan's higher utility when both she and Marcia choose H. For Jan, this penalty outcome has a utility of 40, compared with a utility of only 20 for Marcia. Jan also does not have as strong of an interest in credibility of the field, this is reflected by a lower utility for when both players Disclose, yielding a reward outcome of 60 for Jan and 80 for Marcia. Changes to the temptation and sucker outcomes can also generate these effects, but for simplicity, I have held them constant for both Marcia and Jan.

In this case, the row effect will need to be determined as the difference between the alphas. On average, Marcia can influence Jan's outcome by 60 units, this is annotated as PCJ because it is the amount of partner control Marcia has over Jan's outcome. Jan's Actor Control (AC_J) also needs to be considered to establish the relative effects. Jan chooses the column of outcomes and the difference of 40 between β_1 and β_2 is the AC_J. The index for responsibility is the same as the formula for dependence except that now we are calculating the values for Jan's outcomes:

$$RESP_M = \frac{(PC_J)^2}{(AC_J)^2+(PC_J)^2+(JC_J)^2} \qquad 3$$

After inserting the values for each of the parameters, the effect for Marcia's responsibility is 0.69. Marcia and Jan are both in a socially interdependent situation and they both have a decision that classifies as a Prisoner's Dilemma. But there is an important difference; Marcia is more dependent on Jan's HARKing choice because she has a stronger utility for the reputation of the field and a weaker utility for her own opportunity to publish. In turn, Marcia is less responsible for Jan's outcome because Jan can still gain substantial utility from HARKing when others are HARKing as well. Thus, the PDG faced by Marcia is milder in terms of her own outcomes, but more severe in terms of Jan's outcomes. It remains an open question whether dependence or responsibility is the driving force behind increased cooperation in more socially interdependent situations.

2.1.5 Past Research on Dependence and Responsibility

Social interdependence means that each DM to some extent depends on other(s) and is responsible for the same other(s). In the 2-person game, DM1's dependence is equal to DM2's responsibility, and this is true of all symmetrical and asymmetrical 2 person PDGs. In a symmetric game, DM1 and DM2 are equally dependent on one another. This necessarily means that the DM1 dependence, DM1 responsibility, DM2 dependence, and DM2 responsibility are all equal in symmetric games. The use of the symmetric game limits researchers interested in understanding interdependence because the two components of interdependence (dependence and responsibility) are completely confounded by the outcome structure.

In a series of asymmetric games, the dependence and responsibility of DM1 can be manipulated separately. In the HARKing example, the outcomes available to Jan do not need to be related to the outcomes available to Marcia. Thus, Marcia can be highly dependent on Jan, but less responsible for Jan's outcomes. Figure 4a shows the combined outcomes of Marcia and Jan in the asymmetric form. Assessing cooperation in this game would allow us to determine whether the more dependent DM (Marcia) or the more responsible DM (Jan) is more likely to cooperate. This allows us to address whether dependence or responsibility is the “active ingredient” that elicits the well-known effect that cooperation is more common when DMs are more interdependent (Doi, 1990; Fischer, 2012; Komorita & Parks, 1996; Rapoport & Chammah, 1967; Steele & Tedeschi, 1967).

Furthermore, there are many examples of personal factors that help to explain the relationship between interdependence and cooperation (Kuhlman & Marshello, 1975; Messick & McClintock, 1968; Bogaert, Boone, & DeClerck, 2008), but there has been relatively scarce research investigating which features of interdependence influence the relationship between personal factors (e.g., SVO) and cooperation.

Very limited research has been directed towards understanding asymmetries in dependence and responsibility. In one line of research, a repeated PDG with asymmetric payoffs was used to demonstrate that an alternating strategy of cooperation and non-cooperation became frequent to alleviate the inequality of mutual cooperation (Murnighan, 1991; Murnighan & King, 1992). While these studies directly manipulated dependence and responsibility, the focus of the research was on how groups “solved” the dilemma rather than the prediction of individual cooperation.

There are also a variety of economic games where two DMs have considerably different amounts of control over the outcomes available to each DM, these include the Dictator Game (DG; Kahneman, Knetsch, & Thaler, 1986), the Ultimatum Game (UG; Güth, Schmittberger, & Schwarze 1982), and the Trust Game (TG, Berg, Dickhaut, & McCabe, 1995). These games are useful for investigating things like trust, reciprocity, concerns for fairness, and prosociality. Unfortunately, these games are not useful for distinguishing between dependence and responsibility. This is because these games have other features such as constant-sum payoffs, sequential choices, and different choice formats for each DM. These features make it difficult or impossible to manipulate and assess differences in dependence and responsibility.

The most basic allocation decision is in the DG. DM1 is designated as the dictator (usually determined randomly) and she is given a sum of money (usually $10) to divide between herself and the other person (i.e., the recipient). The DG presents a very drastic form of asymmetry where the Dictator has complete control over all outcomes. The dictator has 0% dependence and 100% responsibility based on the payoffs available. Conversely, the recipient has 100% dependence and 0% responsibility because the recipient is not even allowed a choice. For the dictator, cooperation can be measured for a zero-sum situation with absolute control, but for the recipient cooperation cannot be measured. Thus, the DG cannot help us to distinguish differences in cooperation with varied levels of power (only absolute power).

The UG starts out the same way as the DG, except that the first DM is referred to as a proposer rather than a dictator. The term proposer is used because their decision can be rejected: the proposer does not have absolute power. After the offer has been proposed, the responder (DM2) has a decision whether to accept the proposer's offer or to reject the offer. Rejection has the consequence that neither DM receives any money. Unlike the DG, the UG is not constant-sum; the choice of the responder determines whether the total payoffs sum to $0 (reject) or $10 (accept). The amount of power given to each player is also asymmetrical, the proposer can decide the range of payoffs available to each player, but once that has been determined, the responder has all of the power. The problem with measuring asymmetries of dependence and responsibility in the UG is that any asymmetry in control is confounded by the asymmetry in information created by the sequential nature of the game. The proposer and responder have much different choice formats and the amount of power each DM has changes at different stages of the game.

The TG is also a sequential game. Both DMs are allocated a sum of money (usually $10) and the trustor (usually chosen randomly) can decide how much of the $10 she would like to keep and how much she would like to give to the trustee (DM2). Any money that is given to the trustee is multiplied (usually tripled). The trustee then can decide how much of the multiplied money she would like to keep and how much she would like to return to the trustor. If the trustor keeps everything, the trustee has no decision and no control. On the other hand, the trustee has 100% control over any money that is allocated to them and once the money has already been multiplied, this is a zero-sum decision. For the trustor, it is unclear how much power she has because the trustee has more information than the trustor.

The sequential economic games make it clear that to distinguish dependence and responsibility other confounds need to be avoided. Specifically, a game must be non-constant-sum and the DMs must have simultaneous choices with symmetrical information. In a constant-sum game, dependence and responsibility are still confounded because they are inversely correlated. Sequential choices and unequal distributions of information make it so that the different types of control can be difficult to quantify, may vary over the course of the game, and are partially determined by the DMs' actions rather than the outcome structure. The one-shot PDG avoids all of these confounds, making it an excellent candidate to understand the unique contributions of dependence and responsibility to cooperative behavior.

Insights gained about dependence and responsibility can have the added benefit of helping to understand behavior in other games. For example, if people are not influenced by responsibility for others, money allocated to others in the UG may be a direct consequence of dependence on the decision of the responder. For the TG, a strong role of responsibility in promoting cooperation could help to explain why a trustee would return money.

2.1.6 Current Research and Hypotheses

The first study was designed to test whether overall interdependence, dependence, and responsibility predict cooperation rates in the PDG. To accomplish this, 3 sets of PDG games were utilized. In Set 1, all of the games are symmetric and the level of interdependence (both dependence and responsibility) will vary across the games. This was an attempt to replicate the effect of social interdependence and provided a control condition to measure the other two game sets against. In Set 2, the outcomes of the participant varied across the games just like the first set. However, the outcomes of the other DM were held constant in this set so that responsibility did not vary. This allowed for a test of the unique effect of dependence on cooperation and a comparison to the overall social interdependence effect. Set 3 is the opposite of the second set. The outcomes of the participant were held constant so that there was no variance in dependence. Responsibility varied with changes in the outcomes of the other DM while dependence was held constant. Furthermore, Study 1 tested whether any observed effects of dependence and responsibility are moderated by the Social Value Orientation of the participant.

With these 3 sets of games and the measurement of SVO, several hypotheses can be tested. Based on Social Interdependence Theory (Kelley & Thibaut, 1978; Kelley et al., 2003), it is expected that:

> H1: There will be higher rates of cooperation in games that are more socially interdependent.

The second and third sets of games were used to test 2 exploratory hypotheses:

> H2: People will cooperate at higher rates in games where they are more dependent.

> H3: People will cooperate at higher rates in games where they are more responsible.

As mentioned above, the SVO of each participant will be measured prior to the experiment. Based on SVO theory and the work of Kuhlman and Marshello (1975), it is expected that:

> H4: Joint Gain Maximizers (Js) will cooperate at higher rates than Own Gain Maximizers (Os) and Relative Gain Maximizers (Rs).

> H5: Both Js and Os will cooperate at higher rates in games that are more socially interdependent. Social interdependence will have no effect on Rs.

Finally, analyses will explore interactions between SVO and each of the interdependence components (dependence and responsibility). I had no a priori' hypotheses for these relationships because existing theory and research does not provide a basis to make confident predictions.

2.2 Methods

2.2.1 Participants

A total of 422 University of Delaware undergraduate students participated in the experiment for partial fulfillment of an introductory psychology class. Participants were excluded from analyses if they had missing responses for any of the games (13 participants) or if they failed to get 4 out of 4 correct on a comprehension quiz that followed the instructions (31 participants). Analyses including participants with failed quizzes did not reveal any substantive differences. No analyses were conducted for participants with missing data. As described in the next section, this total was reduced to 345 participants (192 female) based on Social Value Orientation responses. All analyses reported in this chapter are based on the 345 participant sample.

2.2.2 Measure

Prior to the experiment, all participants completed the Ring Measure of Social Value Orientation (Liebrand, 1984). Following the work of Karagonlar and Kuhlman (2013), the original 24 item format has been adapted to a more efficient 12 item version that maintains the same precision as the original version (see Appendix A). Based on the decisions made in the Ring Measure, participants were categorized as Altruists (Alt's, 2.6%), Joint Maximizers (J's, 47.4%), Own Gain Maximizers (O's, 31.2%), Relative Gain Maximizers (R's, 12.7%), or Aggressors (Ag's, 0.3%). The remaining 5.8% (22 participants) were unclassified because they had a score of less than 0.60 on the consistency index. This cutoff was based on the recommendations of Liebrand (1984). Participants classified as Alt or Ag were not be included in analyses because the samples were too small. Analyses were conducted that combined the Alt category with J's and the Ag category with R's. These analyses did not reveal substantive differences. Unclassified participants were excluded from all analyses.

