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COLLECTIVE ACTION SUCCESS IN STEP-LEVEL PUBLIC GOODS GAMES

Experimental Studies on the Role of Social Value Orientation and Information on Efficacy Heterogeneity

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[1] Parts of this chapter are used in two journal articles that resulted from this dissertation in order to submit it to international peer-reviewed journals. The first article co-authored with Jacob Dijkstra and is titled: Social Value Orientation and Learning in Repeated Step-Level Public Goods Games: An Experimental Investigation. This article is currently under review.
The second article is co-authored with Jacob Dijkstra and is titled: Efficacy Heterogeneity and Information in Repeated Step-Level Public Goods Games. This article is in preparation for submission.

1 Introduction

1.1 Collective Action for the Production of Public Goods

A remarkable trait of the human species is its capacity for cooperation among genetically unrelated individuals (Tomasello 2009a, 2009b; Trivers 2006). Many regard the cooperative solution of adaptive problems (such as hunting or defense) as a key driver of human evolution (e.g., Buss, 2005; Cosmides & Tooby, 1992; Mesterton-Gibbons & Dugatkin, 1992; Nowak, 2006; Sapolsky, 2017). Cooperation is as much a problem as it is an adaptive solution. Ranking high among cooperation problems are problems of *collective action* (Hardin 1982). The concept collective action compiles a broad range of social phenomena in which a group of individuals with aligned interests undertakes joint action to further these interests (Axelrod 1986; Elster 1985; Olson 2012). Social phenomena such as *grass-root activism* and *social movements* strongly denote this concept (Baldassarri 2017). Here one can think of political parties campaigning on voting rights to abortion, and social movements or groups protesting governments climate change policies. Other forms that belong to a more extensive understanding of what collective action is about are for instance *crowd-funding initiatives* and *local renewable energy collectives* (Goedkoop and Devine-Wright 2016).

This dissertation is concerned with understanding collective action success and what factors foster or hamper the endeavor. In this dissertation the focus is on types of collective action that are aimed at the production of *public goods* (also known as collective goods) (Olson, 1965). A public good is something that, a single individual cannot produce by their own means, but is rather realized by the contribution of many people (Baldassarri 2017). Public goods are characterized by two key characteristics. The first key characteristic is *jointness of supply*, that is, consumption by one person does not hamper another individual's consumption, public goods are thus non-rivalrous (Offerman

2013). The second key characteristic of public goods is that there is a strict *non-excludability*, meaning that it is impossible to exclude people form consumption (Offerman, 2013). Examples of the public goods are knowledge, common languages, cultural heritage such as monuments, but also national security and streetlights (Olson, 1965).

Collective action for the production of public goods are often plagued with *social dilemmas*. A social dilemma can be defined as a situation where individual and collective rationality are at odds (Dawes 1980; Kollock 1998; Raub et al, 2015; Dijkstra & van Assen, 2016). There two broad categories of social dilemmas.

The first category compiles *cooperation problems*, also known as *free-rider problems* and depicted in the *tragedy of the commons* (Hardin 1982; van Klingeren and de Graaf 2020; Ostrom 1990). In cooperation problems, each individual has the temptation to abstain from making costly investment and contribute to public good production and aim for consumption of the good provided by others, i.e, by means of free-riding. However, if all individuals act on their own interests, the public good is not produced (Albanese and Van Fleet 1985)A large body of research describes that, how individuals value their own and others' outcomes in situations of interdependence is conceptualized as their social preference or *Social Value Orientation* (SVO) (Messick and McClintock 1968). Ample research demonstrates that SVO is predictive of cooperative behavior in various studies on social dilemmas, cooperation and collective action (Balliet et al., 2009; De Cremer & Van Lange, 2001; Dijkstra & Bakker, 2017; Kanagaretnam et al., 2009; Murphy et al., 2011; Van Lange et al., 2013). However, there questions regarding the stability of SVO in collective action when groups are working together for a longer time. In this dissertation SVO as one of the key explanans that are expected to play a role in collective action success.