This distribution of SVO is consistent with past research across a variety of cultures and ages (Au & Kwong, 2004; Bogaert, Boone, & DeClerck, 2008). An identical measure of SVO was given 3 months prior to the experiment in the form of an internet survey. For the participants who attended the experiment, only 254 participants completed the pretest and were classified as J, O, or R. For these participants, 54.33% retained the same SVO categorization for both instances. This is consistent with past work on the test-retest reliability of the Ring Measure (Murphy & Ackermann, 2014) and supports the idea that SVO is a relatively stable goal orientation (Bem & Lord, 1979; Teta, 1994; Van Lange, Otten, De Bruin, & Joireman, 1997; Yamagishi et al., 2013).

2.2.3 Procedure

In 4 roughly equal sessions, participants entered a large auditorium and were seated randomly in every other chair so that each participant had an empty seat to the left and right. Participants completed their responses to the entire experiment on a scantron form while viewing the SVO choices, instructions, quiz, and the 3 sets of games on a large screen projection of a PowerPoint presentation.

First, participants completed the document of informed consent (Appendix B). All of the people who showed up to the experiment agreed to participate. Next, participants were asked to complete the Ring Measure (Appendix A) and then they were presented with oral and written instructions describing how to understand the configuration of outcomes in a matrix (Appendix C). The instructions contain 4 examples of games used in the experiment and a 4 item comprehension quiz. Next, participants made decisions between A (cooperation) and B (non-cooperation) in the 27 games (Table 1).

2.2.4 Analyses

Game 5 is actually identical in each set. This results in 3 copies of the same game and in the dependence and responsibility sets, this is the only symmetric game. There is a moderate level of dependence and responsibility in this game because each DM has outcomes of 70 for mutual cooperation and 30 for mutual defection. This game was used as a measure of choice consistency and potential order effects. In all sessions, these 3 games were #1, #14, and #27 in order, making them the first game, the middle game, and the last game. Out of 345 participants, 261 (75.7%) consistently chose the same option in all 3 of these games. The consistent DM's can be further split into 83 DMs who cooperated in all 3 games (24.1%) and 178 DM's who chose non-cooperation in all 3 games (51.6%).

Table 1: Games used in Study 1

Set	Game	Own Outcomes (T,R,P,S)	Other Outcomes (T',R',P',S')	Dep	Resp	Cooperation
Interdependence	1	(100,50,50,0)	(100,50,50,0)	0.50	0.50	13.33%
	2	(100,55,45,0)	(100,55,45,0)	0.60	0.60	27.54%
	3	(100,60,40,0)	(100,60,40,0)	0.69	0.69	30.43%
	4	(100,65,35,0)	(100,65,35,0)	0.78	0.78	35.07%
	5	(100,70,30,0)	(100,70,30,0)	0.84	0.84	36.52%
	6	(100,75,25,0)	(100,75,25,0)	0.90	0.90	35.36%
	7	(100,80,20,0)	(100,80,20,0)	0.94	0.94	38.55%
	8	(100,85,15,0)	(100,85,15,0)	0.97	0.97	38.26%
	9	(100,90,10,0)	(100,90,10,0)	0.99	0.99	42.61%
Dependence	1	(100,50,50,0)	(100,70,30,0)	0.50	0.84	22.03%
	2	(100,55,45,0)	(100,70,30,0)	0.60	0.84	21.16%
	3	(100,60,40,0)	(100,70,30,0)	0.69	0.84	25.51%
	4	(100,65,35,0)	(100,70,30,0)	0.78	0.84	24.35%
	5	(100,70,30,0)	(100,70,30,0)	0.84	0.84	33.04%
	6	(100,75,25,0)	(100,70,30,0)	0.90	0.84	33.62%
	7	(100,80,20,0)	(100,70,30,0)	0.94	0.84	37.39%
	8	(100,85,15,0)	(100,70,30,0)	0.97	0.84	39.13%
	9	(100,90,10,0)	(100,70,30,0)	0.99	0.84	42.90%
Responsibility	1	(100,70,30,0)	(100,50,50,0)	0.84	0.50	33.91%
	2	(100,70,30,0)	(100,55,45,0)	0.84	0.60	32.46%
	3	(100,70,30,0)	(100,60,40,0)	0.84	0.69	34.20%
	4	(100,70,30,0)	(100,65,35,0)	0.84	0.78	30.43%
	5	(100,70,30,0)	(100,70,30,0)	0.84	0.84	37.39%
	6	(100,70,30,0)	(100,75,25,0)	0.84	0.90	31.30%
	7	(100,70,30,0)	(100,80,20,0)	0.84	0.94	27.83%
	8	(100,70,30,0)	(100,85,15,0)	0.84	0.97	27.54%
	9	(100,70,30,0)	(100,90,10,0)	0.84	0.99	29.86%

Note. The outcomes for each game, indexes for dependence and responsibility, and cooperation rate are provided above. The annotation provided by Rapoport and Chammah (1965) was used to label the outcomes: T, R, P, and S. Outcomes for the other person are indicated by an apostrophe. Dep = Dependence, Resp = Responsibility. Cooperation is the percentage of participants who chose the cooperative option in each game.

After omitting game 5, each set of games was sub-divided into a block of games with a severe social dilemma (games 1-4) and a block of games with a mild social dilemma (games 6-9). This allows for a test of whether dilemmas that are more severe in terms of interdependence (set 1), dependence (set 2) and responsibility (set 3) elicit lower cooperation rates. To test the within subjects effects, a repeated measures ANOVA was used with a 3 (set) by 2 (block) design. Additionally, several between-subjects factors were used in analyses. Participants in session 1 and 2 viewed the games in a different randomized order (game 1, 14, and 27 were not randomized). This allowed for a test of order effects by using the order (session 1-2, session 3-4) as a between subjects factor. Gender (male, female) of participants was self-reported and included as a between subjects factor, although no gender effects were hypothesized. Finally, the SVO of the participant was included as a between subjects factor with participants categorized into J, O, and R groups.

2.3 Results

2.3.1 Gender and Order

Initial analyses were conducted with gender and the order of the games as between-subjects factors. Cooperation rates in the 27 games did not differ for males and females. Participants who were presented with the games in the first random order or the second random order also did not differ with regards to cooperation. Furthermore, there were no interactions with other variables for gender and order. To reduce the number of statistical tests, these variables were removed from subsequent analyses.

2.3.2 Main Effects

Average rates of cooperation are shown in the last column of Table 1. There was no main effect for the within-subjects variable for the set of games, p = .44. This means that overall cooperation rates were statistically the same in the interdependence, dependence, and responsibility sets. This effect is not relevant to the hypotheses because each game set has the same level of dependence and responsibility averaged across the 9 games. It is within each set that dependence and/or responsibility vary, so the crucial test is weather the game set interacts with the severity variable (block).

In support of hypothesis 1, there was a main effect for the severity of the dilemma. Averaged over all sets, there was a higher rate of cooperation in the mild games 6-9 (M = 35.36%) than in the severe games 1-4, M = 27.53%, $F(1, 342)$ = 40.87, $p < .001$, η^2 = 10.7%, Observed Power > 99%.

There was also a main effect for SVO, $F(2, 342) = 61.68$, $p < .001$, η^2 = 26.5%, Observed Power > 99%. A planned Helmert contrast showed that Js (M = 49.87%) had a higher overall cooperation rate than Os and Rs combined, $p < .001$. This provides strong support for hypothesis 4. The cooperation rates for Os (M = 14.91%) and R's (M = 6.79%) were not significantly different, $p = .128$.

2.3.3 Dependence and Responsibility Interaction with Severity

The main effect for severity described above shows that cooperation rates are higher for games with a milder dilemma. The mildness of a dilemma is increased across games if dependence is increased (Set 2), responsibility is increased (Set 3), or both (Set 1). An interaction between Set and Severity shows that the increase in cooperation associated with severity is qualified by how the severity of the dilemma is increased (interdependence, dependence, or responsibility). This interaction was highly significant, $F(2, 341) = 24.13$, $p < .001$, $\eta^2 = 12.4\%$, Observed Power > 99%. In support of hypothesis 2, the first planned contrast showed that severity had similar effect in the interdependence and dependence sets $F(2, 342) = 1.87$, $p = .17$, $\eta^2 = 0.5\%$, Observed Power = 27.6%. The second planned contrast revealed that the effect of severity was different from the interdependence set in the responsibility set $F(2, 342) = 43.95$, $p < .001$, $\eta^2 = 11.4\%$, Observed Power > 99%.

An examination of the means in Table 1 shows that the cooperation rate was higher for more mild games in both the interdependence and dependence sets, but that milder games produced a lower rate of cooperation in the responsibility set. This provides support for hypotheses 1 and 2, but not for the 3rd hypothesis that greater responsibility would positively affect cooperation. Simple effects tests showed this to be the case. For the interdependence set, there was a higher rate of cooperation in the more mild games, $F(1, 344) = 83.22$, $p < .001$, $\eta^2 = 19.5\%$, Observed Power > 99%. This same effect exists for the dependence set, $F(1, 344) = 91.92$, $p < .001$, $\eta^2 = 21.1\%$, Observed Power > 99%. The reverse effect resulted from the responsibility set, games with higher responsibility elicited a slightly lower cooperation rate than games with lower responsibility, $F(1, 344) = 7.07$, $p = .008$, $\eta^2 = 2\%$, Observed Power = 75.5%.

2.3.4 SVO Interactions

The prediction of hypothesis 5 was that the effect of severity would be stronger for individuals with an SVO of J or O. The SVO of the participant did qualify the overall effect of severity, $F(2, 342) = 11.46$, $p < .001$, $\eta^2 = 6.3\%$, Observed Power > 99%. A planned contrast showed that the prosocial Js had a stronger severity effect than the proselfs (Os and Rs), $F(1, 343) = 20.76$, $p < .001$, $\eta^2 = 5.7\%$, Observed Power

> 99%. The difference in response to severity between Os and Rs was in the predicted direction, but marginally non-significant, $F(1, 164) = 2.92$, $p = .09$, $\eta^2 = 1.8\%$, Observed Power > 39.7%. It is worth noting that because Js were omitted from the second contrast, there was a substantially smaller sample size ($N = 166$) which limited the power to detect an effect.

Next, tests of simple effects for each SVO were conducted. For Js, cooperation rates were much higher in the more mild games, $F(1, 178) = 82.07$, $p < .001$, $\eta^2 = 31.6\%$, Observed Power > 99%. The effect was weaker, bus still significant in Os, $F(1, 117) = 15.86$, $p < .001$, $\eta^2 = 11.9\%$, Observed Power = 97.7%. There was no effect of severity on cooperation rates for Rs, $F(1, 47) = 1.19$, $p = .28$, $\eta^2 = 2.5\%$, Observed Power = 18.8%. This pattern of results provides support for hypothesis 5: more mild games elicited higher cooperation rates in both Js and Os, but not for Rs.

There were no 3-way interactions between SVO, game set, and severity. The two way interaction between set and severity shows that dependence caused higher rates of cooperation than responsibility. This was equally true for all SVOs.

2.4 Discussion

Research on the symmetric PDG has consistently yielded a finding that overall cooperation rates are lower in games where the dilemma is more severe (e.g., Rapoport & Chammah, 1967). This was the basis of hypothesis 1 in the current study which was strongly supported. Beyond this, the asymmetric games in the current study allow for a separation of interdependence into its two components: dependence and responsibility. The second set of games provided a test of whether increasing an individual's dependence on another DM would increase cooperation, while controlling for the extent to which the individual is responsible for the other DM (hypothesis 2).