The second category compiles *coordination problems* (Schelling 1980). In coordination problems, individuals find themselves in situations in which interests coincide, and where the aim

is to reach an outcome in which those interests can be reached, however, there are multiple choice options to reach that outcome (Bortolotti, Devetag, and Ortmann 2016; Skyrms 2004). Coordination problems in public good production typically arise when the good's "production technology" implies that the good is produced if and only if a sufficiently large or powerful subgroup of individuals invests. The coordination problem then amounts to identifying and motivating the coalition of individuals who should invest (Dijkstra et al., 2019). A critical insight related from this research is the realization of the fact that group members typically differ in the *impact* their investments have on the likelihood of public good production (Kerr 1996; Kerr and Kaufman-Gilliland 1994). The impact an individual's behavior has on outcomes is generally referred to as their *efficacy* (Bandura, Freeman, and Lightsey 1999; Kerr 1992). Research has established a significant positive relationship between heterogeneity in efficacy and successful collective action (Dijkstra & Oudemulders, 2014; Dijkstra & Bakker, 2017; Kerr, 1992). However, this relationship requires that individuals involved have *information* about each other's efficacy. In fact many laboratory studies that mimic collective action situations provide their subjects with complete information. But it yet remains an open question how the degree of information of efficacy heterogeneity influences collective action success. The degree of information of efficacy heterogeneity constitute the second key explanantia of this dissertation.

In the following paragraphs we discuss the two main explanantia - SVO and information on efficacy heterogeneity - in this dissertation, and discuss how these play a role in collective action success (Elster 1985). For each explanans, we discuss the literature, theoretical framework and empirical approach in brief and formulate research questions that lead the scientific investigations in this dissertation. The chapter concludes with a synthesis of the research questions and an overview of all the following chapters in this dissertation.

1.1.1 The role of Social Value Orientation

In collective action initiatives focused on the production of public goods, a group of individuals with aligned interests undertakes joint action to further these interests (Olson 2012). Even though interests in the benefits of the public goods may be aligned, individuals fundamentally differ in their willingness to contribute and uphold different values for distributing surplus from cooperation among one another. In particular, preferences regarding the distribution of outcomes across self and others provide reasons for group members to invest or not. How individuals value their own and others' outcomes in situations of interdependence is conceptualized as their social preference or *Social Value Orientation* (SVO) (Messick and McClintock 1968).

Literature distinguishes between several SVO categories. Each category is determined by the weight individuals place on their own interests relative to the interests of others (Messick and McClintock 1968). The majority of SVO measures classify individuals as either *prosocial* (altruistic and cooperative individuals) or *proself* (individualistic or competitive) (Murphy et al. 2011). *Prosocials* are motivated to produce joint success, *individualists* are focused on personal gain, and *competitors* want to maximize the positive difference with others and are potentially willing to sacrifice absolute gains to advance in relative terms.

SVO is correlated with personality traits such as generosity, kindness, empathy and trustworthiness (Thielmann and Hilbig 2014). Moreover, SVO is correlated with the extent to which one engages in helping behavior, volunteering, charitable giving, and having a pro-environmental lifestyle (Van Lange et al. 2007; Pletzer et al. 2018). SVO is one of the most frequently studied psychological traits in research on cooperation and social dilemmas (Dijkstra & van Assen, 2016; Bogaert, Boone, and Declerck 2008; Van Lange et al. 2013).

Ample research demonstrates that SVO is predictive of cooperative behavior in various studies on social dilemmas, cooperation and collective action (Balliet et al., 2009; De Cremer & Van Lange, 2001; Dijkstra & Bakker, 2017; Kanagaretnam et al., 2009; Murphy et al., 2011; Van Lange et al., 2013). In highly controlled settings containing few extraneous stimuli (such as lab experiments), the effect of SVO on cooperative behavior is strongest.

It is important to note that most studies have looked at the working of SVO in cross-sectional (experimental) studies in which individuals interact in *one-shot interactions,* that is situations in which individuals cooperate only once (Pletzer et al. 2018). Here one can think of a transaction between strangers that have not met each other before and probably never will again. A real-life example can be individual talking loudly on the phone in a public space that is declared a silent space, a library for instance. The public good here is the silent area and any individual approaching the other that violates the norm invests in the public good by taking the action to ask for the maintenance of silence (Jann and Przepiorka 2017; Przepiorka and Diekmann 2018).

To date research on the influence of SVO on cooperative behavior in *repeated interactions* is scarce. In everyday life, this could for instance be a group of individuals in a village investing in a local renewable energy source. This does not happen overnight and requires repeated interactions to foster and maintain the public good. Repeated collective endeavors are omni present social life and therefore of vital importance to study.

To our knowledge only four papers have examined the role of SVO in cooperative behavior in repeated encounters and also find results that underline the link between SVO and cooperative behavior (Fiedler et al., 2013; Parks, 1994; Pulford et al., 2017; Przepiorka et al. 2020). However, in three of the four studies, groups of participants where reshuffled after each round, and therefore players were exposed to ‘new’ interaction partners after each round. This basically turns these designs into a sequence of one-shot interactions. In these particular designs, participants do have

the opportunity to understand the game better after each round, and may develop expectations on general decision behavior of others, or an averaged believe of what others might do. Yet, in such cases, participants lack the possibility to form expectations or beliefs about specific interaction partners.

The most resent and only paper so far that investigates SVO in repeated settings where groups stay the same for the full experiment is conducted by Przepiorka and colleagues (2020). They find that the effect SVO is not as pronounced as it is in studies with one-shot interactions or studies where groups are constantly reshuffled (Przepiorka et al. 2020). More specifically, they find that prosocials tend to behave in contradiction with to what theory suggests and opposite to what one-shot literature have showed so far. Their findings suggest that the structure of the situation and payoff asymmetry between individuals may overrule the influence of SVO (Przepiorka et al. 2020). However, more research and theory development is necessary to further understand the SVO – Behavior link in repeated settings.

Related research on repeated interactions in cooperative settings that has not looked at SVO shows that mechanisms such as trust, social learning and reciprocity play a significant role in decision making. When groups face a repeated interaction situation, individuals get into a *conditionally cooperative* mind set affecting their strategies because they know they will face each other again (Croson, Fatas, and Neugebauer 2005; Fischbacher, Gächter, and Fehr 2001). This leaves us wondering how repeated interactions in the same group may influence the link between SVO and cooperative behavior.

In this dissertation we explicitly address the link between SVO and behavior under the following research question: *How does the SVO – behavior link change over the course of repeated interactions, and how does this relationship influence collective action success?*

This question is important because we address a clear caveat in the literature and contribute to a better understanding of key confounders of successful collective action. Results of this study yields both useful implications for scientific purposes but also for policy development for team performance and sustainable cooperation encompassing various aspects in everyday life.

The answer to this research question no doubt depends on the incentive structure of the underlying cooperation problem. In this dissertation we focus on cooperation problems with a "critical mass" or threshold structure. A well-known model naturally reflecting public goods problems with a threshold structure is the Step-Level Public Good design (SPG) (Dijkstra & Bakker, 2017; Van de Kragt et al., 1983) which we adopt for the design of my study to answer this research question.

The distinctive feature of this type of situation lies in the nature of the production function of the public good. In particular, the public good is produced if and only if a sufficiently large and resourceful subgroup of group members contributes to its production. Over and above this threshold, additional contributions have little or no effect on the level of the public good. Likewise, when total contributions are shy of the threshold, they have no impact and the public good is not produced. Thus, the SPG has a 'threshold' structure, meaning that in order to produce the good a *minimum of sufficiently impactful individuals* must invest in order for the group to obtain any benefit (Dijkstra and Oude Mulders 2014; Kerr 1992). If enough impactful individuals invest the public good is produced and a beneficial surplus (payoff) is obtained by *all* individuals in the group. Since it is a public good characterized by jointness of supply, all group members obtain the benefits regardless of whether they invested towards its production (Dijkstra & Bakker, 2017). Investing is a costly action, however, so investors reap a lower net gain than non-investors, provided the public good is produced. If the public good is not successfully produced, any investor experiences a net loss whereas non-investors remain unaffected.