Conversely, the third set of games varied responsibility while holding dependence constant (hypothesis 3). Cooperation rates in the second set of games were highly similar to the first set. From this, we can infer that most (if not all) of the cooperation associated with more mild dilemmas can be accounted for by increases in the extent that a DM depends on others, providing strong support for hypothesis 2. In the third set of games, the effect was reversed. A greater level of responsibility caused DMs to be slightly less cooperative, contradicting hypothesis 3. It seems safe to conclude that dependence is the "active ingredient" in interdependence that elicits higher rates of cooperation. The higher responsibility associated with interdependence actually inhibits cooperation somewhat. Mathematically, when JC is set to 0, dependence and responsibility are the only components of interdependence and must account for 100% of the variance in outcomes. This is a property of Kelley and Thibaut's (1978) use of the ANOVA method of parameterizing interdependence. This allows for the inference that manipulations of dependence fully account for increased cooperation in more mild PDG's.

This finding is theoretically important because to my knowledge it is the first research to distinguish between the influences of different components of social interdependence. This was made possible by the use of the asymmetric matrix game, a tool that has been seldom used in research because of its complexity and applicability to psychological constructs. The design of Study 1 addresses the complexity issue by developing a way to quantify parameters of an asymmetric game and addresses the applicability issue by demonstrating the relevance of asymmetric games to our theoretical understanding of how dependence and responsibility influence cooperation. This opens the door for an almost limitless array of future laboratory studies systematically employing asymmetric games and may be applied to many natural settings where individuals are unlikely to depend on one another equally based on individual differences.

It is also a robust finding in prior research that people with a prosocial SVO are more cooperative in the PDG and many other games (see Balliet, Parks, & Joireman, 2009; Yamagishi et al., 2013). The results of Study 1 replicate this finding in support of hypothesis 4 that Js have higher rates of cooperation than Os and Rs (proselfs). Limited past research has also tested whether SVO moderates the effect of severity on cooperation rates. In a study by Kuhlman and Marshello (1975), participants played an iterated game where 30 trials of the PDG with the same partner and feedback were included. The strategy of the ostensible partner was manipulated in 3 conditions to be either 100% cooperative, 100% non-cooperative, or employ a tit-for-tat (TFT). The TFT condition was important because it allowed for a test of whether the different SVOs were responsive to the other DM's decisions. Specifically, one can maximize both joint gain and own gain in the long-term by cooperating with a TFT partner. The result that both Js and Os (but not Rs) increased cooperation when playing with a TFT partner provided a nice demonstration of the motivational goals of each SVO. Additionally, this provides evidence that both Js and Os will adjust behavior based on a manipulation of the incentive structure. In a dissertation by Curt Camac (1986) a different manipulation of incentive structure was employed where one-shot games differed in the severity of the dilemma (very much like the current study). Camac (1986) found that both Js and Os cooperated more frequently in games with a milder dilemma, but that Rs were not responsive. In the current research the results of the Camac (1986) study were replicated: both Js and Os were more cooperative in the mild games and Rs did not alter decisions based on this manipulation. However, the difference in the severity effect between Os and Rs was marginally non-significant. I believe this was mostly due to a lack of power as Os and Rs are less common than Js both in the study sample and in the population.

Returning to the HARKing analogy, the results of this study may imply that potential HARKers who are more dependent on others in the field may be more likely to cooperate by disclosing their hypotheses. Solutions to the HARKing problem might involve emphasizing the importance of other researchers and the field as a whole in deciding on outcomes of importance to the individual researcher. Study 2 will provide a test of whether the effect of dependence on cooperation replicate in a different set of PDGs.

Chapter 3

STUDY 2: RESOURCE ASYMMETRY

The second study serves 2 aims. First it was an attempt to replicate the effects of Study 1 using a more limited manipulation of dependence and responsibility. Secondly, a different form of asymmetry was tested. Study 2 included games that systematically vary the Grand Mean of outcomes for each player. Specifically, there were 1) games where the participant's average outcomes were larger than the corresponding average outcomes for the other DM, 2) games where the average of the outcomes for each DM were equal, and 3) games where the participant had smaller average outcomes. This creates a 3 by 3 by 3 within-subjects design where the independent variables are dependence (high, medium, low), responsibility (high, medium, low), and resource allocation (advantage, equal, disadvantage). SVO was again measured as a between subjects variable.

3.1 Introduction

Let's now imagine Marcia's relationship with a more prominent scientist named Kim. Kim has just as strong of a collective interest in the field as Marcia, but because of her position in the field, she is better off than Marcia. All of her potential outcomes are 100 units higher than those available to Marcia, as shown in Figure 5. Again, the 100 units is only an arbitrarily chosen number, the assumption is that Kim is 100 units better off than Marcia, before the social dilemma is even considered. In this PDG, dependence and responsibility for both players is 0.94, but the 2 players still have asymmetrical outcomes. Dependence and responsibility are equal because AC and PC are both a function of the ratios of payoffs and are not influenced by the overall magnitude of the payoffs. So, as long as every payoff for a player is changed by the same amount, dependence and responsibility are held constant. In this case, the outcomes of Marcia and Kim are asymmetrical only with respect to resources.

Figure 5: Resource asymmetry for Marcia (resource disadvantage) and Kim (resource advantage)

		Kim	
		Disclose	HARK
Marcia	D	80 / 180	0 / 200
	H	100 / 100	20 / 120

Note. The fictional researchers "Marcia" and "Kim" each have a choice to Disclose hypotheses (D) or HARK (H). Marcia's choice is between the rows and her outcomes (100, 80, 20, 0) are represented below the diagonal. Kim's choice is between columns and her outcomes (200, 180, 100, 20) are represented above the diagonal. In this game, Kim has a resource advantage.

The component of the matrix that is asymmetrical is the Grand Mean (GM) of all 4 payoffs available to Marcia (GMM) and Kim (GMK). The GM for either researcher is a function of the total amount of her outcomes:

$$GM = \frac{T+R+P+S}{4} \tag{4}$$

For Marcia, the overall outcomes are lower (GM_M = 50) than the overall outcomes for Kim (GM_K = 150). The difference between these two figures represents a resource inequality in the social dilemma. For Kim, this is a resource advantage of 100 units. Limited prior research shows that people in Kim's position (relative advantage) are more likely to choose cooperation (Sheposh & Gallo, 1973; Parks, Rumble, & Posey, 2002). However, more research is needed to understand why this happens and whether inequality may interact with other forms of asymmetry in predicting cooperation. For example, individuals with a material advantage and low responsibility may be less inclined to cooperate that those with high responsibility.

The first 5 hypotheses for Study 2 are identical to the hypotheses for Study 1. In addition, a main effect for resources was expected:

> H6: In games where people have a resource advantage, there will be higher rates of cooperation.

Interactions between resources and the other 3 variables (SVO, dependence, responsibility) were an important focus of the study, but no predictions were made because of a lack of a theoretical basis.

3.2 Methods

Procedurally Study 2 was almost identical to Study 1. The only difference is that the 27 games presented to participants had different outcomes and a different analysis strategy was utilized to accommodate a more complex within-subjects design.

3.2.1 Participants

Participants were 198 University of Delaware undergraduate students receiving course credit in an introductory psychology class. There was a session with 75 participants in the fall, 2015 semester, a session with 105 participants in the spring 2016 semester, and an online session with 18 participants to supplement the fall sample. Fall semester and online students viewed the games in the first order, the spring participants viewed the games in a different order. The exclusions were similar to the first study: 2 participants were removed for missing data, 35 participants were excluded for failing the quiz, and 16 of the remaining participants had a rare or unclassified SVO. For analyses, 145 participants remained (55 male).

3.2.2 Measure

The Ring Measure of SVO (Appendix A) was identical to Study 1. The distribution of SVO was similar to the first study; 1.2% Alts, 45.1% Js, 27.8% Os, 16.7% Rs, 1.2% Aggs, and 8% unclassified. A pretest of SVO using the same Ring Measure was given approximately 3 months prior to the experiment over the internet. The pretest of SVO was given to 125 of the participants and 62.4% of them were classified with the same SVO on both occasions.

3.2.3 Procedure

Participants were first presented with a document of informed consent (Appendix D) which all attendees signed, indicating their agreement to participate. After completing the Ring Measure (Appendix A) and the instructions (Appendix C), participants were asked to choose between A and B in 27 games that varied in resources, dependence, and responsibility.

Nine games from Study 1 were chosen in order to test the effects of dependence and responsibility. Games 3, 5, and 7 were chosen from each set to represent severe, moderate, and mild levels of each variable (interdependence, dependence, and responsibility. In these 9 games, resources (the grand mean) is held constant and equal for the participant and the other DM while dependence and responsibility vary systematically. Next, I generated a set of games where a constant of 100 was added to each of the other DMs outcomes. This is the resource disadvantage set. In the final set of games, the first set is altered by adding 100 points to the outcomes of the participant – a resource advantage.

Table 2 shows the outcomes for both DMs in all 27 games. Using these outcomes, the within-subjects design of the study is 100% orthogonal, each of the variables (resources, dependence, and responsibility) was manipulated independent of the other 2 variables. This allows for a pure test of the effects of each of the variables.

3.2.4 Analyses

In this study, none of the games were identical and all of the games were included in the 3 (Resources) by 3 (Dependence) by 3 (Responsibility) within subjects design. The between subjects factors were the same as Study 1. Gender (male, female) was included in initial analyses along with the order of the games. SVO was again included as a between subjects factor with 3 categories (J, O, R).

3.3 Results

Initial analyses were conducted with gender and order as between-subjects factors. For the order variable, the fall session and the online session were collapsed into one group because they saw the games in the same order and the online session had too small of a sample to analyze as a separate group. There were no main effects or interactions for gender and order, so these two variables were removed from subsequent analyses.