The SPG provides an interesting context for investigating the SVO – behavior link. SVO affects behavior in situations of interdependence, because such behavior affects payoff distributions across self and others. In the SPG the extent to which such payoff effects exist depends on whether the investment pushes the group over the threshold for public good production. Thus, individuals' expectations as to the investments of others is likely to impact the SVO – behavior link, opening up an avenue for learning effects.

By means of a computerized experiment with a Step-Level Public Goods design (N=120), participants were randomly assigned to interact in groups of five and interacted for six rounds. SVO was measured with the 9-item Triple-Dominance Measure. We used multi-level logistic regression models following a Bayesian approach to test hypotheses.

1.1.2 The role of information on Efficacy Heterogeneity

Many instances of collective action also have a '*critical mass'* structure, where collective action is only successful if a sufficient number of group members participate (Marwell and Oliver 1993). Coordination problems in public good production typically arise when the good's "production technology" implies that the good is produced if and only if a sufficiently large or powerful subgroup of individuals invests. The coordination problem then amounts to identifying and motivating the coalition of individuals who should invest.

One of the first attempts to explain theoretically how individuals overcome coordination problems was made by Tomas Schelling and Robert Aumann and resulted in a Nobel prize 2005. In his seminal work "the Strategy of Conflict" (1960), Schelling posits that when individuals are involved in coordination problems, they try to find the choice-option that seems most salient and that signals to them what they should do, what is likely that others will do and vice versa. Schelling

denoted these salient choice-options as “focal points” and that’s how the and argues that social norms, conventions and institutions likely are creators of focal points, as there is a normative and social recognizable trait of the focal point that has unanimous understanding and significance, so much that individuals could find solutions by means of tacit coordination (Schelling, 1960; Dixit, 2006). A number of models have been developed to test focal point theory and investigate coordination problems of finding the subset of necessary investors in public goods. Well-known models include Marwell and Oliver’s formalization of *critical mass theory* (Marwell and Oliver, 1990), the *best-shot public goods game* (Bramoullé and Kranton 2007) and step-level public goods games (Van de Kragt, Orbell, and Dawes, 1983; Dijkstra & Bakker, 2017).

A critical insight related from this research is the realization of the fact that group members typically differ in the *impact* their investments have on the likelihood of public good production (Kerr & Kaufmann-Gilliland, 1994), and that the difference between individuals can help with overcoming coordination problems. Experimental studies indeed confirm that heterogeneity serves as a point of departure in singling out certain coalitions of potential investors more prominent or focal than others (Dijkstra & Bakker, 2017; Dijkstra et al, 2019).

The impact an individual’s behavior has on outcomes is generally referred to as their *efficacy* (e.g., Bandura, 1997; Kerr, 1992). As Efficacy is construct that is subjective and cannot be completely captured by an individual’s objective characteristics (Kerr, 1992). Actually, it rather consists of an individuals’ perception of their power relative to others with respect to that their contribution to a public good is necessary or at least important to reach collective action (Dijkstra & Bakker, 2017; Dijkstra, 2012; Dijkstra & van Assen, 2013). Research has established that there is a significant positive relationship between efficacy and investment in public goods (Kerr, 1996; Dijkstra & Oude Mulders, 2014). Studies show that individuals who regard their contribution

valuable and/or necessary (i.e. are more efficacious) are significantly more likely to cooperate and invest in the public good (Kerr, 1996).

Compared to a situation in which individuals all have the same efficacy, heterogeneity in efficacy can render certain coalitions of potential investors more 'prominent' or more 'obvious' than others. Here neatly fits Schelling's *Focal Point Theory* (Schelling, 1960). In the context of collective action problems, differential efficacies of individuals could pose as focal points that individuals will tend to use as their guidelines, because they have characteristics that make players *focus their attention* on them and *expect others to do the same*. Indeed, experimental research into the *Volunteer Dilemma* (see, Diekmann 1985) shows how heterogeneous efficacy distributions (also termed as *payoff asymmetry)* alleviates the coordination problem (Diekmann, 1984, 1985, 1986; Diekmann & Przepiorka, 2016; Przepiorka & Diekmann, 2013, 2018; Weesie, 1993; Przepiorka, Bouman & de Kwaadsteniet, 2020).

An important aspect of decision making in any type of situation is whether individuals possess *common knowledge* on the structure of the situation (Camerer and Weber 2012; Kagel and Roth 2016)(Kagel & Roth, 2016; Camerer 2013). Also the relationship between heterogeneity in efficacy and successful collective action requires that individuals involved have information about each other's efficacy, and many laboratory studies that mimic collective action situations, in fact provide their subjects with *complete information.*

However in real life, individuals in collective action endeavors, do not always have access to complete information. The question then becomes, does this relationship between heterogeneity and collective action success hold when individuals are shy off this information? How do groups deal with information sources regarding the efficacy distributions in step-level public goods games, and how may information help or hinder them in reaching collective action?

Dijkstra & Bakker, (2017) performed an experiment using a step-level public goods game (Van de Kragt et al. 1983) in which the degree of information was manipulated as follows; some groups interacted in a *complete information condition.* In this condition subjects knew their own efficacy and the efficacy of their group members). In the *incomplete information condition,* subjects only knew their own efficacy, but are not informed about the efficacies of their group members). Dijkstra & Bakker (2017) find that the degree of information affects behavior significantly. For instance, complete information makes the efficacy-cooperation hypothesis more apparent, and those with lower efficacy opt out of cooperative strategies. Furthermore, complete information makes coordination problems more salient and acute, whereas incomplete information brings about uncertainty and increases likelihood for investment.

The results indicate that especially in cases where groups would have the same efficacies, that is, groups that are homogenous in individual efficacies, complete information could have a negative effect. There are to our knowledge no studies that have investigated experimentally how homogenous groups perform in incomplete information conditions compared to complete information conditions in the same study. Studying the role of information on efficacy distribution is a vital objective for both scientific fields studying collective action and cooperation across social disciplines, but also highly relevant for both policy development, team building and team performance. Therefore it makes up the second key factor of investigation in this dissertation.

To obtain more insight on the role of homogeneity and heterogeneity in efficacy distributions and the degree of information on these distributions, we formulate the following research question: *"How does the distribution of individual efficacies and the degree of information on efficacy distributions influence collective action success?*"

This is an important topic for the following reasons, first we contribute to the literature on conditions under which individuals can overcome social dilemmas in collective action endeavors,

and further understanding on group composition can influences cooperative behavior. Second, we contribute to the literature how the degree of information about group composition influences cooperative behavior. Finally, research results should deliver practical implications regarding group composition and cooperative behavior useful for organizations to improve teams performance in real life.

We conducted a computerized experiment with a Step-Level Public Goods design (N=140). Subjects in groups of 5 repeatedly decide to invest in the public good. Subjects differential efficacies are manipulated as a between subjects' factor. In the homogeneous treatment individuals have the same efficacy, and in the heterogeneous treatment efficacies differ. Information is a between subject's factor manipulated as follows; a complete information treatment where subjects know the group's efficacy distribution, and an incomplete information treatment where subjects only know their own efficacy. SVO is treated as an observational factor and measured in the SVO slider measure developed by Murphy, Ackermann and Handgraaf (2011). SVO has been shown to be highly stable as an individual difference with a test-retest reliability of r = 0.915 (Murphy et al. 2011). We used multi-level logistic regression models to test hypotheses.

1.2 Overarching Research question

The two main explanans - SVO and information on efficacy heterogeneity - in this dissertation focus on how on individual characteristics, group characteristics and the structure of the situation influence collective action success. Both elements are closely related to the two social dilemmas (cooperation and coordination problems) inherent to collective action. Bringing both questions together constitute an overacting question for the dissertation*:*

- *How does social value orientation and information on efficacy heterogeneity influence collective action success ?*

In the next paragraph I give an overview of the chapters in this dissertation.