Table 2: Games used in Study 2

Set	Game	Own Outcomes (T,R,P,S)	Other Outcomes (T',R',P',S')	Dep	Resp	Cooperation
Resource Equality	1	(100,60,40,0)	(100,60,40,0)	0.69	0.69	28.28%
	2	(100,60,40,0)	(100,70,30,0)	0.69	0.84	24.83%
	3	(100,60,40,0)	(100,80,20,0)	0.69	0.94	24.83%
	4	(100,70,30,0)	(100,60,40,0)	0.84	0.69	30.34%
	5	(100,70,30,0)	(100,70,30,0)	0.84	0.84	32.41%
	6	(100,70,30,0)	(100,80,20,0)	0.84	0.94	30.34%
	7	(100,80,20,0)	(100,60,40,0)	0.94	0.69	31.72%
	8	(100,80,20,0)	(100,70,30,0)	0.94	0.84	34.48%
	9	(100,80,20,0)	(100,80,20,0)	0.94	0.94	28.97%
Resource Disadvantage	10	(100,60,40,0)	(150,110,90,50)	0.69	0.69	15.86%
	11	(100,60,40,0)	(150,120,80,50)	0.69	0.84	14.48%
	12	(100,60,40,0)	(150,130,70,50)	0.69	0.94	11.03%
	13	(100,70,30,0)	(150,110,90,50)	0.84	0.69	17.24%
	14	(100,70,30,0)	(150,120,80,50)	0.84	0.84	15.86%
	15	(100,70,30,0)	(150,130,70,50)	0.84	0.94	17.24%
	16	(100,80,20,0)	(150,110,90,50)	0.94	0.69	20.69%
	17	(100,80,20,0)	(150,120,80,50)	0.94	0.84	19.31%
	18	(100,80,20,0)	(150,130,70,50)	0.94	0.94	19.31%
Resource Advantage	19	(150,110,90,50)	(100,60,40,0)	0.69	0.69	37.93%
	20	(150,110,90,50)	(100,70,30,0)	0.69	0.84	35.86%
	21	(150,110,90,50)	(100,80,20,0)	0.69	0.94	34.48%
	22	(150,120,80,50)	(100,60,40,0)	0.84	0.69	41.38%
	23	(150,120,80,50)	(100,70,30,0)	0.84	0.84	35.86%
	24	(150,120,80,50)	(100,80,20,0)	0.84	0.94	37.24%
	25	(150,130,70,50)	(100,60,40,0)	0.94	0.69	40.00%
	26	(150,130,70,50)	(100,70,30,0)	0.94	0.84	40.69%
	27	(150,130,70,50)	(100,80,20,0)	0.94	0.94	40.69%

Note. The outcomes for each game, indexes for dependence and responsibility, and cooperation rate are provided above. The annotation provided by Rapoport and Chammah (1965) was used to label the outcomes: T, R, P, and S. Outcomes for the other person are indicated by an apostrophe. Dep = Dependence, Resp = Responsibility. Cooperation is the percentage of participants who chose the cooperative option in each game.

Table 3: Cooperation rates for Js, Os, and Rs in Study 2

			Cooperation Rates by SVO		
Component	**Level**	**Total**	**J** (*N*=73)	**O** (*N*=45)	**R** (*N*=27)
Dependence	Low	25.29%	42.47%	10.37%	3.70%
	Moderate	28.66%	47.43%	11.85%	6.17%
	High	30.65%	50.23%	13.83%	5.76%
Responsibility	Low	29.27%	47.49%	13.58%	6.17%
	Moderate	28.20%	46.73%	11.85%	5.35%
	High	27.13%	45.81%	10.62%	4.12%
Resources	Disadvantage	16.78%	27.55%	7.16%	3.70%
	Equality	29.58%	47.64%	14.81%	5.35%
	Advantage	38.24%	64.84%	14.07%	6.58%

Note. The table above provides average cooperation rates for 9 games sharing a characteristic. For example, in the "Total" column, Dependence/Low = 25.29%, this is an average of the 9 games that had low dependence (games 1, 2, 3, 10, 11, 12, 19, 20, 21). The columns J, O, and R designate the cooperation averages for each of the 3 SVOs: J = Joint gain maximizers, O = Own gain maximizers, and R = Relative gain maximizers.

The key results are divided into 4 sub-sections. The first section is a report of the main effect and contrasts for SVO. The remaining three subsections each report the main effects and interactions for the three within-subjects variables: resources, dependence, and responsibility. Cooperation rates for all 27 games are reported in Table 2. Means for groups of games are reported in Table 3. All of the within subjects effects reported in the following section are based on a 3 (resources) by 3 (dependence) by 3 (responsibility) repeated measures ANOVA using the multivariate model, with SVO (J, O, R) as a between-subjects factor. The cooperation rate for each game was the dependent variable.

3.3.1 Social Value Orientation Main Effect

Study 2 provided a replication of the SVO main effect from Study 1 and additional support for hypothesis 4. The effect sizes were large for both studies, $F(2, 142) = 32.65$, $p < .001$, $\eta^2 = 32.2\%$, Observed Power > 99%. Planned contrasts also yielded the same results. Js ($M = 46.7\%$, SD = 33.8%) had higher cooperation rates that the average of Os (M = 12%) and Rs, M = 5.2%, $p < .001$. The contrast between cooperation rates for Os and Rs did not reach significance, $p = .31$.

3.3.2 Resource Asymmetry Effects

There was a strong main effect for resources, $F(2, 141) = 16.87$, $p < .001$, $\eta^2 = 19.3\%$, Observed Power > 99%. In planned contrasts, cooperation rates were compared between the resource disadvantage and equal resources games, and then between the equal resource and resource advantage games. The first planned contrast showed that cooperation rates were higher in games with equal resources than in games with a resource disadvantage, $F(1, 142) = 19.01$, $p < .001$, $\eta^2 = 11.8\%$, Observed Power > 99%. The second planned contrast showed that cooperation rates in the resource advantage games were even higher than games with equal resources $F(1, 142) = 5.88$, $p = .017$, $\eta^2 = 4\%$, Observed Power = 67.3%. There were no interactions between resources and dependence or responsibility, p's > 0.5.

The effect of resources on cooperation rates was moderated by SVO, $F(4, 284) = 12.19$, $p < .001$, $\eta^2 = 14.7\%$, Observed Power > 99%. The same planned contrasts for resource conditions were tested with SVO as a moderator. The first planned contrasts for resources showed that SVO moderated the difference in cooperation between games with a resource disadvantage and games with equal resources, $F(2, 142) = 6.78$, $p < .01$, $\eta^2 = 8.7\%$, Observed Power = 91.4%. SVO also moderated the second contrast between equal resource and resource advantage games, $F(2, 142) = 7.39$, $p = .001$, $\eta^2 = 9.4\%$, Observed Power = 93.6%. This pattern of results shows that the effects of advantage on cooperation were moderated by SVO throughout the range of games used.

Follow up tests were conducted to determine the directionality and significance of SVO differences in the effect of resources on cooperation. First, prosocials (Js) were compared to proselfs (Os and Rs) and there was a strong effect $F(2, 142) = 19.2$, $p < .001$, $\eta^2 = 21.3\%$, Observed Power > 99%. Planned contrasts showed this was true for both levels of the resource manipulation. The prosocials showed a stronger effect on cooperation rates for resource equality relative to resource disadvantage $F(1, 143) = 12.56$, $p = .001$, $\eta^2 = 8.1\%$, Observed Power = 94.1%. This effect held for resource advantage relative to resource equality, $F(1, 143) = 14.79$, $p < .001$, $\eta^2 = 9.4\%$, Observed Power = 96.8%. These results show that greater resources relative to others influences prosocials to cooperate more than it influences proselfs. Next, Os were compared to Rs to see if they differ in the effect of resources on cooperation rates. The interaction ($p = .31$) and contrasts (p's > .15) were all non-significant.

Finally, tests of simple effects were conducted to examine whether the resource manipulation had an effect on cooperation rates for each of the 3 SVO groups. Greater resources positively affected cooperation rates for Js, $F(2, 71) = 31.38$, $p < .001$, $\eta^2 = 46.9\%$, Observed Power > 99%. Js were more cooperative in resource equality relative to resource disadvantage games $F(1, 72) = 31.4$, $p < .001$, $\eta^2 = 30.4\%$, Observed Power > 99%. Js were also more cooperative with a resource advantage than when resources were equal, $F(1, 72) = 20.78$, $p < .001$, $\eta^2 = 22.4\%$, Observed Power > 99%. Although the effect of resources on cooperation was much weaker for Os, it was still a significant effect, $F(2, 43) = 5.04$, $p = .011$, $\eta^2 = 19\%$, Observed Power = 79%. Interestingly, Os were only influenced by the resource equality vs. resource disadvantage contrast, $F(1, 44) = 6.04$, $p = .018$, $\eta^2 = 12.1\%$, Observed Power = 67.1%. For Os the difference in cooperation rates between resource advantage and resource equality was non-significant, $p = .84$. For Rs the multivariate effect and contrasts for resources were all non-significant, *p*'s > .25. This pattern of results show that Js are considerably more cooperative when they have more resources available and that Os are particularly non-cooperative when they have a resource disadvantage.

3.3.3 Dependence Effects

To test dependence, the planned analyses were first conducted. When most of the results did not reach significance, additional exploratory analyses were conducted.

3.3.3.1 Planned Analyses

The multivariate effect of dependence on cooperation rates provided a replication of Study 1 and support for the second hypothesis, $F(2, 141) = 7.52$, $p = .001$, $\eta^2 = 9.6\%$, Observed Power = 94%. Planned contrasts were conducted to compare cooperation rates in the low dependence (severe) versus moderate dependence games and then the moderate dependence versus high dependence (mild) games. Only the first planned contrast was significant; there was a higher rate of cooperation in moderate dependence games than low dependence games, $F(1, 142) = 8.08$, $p = .005$, $\eta^2 = 5.4\%$, Observed Power > 80.6%. While the second contrast did not reach significance, the trend was in the predicted direction, with high dependence games having a higher cooperation rate than moderate dependence games, $p = .2$, Observed Power = 24.6%.

The moderating effect of SVO on dependence that was observed in Study 1 was not replicated in Study 2, $F(4, 284) = 1.41$, $p < .23$, $\eta^2 = 2\%$, Observed Power = 43.8%. This fails to provide support for the fifth hypothesis. For the SVO and dependence interaction, planned contrasts were conducted across different levels of dependence (low vs. moderate, moderate vs. high) and SVO (J vs. OR, O vs. R). None of the planned contrasts reached significance. Finally, the simple effect of dependence was only significant in Js, $F(2, 71) = 9.6$, $p < .001$, $\eta^2 = 21.3\%$, Observed Power = 97.7%. While these results are generally not supportive of an interaction between SVO and dependence, all of the values for cooperation rates differed in the same direction as Study 1 (see Table 3). A major concern is that the tests of the SVO and dependence interaction in Study 2 were under-powered compared to Study 1. In Study 2 ($N = 145$) there were considerably fewer participants than Study 1 ($N = 345$). The range of dependence across games in Study 2 (0.5 < dependence < 0.99) was smaller than in Study 2 (0.69 < dependence < 0.94).

3.3.3.2 Supplemental Analyses

To address the power limitation, exploratory analyses were conducted for Study 2 that included participants who had failed the quiz given after the instructions, increasing the sample size to $N = 174$. In the larger sample there was an effect for the interaction between SVO and dependence on cooperation rates, $F(4, 342) = 2.55$, $p = .039$, $\eta^2 = 2.9\%$, Observed Power = 71.8%. Planned contrasts showed that the effect of dependence on cooperation rates was stronger in Js than the combination of Os and

Rs, $F(2, 171) = 4.73$, $p = .01$, $\eta^2 = 5.2\%$, Observed Power = 78.4%. The strength of the dependence effect did not differ between Os and Rs, $p > .5$.

Next, the simple effect of dependence on cooperation for each SVO was tested. For Js, cooperation was found to be positively related to dependence, $F(2, 84) = 12.58$, $p < .001$, $\eta^2 = 23\%$, Observed Power > 99%. The effect was only marginal for Os, $F(2, 52) = 2.07$, $p = .14$, $\eta^2 = 7.4\%$, Observed Power > 40.7%. There was no effect of dependence on cooperation for Rs, $p = .7$. The supplemental analyses match the Study 1 results closely except that the simple effect of dependence for Os was marginal in Study 2 and significant in Study 1.

3.3.4 Responsibility Effects

There were no effects or interactions for responsibility. These null effects replicate Study 1 and fail to provide support for the third hypothesis.

3.4 Discussion

The second study was designed to replicate dependence and responsibility effects from the first study and to test the effects of asymmetric resources. For the discussion of Study 2, one subsection is devoted to each of these aims.

3.4.1 Replication of Study 1

The first aim of Study 2 was to conduct a conceptual replication of Study 1. In the first study, it was found that DMs are more cooperative in games that have more dependence (mild), a component of interdependence. This was true for joint gain maximizing and own gain maximizing SVOs, but not for relative gain maximizers. The second study provides a clear replication of the first effect; games with more dependence (but not games with more responsibility) elicited higher cooperation rates.

The results for the SVO interaction were mixed. In the initial analyses, only Js were more cooperative in games with more dependence and the interaction and contrasts failed to reach significance. Based on the smaller sample size, restricted range of dependence, and observed power statistics, I am confident that the null results stem from a lack of power. It is also important to note that the values of cooperation rates differed (non-significantly) in the predicted directions in all tests. The supplemental analyses provide additional support for the SVO and dependence interaction, but these results should be interpreted with caution because they include participants who displayed a limited understanding of the experiment and these analyses were done in an exploratory manner, making the degrees of freedom for the statistical tests questionable. The contrasts in the supplemental analyses also replicated Study 1; the effect of dependence on cooperation was strongest in Js and the difference between Os and Rs was non-significant. The simple effect for Js was also a replication, but the simple effect for Os that was significant in Study 1 was marginally non-significant in Study 2. The simple effect for Rs was non-significant in both studies.

There was also a replication of the main effect of SVO: J's were more cooperative than Os and Rs overall. Based on the 2 studies in this dissertation and the work of Camac (1986), it appears that Js (prosocials) are most sensitive to the effects of dependence and that all SVOs are non-responsive to changes in responsibility.

3.4.2 Cooperation Based on Relative Resources

The results provided strong support for hypothesis 6. DMs with a resource advantage were much more cooperative than DM's with equal resources, who were in turn, much more cooperative than DMs with a resource disadvantage. Both of these differences were strongest for Js, although Os were also influenced by the resource manipulation with higher cooperation rates in games where they had greater resources.

In the HARKing example, we can expect that Kim (resource advantage) would be less likely to HARK than Marcia (resource disadvantage). In the example, it would be impossible to put all researchers in a position where they have more resources than other researchers. That said, these findings suggest a policy in which prosociality towards the field should be promoted as a basis for attaining resources. People who are joint maximizers would be more likely to use their extra resources more prosocially. It also might make sense to encourage collaborative relationships between researchers who differ in their relative resources. This could allow more advantaged researchers to ensure the work is in the best interest of the field while the less advantaged researchers may benefit from greater access to resources and still maintain a strong pursuit of individual goals.

Chapter 4

GENERAL DISCUSSION

The two studies provide an initial examination of how asymmetry of power and asymmetry of resources can influence cooperation in social dilemmas. Research on asymmetric games is important because it can be generalized to relationships outside the laboratory that are frequently asymmetric. From a theoretical perspective, the study of asymmetric games allows us to disentangle theoretical constructs pertaining to the evaluation of one's own possible outcomes (e.g., dependence) the outcomes of others (e.g., responsibility) and a social comparison between the two sets of outcomes (e.g., resource asymmetry).

The decisions of researchers of different status to HARK or disclose hypotheses provides just one example of this. There are many additional interpersonal applications including romantic relationships with a power differential and social relationships between members of high and low status groups within society. At the group level, teams with coaches and star players or organizations with bosses and employees have asymmetries in the outcomes available to each person. At the international level, nations vary in the extent to which they are wealthy and can exert influence over other nations they depend on and are responsible for.

In this final section, I will 1) summarize conclusions with regards to power and resource asymmetries, 2) describe extensions of the current paradigm in gaming research, and 3) offer final remarks.

4.1 Summary of Findings

Asymmetry in social relationships is prevalent in our daily lives. In socially interdependent situations, we routinely need to make decisions where we are dissimilar to others in terms of power, resources, and risk. In the current paper, two forms of asymmetry have been classified and Kelley and Thibaut's (1978) Social Interdependence Theory has been used to represent and quantify each of these asymmetries in the matrix form.

4.1.1 Power Asymmetry

The power a person has in a social dilemma can be divided into two parts: the power one has over outcomes to self and the power one has over the outcomes to others. In this paper, the former is referred to as dependence (on others) and the latter is responsibility (for others). Theoretically, these two parts are both important and distinct features of an interdependent relationship. Substantial prior research has empirically demonstrated that people are more likely to cooperate in social dilemmas that are more interdependent (e.g., Rapoport & Chammah, 1967). Asymmetric games used in the current research allowed for a test of whether dependence or responsibility is the driver of the cooperation increases. The findings were quite clear: dependence resulted in higher rates of cooperation in both studies and there was no effect at all for responsibility. This shows that the reason people are more likely to cooperate in situations with higher interdependence is because they are more dependent on others. In short, we are more cooperative with people who have more power to decide our outcomes.

The effects for dependence were most pronounced for DMs with a joint maximizing orientation and non-existent for DMs with a relative gain maximizing orientation. These findings are both consistent with theory on SVO emphasizing individual differences in the goals or social motives of Js, Os, and Rs. Higher levels of dependence make mutual cooperation more advantageous relative to mutual non-cooperation. This should make the cooperative option even more attractive for Js because the potential joint gain for cooperation is greater in games with high dependence. While the prospects for relative gain may be enhanced with greater dependence, past research has shown that Rs are not influenced by changes to outcomes, possibly because they have very negative expectations of the cooperation of others (Camac, 1986; Kelley & Stahelski, 1970; Kuhlman & Wimberley, 1976). There were mixed results for own gain maximizers who seem to be influenced by dependence, but not nearly as much as Js. This may reflect the fact that even with high amounts of dependence, non-cooperation is always a strictly dominant strategy for own gain in the PDG, however the difference between own outcomes for cooperation and competition is not as extreme when a DM is more dependent. This helps to explain why Os are more cooperative in response to dependence, but this is not a particularly strong effect.

On the other side, responsibility is the amount of power we have over the outcomes for others. A greater amount of responsibility means that an act of cooperation has a greater benefit to others and an act of competition is more detrimental to others. Unfortunately, it does not appear that even prosocials are motivated by a responsibility to benefit others. Study 1 even provides evidence that responsibility decreases cooperation slightly, but this effect was not replicated in Study 2. The willingness to cooperate more when others have power over us combined with an unwillingness to compete more when we have power over others explains the increases in cooperation when both DMs have more power over each other (social interdependence).

Methodologically, the current paper makes the contribution of demonstrating that dependence and responsibility can be manipulated independently across different games and that these components can be quantified. The current findings contribute to theory on social interdependence by evaluating how the underlying components of social interdependence each contribute to cooperation. Finally, theory on SVO is enhanced because conditions under which different SVOs are more or less likely to cooperate have been identified.

4.1.2 Resource Asymmetry

Past research has provided some evidence that individuals are more likely to cooperate in a PDG if they have a higher average outcome relative to the other DM (Parks, Rumble, & Posey, 2002; Sheposh & Gallo, 1973). The current research further refines this finding by testing both a resource advantage and a resource disadvantage against the standard condition of equal resources. The findings clearly supported past research and showed that differences across all levels of resources positively influence cooperation. Furthermore, this effect was moderated by SVO such that Js were most motivated to cooperate with more resources. Os were also more cooperative when they were not at a resource disadvantage, but the effect was much weaker than the effect for Js. This may suggest that the effect of resources on cooperation for Rs is limited to an inequality aversion. Rs were unmoved by changes to resources.

These findings suggest that cooperation in the PDG is influenced by a sense of fairness. Participants who were given a disadvantage were less likely to cooperate, possibly viewing competition as a way to even up the outcomes. In contrast, participants with a resource advantage were more generous with cooperation, possibly to restore fairness. The finding that these effects were strongest for the prosocial Js supports the idea that morality and fairness may be important concerns for cooperation when resources are unbalanced (Eek & Garling, 2000; Eek & Garling, 2006; Liebrand et al., 1986).

In the current research, the resource advantage and disadvantages were arbitrarily determined and the participants were provided with no justification for why their outcomes differed from the other DM. It is also unlikely in this paradigm that they would have any prior reason to believe they were given relatively favorable or unfavorable outcomes based on anything other than chance, this is especially true because in the within-subjects design all participants were exposed to all levels of resources. Outside the laboratory, individuals vary in their attributions for the basis of asymmetry in resources. It would be interesting to see how cooperation rates would be affected if the resource distribution was attributed to luck, effort, ability, or even deceit. This provides an interesting avenue for future research.

4.2 Social Risk Asymmetry

It was mentioned in the introduction that there are 3 parameters that account for variance in outcomes for each individual: actor control, partner control, and joint control. Actor control and partner control were examined for both studies with regards to one's own outcomes (dependence) and the other's outcomes (responsibility). Joint control is the interaction parameter for the matrix, it was set to zero in all games and ignored for practical reasons. However, recent research shows that joint control can influence PDG cooperation depending on individual differences in risk seeking (Ng & Au, 2015).

To illustrate, imagine you have a choice between two gambles, X and Y. If you choose gamble X, you have a 50% chance of getting $80 and a 50% chance of getting $0. If you choose Y, you have a 50% chance of getting $70 and a 50% chance of getting $10. First, note that both gambles have an expected value of $40 based on the average of the 2 equally probable outcomes. The difference between these two gambles is that Y is a safer choice, it guarantees the gambler at least $10. X is a riskier choice and has the possibility of yielding a large outcome. Thus, an individual motivated by a fear of getting $0 may be more likely to choose Y. In contrast, an individual motivated by greed may be more attracted to choice X and the possibility of getting $80 (Bonacich, 1970; Harris, 1972).

In a PDG, the player is also given two options which can be described as gambles with different expected outcomes for the player. The outcomes in a PDG are such that non-cooperation always has a higher expected value than cooperation, this is the conflict of interest between incentives to benefit self and incentives to benefit others (Ng & Au, 2015). In Figures 4a and 4b, the expected value of cooperation for Marcia is always 20 units less than the expected value of non-cooperation. This is true for Marcia's personal outcomes regardless of what Jan chooses in this PDG. However, this condition is not necessary. In the HARKing example, imagine that Jan is also a co-author on Marcia's manuscript. This is reflected in the outcomes in Figure 6: Jan has an outcome of 10 when she chooses D and Jan chooses H, this reflects Jan's benefit from Marcia's HARKing and publishing a paper with Jan as a co-author. Mutual Disclosure is also not as attractive to Jan (70), if Marcia chooses D, Jan has a smaller chance of being a co-author on a published paper.

Figure 6: Social risk asymmetry for Marcia (riskier dilemma) and Jan (safer dilemma)

		Jan	
		Disclose	HARK
Marcia	D	70 80	100 0
	H	10 100	20 20

Note. The fictional researchers “Marcia” and “Jan” each have a choice to Disclose hypotheses (D) or HARK (H). Marcia’s choice is between the rows and her outcomes (100, 80, 20, 0) are represented below the diagonal. Jan’s choice is between columns and her outcomes (100, 70, 20, 0) are represented above the diagonal. Cooperation is riskier for Marcia.