1.3 An overview of the dissertation

In chapter 2, we lay out the theoretical framework of the dissertation and simultaneously discuss the state of the art in the literature with respect to our main questions and follow up with paragraphs on how SVO, and information on efficacy heterogeneity influence collective action within the SPG model. Furthermore, we discuss how current theories explain the dynamics and current knowledge of these elements in the model. Most importantly, in this chapter I derive the hypotheses of my theses on how SVO and efficacy heterogeneity influence collective action.

In chapter 3, we discuss research designs namely, two laboratory experiments and an overview of techniques we used to answer research question and test hypotheses that where derived in chapter 2.

In chapter 4, we report the results on the SVO-behavior link in repeated interactions. and the SVO-behavior link in repeated SPG's. In sum, we corroborate that SVO is predictive of behavior in the onset of collaboration. Yet, after the first interaction, the relationship between SVO and behavior virtually disappears. Instead, learning from results in past rounds steers decision behavior over the next.

In chapter 5, we report the results from hypotheses tests on the role of information on efficacy heterogeneity. In sum, the experiment corroborates the efficacy-cooperation hypothesis pertaining that there is a significant positive relationship between efficacy and investment in public

goods. Our data clearly shows that individuals with a higher efficacy are significantly more likely to invest. We do not find any support for our hypotheses that the degree of information influences the efficacy-cooperation link. We find that SVO is a significant predictor of behaviour over all rounds and regardless of treatment, contradictory to results in chapter 4.

In chapter 6, we bring findings together and answer the overarching research question. Taking all aspects together it seems that the SVO-behavior link and the efficacy-cooperation link survive the tests, and that complete information on the degree of heterogeneity within the group is irrelevant in these particular collective action situations. The results imply that the aspects SVO, efficacy and learning mechanisms emerging by iteration remain of significant importance for collective success. Any collective striving for success may want to zoom in on how to emphasize the significance and importance of each member and how successes can be reached cooperatively.

The results of the experiments and limitations of the study propose several directions for future research. Direct follow up studies could first of all continue investigating the SVO-behavior link and investigate this across various structural conditions. As many studies, including those in the dissertation strongly underline the relevance and importance of understanding SVO and the SVO-behavior link, this is a logical next step to take in future studies.

Lastly, future studies can improve by taking a more realistic and detailed account for what hampers or facilitates collective action by employing lab in the field studies and by means of case studies in real life collective action groups to help collectives obtain more ongoing and long-term success.

Chapter 2[2]

[2]Parts of this chapter are used in two journal articles that resulted from this dissertation in order to submit it to international peer-reviewed journals. The first article co-authored with Jacob Dijkstra and is titled: Social Value Orientation and Learning in Repeated Step-Level Public Goods Games: An Experimental Investigation. This article is currently under review.

The second article is co-authored with Jacob Dijkstra and is titled: Efficacy Heterogeneity and Information in Repeated Step-Level Public Goods Games. This article is in preparation for submission.

2 Literature Review & Theoretical Framework

2.1 Overview

In this chapter we lay out the theoretical framework of the dissertation and simultaneously discuss the state of the art in the literature with respect to our main questions. The structure is as follows, we first explain the model and its variations, and follow up with paragraphs on how SVO, and information on efficacy heterogeneity influence collective action within the SPG model and how current theories explain the dynamics and current knowledge if these elements in the model.

2.2 Step-Level Public Goods Games as theoretical context

In an SPG a group of individuals can jointly produce a public good valuable to all. Investing in the public good is costly, but the value of the public good (when produced) exceeds this cost for each investor. Individuals differ in the extent to which their investments have an impact on the production of the public good. In the SPG these efficacies are modeled by assigning each individual a personal *share*. The public good is produced if and only if the summed shares of the investors exceed a given threshold. If this sum falls short of the threshold the public good is not produced, and any investors incur a net loss. If the sum exceeds the threshold the public good is produced, and all group members enjoy a net gain. However, the net gain for investors is less than the net gain for non-investors, as the latter do not incur the costs of investment. Hence, the SPG models a coordination problem in the context of the production of a public good, the problem being the quest

for a set of investors whose added shares exceed the threshold. These shares, precisely, model individuals' efficacies and heterogeneity is reflected in the fact that different individuals (may) have different shares. Below we the describe the SPG games employed in this dissertation and used as base for the experiments designed for data collection that are described in detail in chapter 3.