For Jan, the D option in the new version of the dilemma (Figure 6) is less risky than the original dilemma presented in Figure 4a. Another way of putting this is that the utility of Disclosure for Jan depends on Marcia’s choice to a larger extent. The difference in outcomes for Disclosure between Figure 4a and Figure 6 is identical to the gamblers choice described above. When the outcomes for Disclosure are 70 and 10, D is a safer choice. The opportunity for co-authorship on Marcia’s paper allows Jan a way to hedge her bet.

In Kelley and Thibaut’s (1978) theory of social interdependence, variations along the risk dimension are accounted for by the Joint Control (JC) component. It is calculated as the difference between the diagonal of the matrix and the off-diagonal. Many PDG’s do not have a JC component (e.g., all games in Study 1 and 2). This means that based on personal outcomes, cooperation and non-cooperation are equally risky. If there is JC, a player's dependence is partially determined by the choice of the other player.

To calculate JC, the average outcome of the diagonal is denoted as αβ1 and the average outcome of the off diagonal is denoted as $\alpha\beta_2$. In the notation used by Rapoport and Chammah (1965), the diagonal is comprised of R and P whereas the off-diagonal I comprised of T and S. The difference between $\alpha\beta_1$ and $\alpha\beta_2$ represents the interaction effect or JC. Let's examine this first in terms of the outcomes available to Marcia in Figure 6. For her, $\alpha\beta_1$ is 50 because this is the average of the diagonal payoffs 80 and 20. On the off-diagonal, Marcia's outcomes are 100 and 0. These outcomes also average to $\alpha\beta_2 = 50$. Since there is no difference between $\alpha\beta_1$ and $\alpha\beta_2$ for Marcia, $JC_M = 0$.

Next, consider Jan's outcomes in Figure 6. The diagonal has the outcomes 70 and 20, yielding $\alpha\beta_1 = 45$. The off-diagonal has outcomes of 100 and 10, and $\alpha\beta_2 = 55$. The Joint Control of Jan's outcomes is the difference between $\alpha\beta_1$ and $\alpha\beta_2$. The result of this calculation is $JC_J = -10$. The Risk parameter for Jan's outcomes is then defined by the formula:

$$RISK_J = \frac{(JC_J)^2}{(AC_J)^2+(PC_J)^2+(JC_J)^2} \qquad 5$$

To create the formula for Marcia's risk, all of the subscripts would need to be replaced with "M". Since $JC_M = 0$, the $Risk_M$ also equals 0. This is not to say that Marcia does not have any risk in the social dilemma. Rather, it indicates that Marcia's risk is the same for the H and D options.

For Jan, the two choices have a different level of risk. Using the calculations described in the Dependence section of this paper, $AC_J = 20$ and $PC_J = 70$. Using these numbers in the formula yields $RISK_J = .018$. This means that 1.8% of the variance in

Jan's outcomes is determined by the interaction between the choices of Marcia and Jan. But is cooperation more risky for Jan or Marcia? The JC component for Jan is negative, indicating that the D choice is less risky than the H choice. So, we would say that cooperation is less risky for Jan based on the lower value of JC_J. When JC is positive, this means that cooperation is riskier than non-cooperation.

In Figure 6, the risk for Marcia and Jan is asymmetric. How would the asymmetry in risk influence the decision to cooperate for Jan? What about for Marcia? Camac (1986) manipulated the risk in PDG games by having participants make choices in games with more incentive for greed (like the 80/0 gamble) and games with more incentive to avoid fear (like the 70/10 gamble). In this study, Camac did not find any effects for fear and greed manipulations on aggregate cooperation. Participants were more cooperative when the dilemma was more severe, but it did not matter whether the severity was increased by changes in the amount of greed (lower R outcome) or changes in the amount of fear (higher P outcome). Work by Ng and Au (2015) has shown than individuals with higher risk aversion are more likely to cooperate in response to fear incentives (low risk for cooperation choice) and less likely to cooperate in response to greed incentives (high risk for cooperation choice). This has helped to validate JC as a measure of the inherent riskiness in a game, but all of the PDGs used by Ng and Au were symmetrical. It remains to be seen whether asymmetries in social risk for 2 players have an effect on cooperation and whether this effect is moderated by individual differences such as risk aversion and SVO.

4.3 Other Extensions of the Asymmetric PDG

The PDG can take many forms. The focus of the current paper is to address asymmetric relationships in a basic form of the PDG where factors other than the asymmetry of the payoffs are controlled for. As a starting point, this approach helps to create a classification system for asymmetric games and a framework for understanding the psychological processes related to asymmetric PDG games. This aim has the consequence that the games presented in this paper may be limited in the extent to which they describe natural social interactions. One way to make experimentation on the PDG more externally valid will be to extend research by changing some of the key restrictions of games utilized in this paper. Specifically, there are at least 5 unnecessary features shared by all of the PDGs in the current research; 1) they are dyadic, 2) they are limited to one-shot interactions, 3) DM1 and DM2 have simultaneous choices, 4) the DMs have binary choice options, and 5) there is no communication between DM1 and DM2. This section will explain each of these features in turn while also providing examples of alternative PDG formats that do not adhere to these specifications.

4.3.1 The N-person PDG

The PDG analogy only has 2 DMs, but it is easy to imagine a case where there may be 3 or more DMs. In the Prisoner's analogy, imagine that a gang is arrested and only one confession is necessary to obtain convictions. For the HARKing analogy, it is probably more realistic to consider a much bigger social dilemma where there are many scientists that are all faced with choices whether to disclose hypotheses or to HARK. Conventionally, research on the PDG is restricted to the dyadic situation, but the logic and mathematical properties can be extended to the N-person PDG format (Komorita, 1976; Yamagishi, 1986). While the N-person PDG is mathematically similar to the 2 person PDG, the 2 person version may be unique psychologically. Dawes (1980) points out that in the N-person PDG, the harm caused by non-cooperation is diffused over multiple players and the non-cooperator may enjoy a higher degree of anonymity. Future research can determine whether the effects of diffusion and anonymity in the N-person PDG are influenced by different types of asymmetry.

4.3.2 The Repeated PDG

Outside of the laboratory, our interdependent social interactions are likely to be part of relationships with others that extend beyond one decision. Business partners, married couples, scientists, conflicting nations, and even prisoners are likely to have repeated interactions. Thus, the relationships that occur in our daily lives may be more closely approximated as repeated PDGs (rather than one-shot). The repeated PDG introduces the possibilities for reputational concerns, reciprocity, and conditional behavior (Nowak, 2011; Rapoport & Chammah, 1965). The effects of asymmetries in the PDG may be attenuated or amplified over multiple trials. For example, an individual who is persistently disadvantaged by inequality asymmetries may develop a learned helplessness, further discouraging cooperation (Lamb et al., 1987).

4.3.3 The Sequential PDG

In the prisoner example, each of the prisoner's is forced to make their own decision whether or not to confess without any knowledge of the other prisoner's decision. This process is commonly referred to as "simultaneous", although the DMs do not necessarily make their choice at the exact same time. One prisoner may take much longer to decide, but the choice is still considered simultaneous as long as both decisions are made within a time frame such that the DM1 has no knowledge of the DM2's decision (and vice versa). The basic PDG can easily be modified to a sequential PDG that again has the same mathematical properties, but has much different psychological properties. Making the PDG sequential forces DM1 to commit early; cooperation can expose the DM1 to exploitation or may influence the DM2 to reciprocate cooperation. For DM2, uncertainty and risk (Ng & Au, 2015) is removed with complete information on the consequences of cooperation and non-cooperation. Thus, the sequential PDG may provide a good paradigm for examining asymmetries in social risk.

4.3.4 Non-binary PDGs

Marcia and Jan were faced with 2 discrete alternatives: disclosure or HARKing. While this framework is useful for research purposes, it is probably more common outside the laboratory that decision makers have a variety of options. A scientist in Marcia's position may also have choices such as replicating the study, seeking the advice of colleagues, using different statistical tests, and omitting prior hypotheses as opposed to creating new hypotheses. Choices in a PDG may also range along a continuum from no cooperation to 100% cooperation. For example, people jointly investing in a business may decide not only whether to invest time or money, but also may decide exactly how much they would like to invest. Again, the mathematical properties and logic of the PDG can be extended to offer multiple options in the Give Some Game and Take Some Game (Dawes, 1980; Hamburger, 1973). Using these games can allow for a more refined test of asymmetric games that can capture more of the variance in the choices of DMs.

4.3.5 Communication

Outside the laboratory it is much more common that DMs can communicate with other people that are involved in the dilemma. The communication available to DMs in a PDG can be difficult to quantify though, because there is no clear way to incorporate communication into the outcome structure of a PDG. Dawes, McTavish, and Shaklee (1977) showed that communication in a PDG can increase cooperation, but only if the communication is about the game. When participants were instructed to discuss topics irrelevant to the game, cooperation rates were similar to a condition with no communication. It is possible that communication about the game may help by 1) creating conformity pressures, 2) mitigating expectations that others will not cooperate, and 3) improving the knowledge DMs have about the game. Conformity pressures may be weaker in asymmetric games because the DMs are not faced with the same choice. Improving trust or expectations of cooperation may be more important when there is inequality of resources. Finally, knowledge of the game may be more important for asymmetric games in general because of the added complexity. All of these are important directions for future research.

4.4 Final Remarks

The asymmetric dilemma provides an excellent research tool for addressing a range of psychological motives that have traditionally been confounded by research designs or ignored altogether by social dilemma researchers. One reason for this may be that asymmetric matrix games are “messy” and “complicated” compared to more popular but limited paradigms such as the Dictator Game and the Ultimatum Game. In this paper, I have revisited Social Interdependence Theory in light of more contemporary research to provide a classification and quantification system to make asymmetric games more clean, simple, and approachable. My hope is that this can open the door to a vast array of games and can help to address many important research questions. I have briefly discussed asymmetric manipulations of the PDG and modifications of the PDG as a starting point. The future directions could go much further to address all games that can be represented by an outcome matrix. For example, researchers may investigate asymmetries in the Chicken Game and even mixed games where one player's outcomes meet the criteria for an interdependent PDG and the other player is faced with the outcomes of a risky Chicken Game.

Outside of laboratory settings, people are frequently engaged in interdependent situations where there is some form of asymmetry. It seems quite possible that individuals consider not only their own decision and outcomes, but also calculate based on the options available to the other person and consider their outcomes relative to those of others. The HARKing dilemma provides just one example of an applied research question that can be of great interest to scientists. How does a scientist's position and decision relative to others influence ethical decisions in the (mis)representation of findings and the publication process? It is my assertion that the asymmetric game can provide an invaluable tool for investigating this issue. The current research provides a basis that social motives to improve the field as a whole, dependence on others in the field, and a resource advantage all may contribute to a greater disclosure of hypotheses (cooperation). Towards that end, the current paper has developed a new classification of asymmetric games that can be used to examine cooperation in situations where power, resources, and social risk differ between socially interdependent individuals.

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Appendix A

RING MEASURE OF SOCIAL VALUE ORIENTATION (12 ITEM)

This decision task is one in which you have been randomly paired with another person, whom we refer to simply as the "Other". You will never knowingly meet or communicate with the Other, nor will he/she ever knowingly meet or communicate with you. In this decision task, both you and the Other will choose between two options, labeled A and B.