2.2.1 The basic experimental SPGs in this dissertation

Individuals in the game are referred to as 'players', and this SPG has five of them. Each player has an endowment of 10 points and decides (anonymously and in isolation) whether to invest or keep her entire endowment. Investing means a player loses her 10 points. In the event that the SPG is produced all players, regardless of their investment, receive 15 points. Thus, investors end up with a total of 15 points (for a net gain of 5) while non-investors end up with a total 25 points (for a net gain of 15). If the SPG is not produced no points are awarded. In that case, investors end up with 0 points (for a net loss of 10), whereas non-investors simply keep their endowment of 10 points (neither gain nor loss). To produce a public good, enough individuals (a critical mass) must invest.

2.2.1.1 SPG theoretical model Variation 1: SPG with a heterogeneous efficacy distribution

The rules determining SPG production with heterogeneous players are as follows. Each player is assigned a *share* between 1 and 50, modelling their efficacy. It is common knowledge that the shares of all five players sum to 100 and that no single player has a share greater than 50. The share distribution is such that one player has a share of 50, one player has a share of 1, one player a share

of 9, and two players have a share of 20. The SPG is produced only if the shares of the investors are 51 or more. A successful group of investors must include the player with a share of 50.

2.2.1.2 SPG theoretical model Variation 2: SPG with a homogenous efficacy distribution

The rules determining SPG production with homogenous players are as follows. All players are each assigned a *share* 20, modeling their efficacy. It is common knowledge that the shares of all five players sum to 100. The SPG is produced only if the shares of the investors are 51 or more. A successful group of investors must include at least three investors.

2.3 The Role of SVO

2.3.1 SVO and Cooperative Behavior

Ample research demonstrates that SVO is predictive of behavior in collective action (Au and Kwong 2004)Au & Kwong, 2004; Balliet et al., 2009; De Cremer & Van Lange, 2001; Dijkstra & Bakker, 2017; Kanagaretnam et al., 2009; Murphy, Ackermann, & Handgraaf, 2011; Van Lange et al., 2013). The theoretical mechanism underlying this effect is that in collective action and social dilemmas generally, individual actions carry externalities for other group members. In fact, individual contribution decisions (co-)determine payoff distributions across self and other. Hence, in any rational or purposeful form of decision making preferences over such payoff distributions are pertinent to the decision.

The distinctive feature of this type of situation lies in the nature of the production function of the public good. In particular, the public good is produced if and only if a sufficiently large and resourceful subgroup of group members contributes to its production. Over and above this threshold, additional contributions have little or no effect on the level of the public good. Likewise,

when total contributions are shy of the threshold, they have no impact and the public good is not produced. Thus, the SPG has a 'threshold' structure, meaning that in order to produce the good a *minimum of sufficiently impactful individuals* must invest in order for the group to obtain any benefit (Dijkstra & Oude Mulders, 2014; Kerr, 1992). If enough impactful individuals invest the public good is produced and a beneficial surplus (payoff) is obtained by *all* individuals in the group. Since it is a public good characterized by jointness of supply, all group members obtain the benefits regardless of whether they invested towards its production(Dijkstra & Bakker, 2017). Investing is a costly action, however, so investors reap a lower net gain than non-investors, provided the public good is produced. If the public good is not successfully produced, any investor experiences a net loss whereas non-investors remain unaffected. The SPG provides an interesting context for investigating the SVO – behavior link. SVO affects behavior in situations of interdependence, because such behavior affects payoff distributions across self and others. In the SPG the extent to which such payoff effects exist depends on whether the investment pushes the group over the threshold for public good production. Thus, individuals' expectations as to the investments of others is likely to impact the SVO – behavior link, opening up an avenue for learning effects.