Your own choices will produce points for yourself and the Other. Similarly, the Other's choices will produce points for him/her and for you. Therefore, the TOTAL number of points you receive depends on your own choice and the Other's choice as well. Similarly, the Other's TOTAL points depend on his/her choices and your choices as well.

An example of this decision task is displayed below.

A			B	
You Get	400		You Get	500
Other Gets	100		Other Gets	300

In this example, if you choose A you would receive 400 points and the Other would receive 100 points. If you chose B, you would receive 500 points and the Other 300. At the same time you are making your choices, the Other is also choosing between A and B.

Look at the decision problem from his/her point of view.

A			B	
You Get	400		You Get	500
Other Gets	100		Other Gets	300

If he/she chooses A, he/she receives 400 and you receive 100. If he/she chooses B, he/she receives 500 and you receive 300. So, the TOTAL number of points that you receive and that the Other receives is determined by your own choice in combination with that of the Other.

In just a moment, we will ask you to make a series of decisions. Before you begin, we want to ask you to imagine that the points involved with the decisions have value to you; specifically, the more of them you accumulate the better. Also, imagine that the Other feels about his/her points in the same way; the more of them he/she accumulates, the better for him/her.

For each of the 12 decision problems please indicate which choice (A or B) YOU think is best for whatever reason. We fully expect different people to have different opinions as to which is the best choice, and we're interested in knowing what you think.

1	A		B
You get	50	You get	25
Other gets	-86	Other gets	-96

2	A		B
You get	86	You get	96
Other gets	50	Other gets	25

3	A		B
You get	0	You get	25
Other gets	-100	Other gets	-96

4	A		B
You get	50	You get	70
Other gets	86	Other gets	70

5	A		B
You get	70	You get	86
Other gets	-70	Other gets	-50

6	A		B
You get	50	You get	25
Other gets	86	Other gets	96

7	A		B
You get	70	You get	86
Other gets	70	Other gets	50

8	A		B
You get	100	You get	96
Other gets	0	Other gets	-25

9	A		B
You get	50	You get	70
Other gets	-86	Other gets	-70

10	A		B
You get	0	You get	25
Other gets	100	Other gets	96

11	A		B
You get	96	You get	86
Other gets	-25	Other gets	-50

12	A		B
You get	100	You get	96
Other gets	0	Other gets	25

Appendix B

STUDY1 INFORMED CONSENT DOCUMENT

UD IRB Approval from 04/28/2014 to 05/05/2015

Certificate of Informed Consent

Title of study: Social Decision Making

Principal Investigators: Dr. D.M. Kuhlman and Mr. Adam Stivers

You've been chosen to participate in the Social Decision Making study because you are enrolled in PSYC100, chose the research option for the Research Participation Requirement, and are 18 or older. In all, the total number of participants in this study will be around 200.

In this study, you and another person will be making a series of decisions in a situation where you will each receive a certain number of points. Although these points will not be exchanged for any tangible reward (such as money), we will ask that you imagine the points have value to you. Specifically, the more of them you accumulate the better. We will also ask you to imagine that the points have value to the other person as well. The more he/she accumulates the better for him/her. Details of the social decision task will be given in the instructions to this study.

You are free to decline to participate in this study and you can withdraw participation at any time.

If you do choose not to participate or if you fail to complete the study, you will write a paper summarizing one of the articles available on the internet.

If you choose to not participate in the study, and to write a paper instead, here is the link to information regarding the format of the paper and the journals from which you may select articles:

http://fleen.psych.udel.edu/studenthomepage.php

There are no known risks to participating in this study. Your data are confidential and will be stored so that no association can be made with your name. Benefits of your participation include an increased knowledge of how psychological research is conducted. The study takes less than 30 minutes and you will receive 30 minutes of credit towards the PSYC100 Research Requirement. Data from the Social Decision Making study will be reported in terms of statistical aggregates and averages in such a way that identification of individuals is impossible.

Contacts: If you have any questions about the research experiment, you may contact Dr. D. Michael

Kuhlman, Associate Professor, Department of Psychology (831-8084). For questions and concerns about your rights as a participant or about any issues concerning the use of human subjects in research you can contact the Principal Investigator or the Human Subjects Review Board Chairperson, (302-831-2137).

Signing below indicates that you are at least 18 years old and that you are choosing to participate in the Social Decision Making Study. In addition, it indicates that you have read and understood the information on this page.

_________________________________ ______________

Signature of Participant Date

____

Printed Name of Participant

Appendix C

STUDY 1 & 2 INSTRUCTIONS AND QUIZ

Note: instructions were shown as a PowerPoint slideshow. In this appendix, separate slides are indicated by bold headings and for the text of each slide, the formatting (as seen by the participants) has been removed.

SLIDE 1

You have now completed the first social decision task

Next, I will provide instructions with a brief quiz before starting the second social decision task

SLIDE 2

HERE ARE THE INSTRUCTIONS FOR THE 2nd SOCIAL DECISION MAKING STUDY.

Shown below is a matrix.

The matrix has two rows labeled A and B, and two columns labeled X and Y.

In today's study YOU will be making a choice between Row A and Row B.

And, another student, with whom you have been randomly paired, will be choosing between Column X and Column Y.

	X	Y
A	Cell 1	Cell 2
B	Cell 3	Cell 4

SLIDE 3 (Quiz Question #1)

	X	Y
A	Cell 1	Cell 2
B	Cell 3	Cell 4

13. In this experiment, will you be choosing between Row A and B, or between Column X and Column Y?

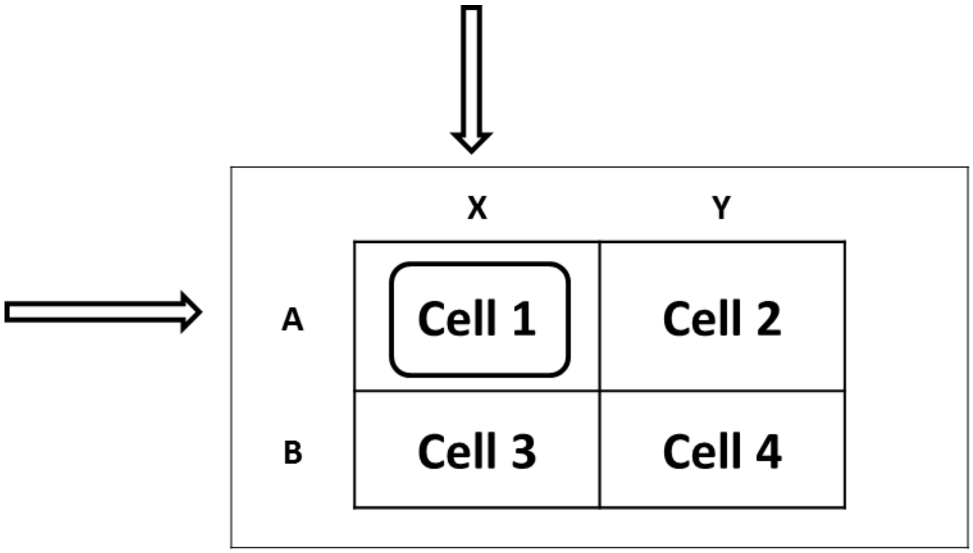
A. I will be choosing between Row A and Row B.
B. I will be choosing between Column X and Column Y.

SLIDE 4

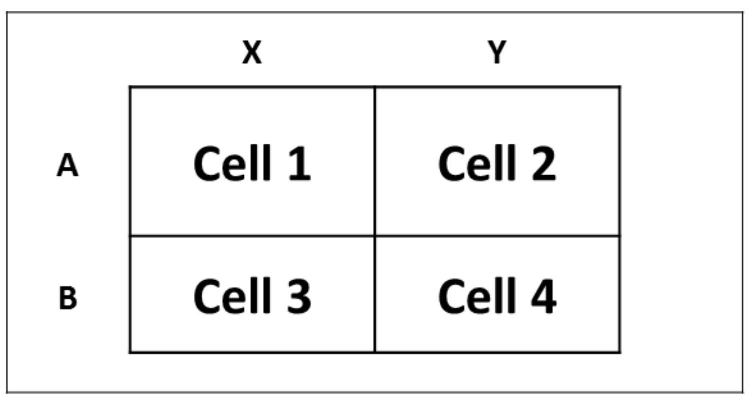
To repeat: you will make a choice between Row A and B, and the other student will choose between Column X and Y.

The choices that the two of you make will determine which Cell is the outcome for that trial.

For example, if you choose Row A and the other student chooses Column X, the outcome would be Cell 1.



SLIDE 5 (Quiz Question #2)



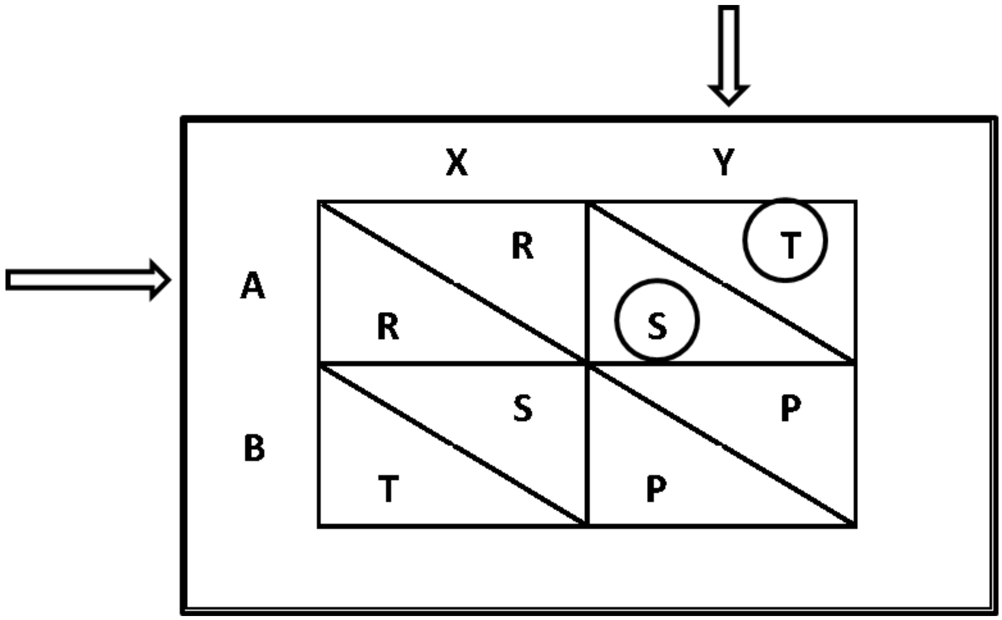
14. What would be the outcome if you choose Row B and the other student chooses Column Y?
    A. Cell 1
    B. Cell 2
    C. Cell 3
    D. Cell 4

SLIDE 6

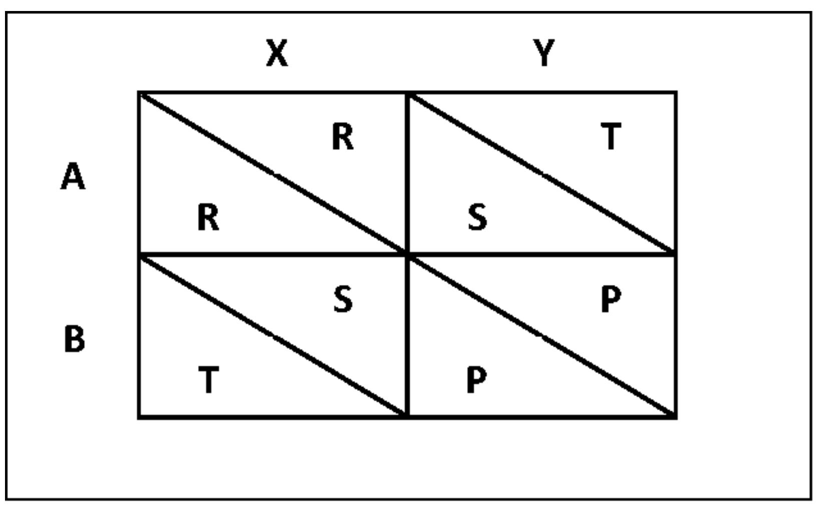
Each cell of the matrix contains a certain number of points for you and a certain number of points for the other.

Your points are in the lower part of each cell, and are shown in red.

The other student's points are in the upper part of each cell, and are shown in blue.



SLIDE 7 (Quiz Question #3)



15. What would each of you get if you choose A and the other student chooses Y?
    A. I would get R and the other student would get R.
    B. I would get S and the other student would get T.
    C. I would get T and the other student would get S.
    D. I would get P and the other student would get P.

SLIDE 8

We will begin the study in just a moment. The study will consist of a number of trials. On each trial, you will be shown a matrix with points for yourself and for the other student. From one trial to the next, these points will vary.

On each trial, you will be asked to indicate which choice (Row A or Row B) you think is the best, for whatever reason. We fully expect different people to have different ideas concerning the best choice, and what we want to know is what YOU think.

As you are making your decisions, please keep these things in mind:

1) Imagine that the points you receive are important to you; that the more of them you receive the better.
2) Imagine that the points the other student receives are important to him/her; the more of them he/she receives the better.

SLIDE 9

BEFORE BEGINNING THE ACTUAL STUDY, WE WANT YOU TO SEE SOME OF THE DIFFERENT DECISION MATRICES THAT WILL BE IN TODAY'S STUDY.

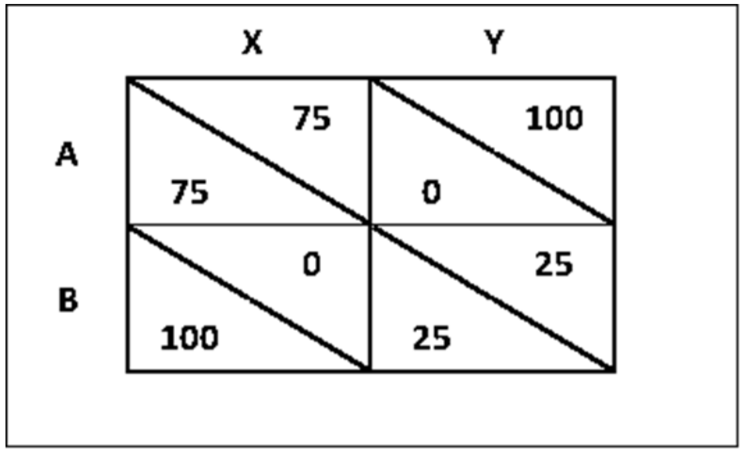
FOR NOW, DO NOT FILL IN ANY BUBBLES ON YOUR ANSWER SHEET, SIMPLY LOOK AT THE MATRICES TO SEE WHAT THE POSSIBLE OUTCOMES FOR YOU AND THE OTHER STUDENT ARE.

SLIDE 10

Below is an example of one of the matrices.

Remember that you are choosing between Row A and Row B.

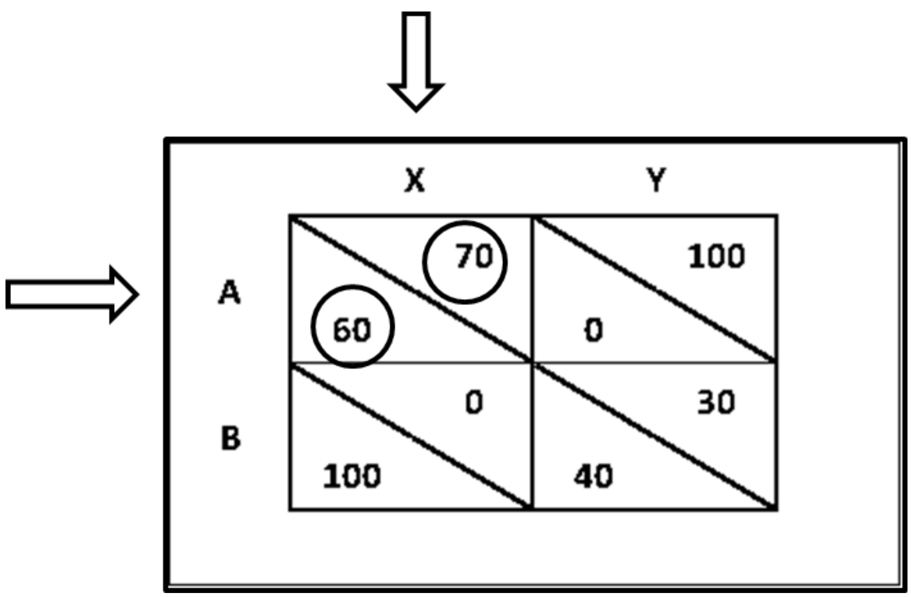
Your points are colored in RED and the other student's points are colored in BLUE



SLIDE 11

Here is an example of one of the matrices.

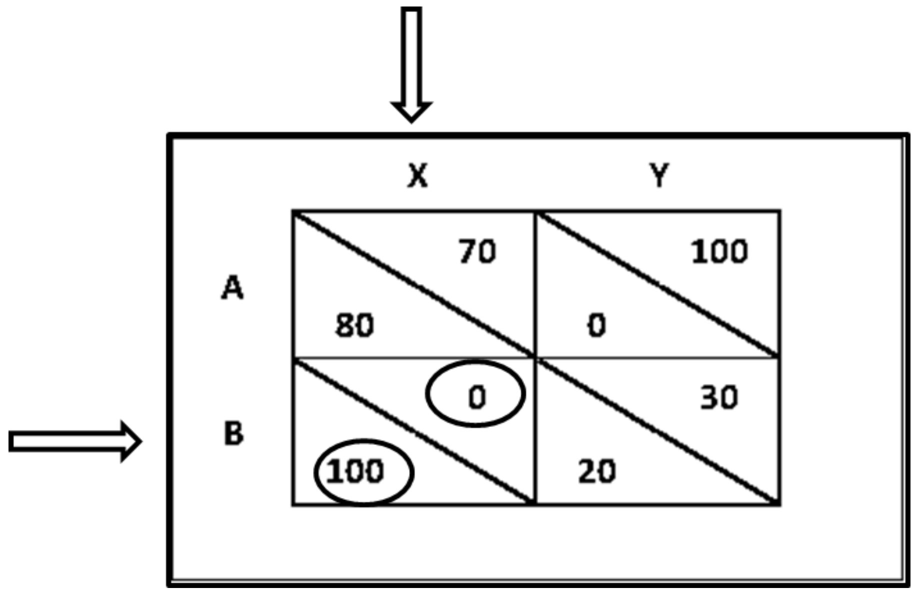
If you chose A and the other student chose X, you would get 60 and the other student would get 70.



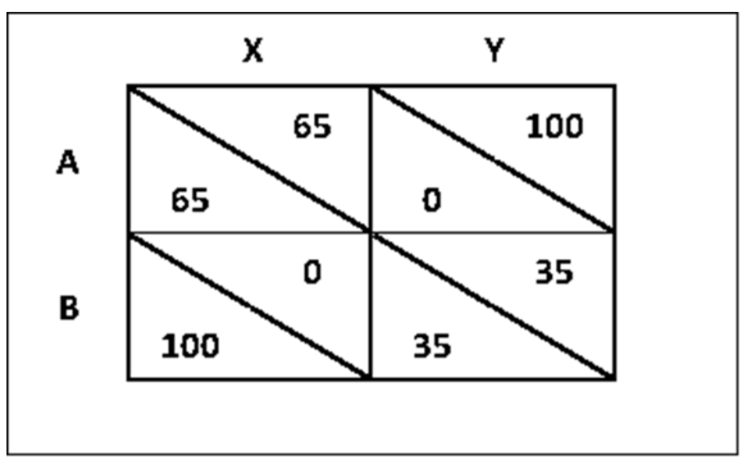
SLIDE 12

Below is another example of one of the matrices.

If you chose B and the other student chose X, you would get 100 and the other student would get 0.



SLIDE 13 (Quiz Question #4)



16. What would each of you get if you choose A and the other student chooses X?
    A. I would get 65 and the other student would get 65.
    B. I would get 100 and the other student would get 0.
    C. I would get 0 and the other student would get 100.

D. I would get 35 and the other student would get 35.
E. I would get 65 and the other student would get 35.

Appendix D

STUDY 2 INFORMED CONSENT DOCUMENT

UD IRB Approval from 05/01/2015 to 05/05/2016

Title of study: Social Decision Making
Principal Investigators: Dr. D.M. Kuhlman and Mr. Adam Stivers

You've been chosen to participate in the Social Decision Making study because you are enrolled in PSYC100, chose the research option for the Research Participation Requirement, and are 18 or older. In all, the total number of participants in this study will be around 200.

In this study, you and another person will be making a series of decisions in a situation where you will each receive a certain number of points. Although these points will not be exchanged for any tangible reward (such as money), we will ask that you imagine the points have value to you. Specifically, the more of them you accumulate the better. We will also ask you to imagine that the points have value to the other person as well. The more he/she accumulates the better for him/her. Details of the social decision task will be given in the instructions to this study.

You are free to decline to participate in this study and you can withdraw participation at any time.

If you do choose not to participate or if you fail to complete the study, you will write a paper summarizing one of the articles available on the internet.

If you choose to not participate in the study, and to write a paper instead, here is the link to information regarding the format of the paper and the journals from which you may select articles:

http://fleen.psych.udel.edu/studenthomepage.php

There are no known risks to participating in this study. Your data are confidential and will be stored so that no association can be made with your name. Benefits of your participation include an increased knowledge of how psychological research is conducted. The study takes less than 30 minutes and you will receive 30 minutes of credit towards the PSYC100 Research Requirement. Data from the Social Decision Making study will be reported in terms of statistical aggregates and averages in such a way that identification of individuals is impossible.

Contacts: If you have any questions about the research experiment, you may contact Dr. D. Michael Kuhlman, Associate Professor, Department of Psychology (831-8084). For questions and concerns about your rights as a participant or about any issues concerning the use of human subjects in research you can contact the Principal Investigator or the Human Subjects Review Board Chairperson, (302-831-2137).

Signing below indicates that you are at least 18 years old and that you are choosing to participate in the Social Decision Making Study. In addition, it indicates that you have read and understood the information on this page.

Signature of Participant ____________________ Date__________________

Printed Name of Participant _____________________