In Step-Level Public Goods in particular, individual contributions raise the likelihood that the public good will be successfully produced, generating positive externalities for others in addition to higher payoffs for self. Moreover, since contributing carries a cost whereas receiving the positive externality is a windfall, especially individuals with a prosocial value orientation are expected to be motivated to contribute. We expect that SVO is crucial in the onset of repeated interactions. In particular, in the first (few) encounter(s) of a series we expect individuals to behave in congruence with their SVO. From this we derive the following hypothesis:

Hypothesis 1*: SVO predicts individual behavior in the onset of repeated interactions in the SPG. Especially, prosocial individuals have a higher investment probability than others.*

2.3.2 SVO and behavior in repeated SPG's

The structure of the SPG creates at least two problems for groups to overcome. The first problem is the *free-rider problem*: though for each player the value of the public good exceeds the costs of contributing to it in case of successful production, things would be even better from a selfish perspective if others invested and one could benefit from the good without getting one's hands dirty (Lumsden et al. 2012; Rapoport 1988). However, if all players follow this reasoning, the good is not produced. The second problem that the group of individuals has to deal with is designating the coalition of investors. Thus, the threshold structure of the game also creates a *coordination problem* of who should invest. Too few investments leads a failure in public good production and to many investments above the threshold will not have any additional effects, leading to loss of costly efforts.

The threshold structure and the resultant coordination problem have an important implication for the *subjectively perceived consequences* of individual behavior. In particular, if a player "pessimistically" believes her potential contribution will add little or nothing to the probability that the SPG is produced, the consequence is that one believes that their decision will not produce any positive externality for others at all. Hence, the conduit for SVO to affect choice behavior in the SPG is cut off. Such "pessimistic" beliefs about the effects of one's contribution easily arise in the SPG; they result whenever a player believes the contributions of others put the group either well below or well above the threshold for success (Dijkstra & Bakker, 2017). In either case, any additional individual contribution is subjectively inefficacious. Hence, due to the

threshold property of the SPG individual contributions cannot be said to unconditionally carry positive externalities for other group members, contrary to what is the case in for instance a linear public good (Zelmer 2003).

In a repeated interactions context, beliefs about the efficacy of one's contribution are dependent upon the history of the interaction. Research demonstrates that repetition has a major influence on an individual's tendency to cooperate/invest (Axelrod 1986; Bó 2005). When individuals share a cooperative future, two key features affect individuals' considerations for cooperative behavior; past experiences (shadow of the past) and expected future interactions (shadow of the future) (Blake et al. 2015). These mechanisms are known as '*learning*' and '*control*' respectively (Flache and Macy 2002; Macy and Flache 2002). Individuals learn from past interactions, form beliefs or expectations about their partners' future actions, and adjust their behavior as a control mechanism for outcomes in the future. For instance, if individuals in groups learn by experience that their counterparts repeatedly defect or do not contribute, they become more likely to also defect and retaliate, even though some do uphold more cooperative preferences (Rapoport, Seale, and Colman 2015).

Given the threshold structure of the SPG and the learning and control mechanisms that emerge in repeated play, we expect that the influence of SVO is overridden when groups interact repeatedly. In particular, through repeated play a player is confronted with the fact that her behavior does not unconditionally produce positive externalities for others. Rather, the extent to which a player believes her potential contribution to be efficacious (i.e., to have a discernible impact on the probability that the public good is produced) depends on her beliefs concerning the contributions of others. Said beliefs are in turn determined by the history of group interaction.

Thus, the extent to which a player believes to be able to affect the payoff distribution between self and others at all is crucially dependent upon the history of group interaction.

Therefore, the impact of dispositional traits such as SVO should wane over time as contextual structure (i.e., the threshold feature) and learning mechanisms (i.e., forming beliefs about how far removed from the threshold the group's contributions likely are) have a more profound influence. To investigate this proposition we derive the following hypothesis:

Hypothesis 2*: The impact of SVO on investment in the SPG decreases over multiple interactions*

2.3.3 Investment probability and learning

Here we take a closer look at how the mechanisms of learning and control in repeated play override the effects of SVO in the SPG. Beliefs, learning and control behavior can develop both trough *rational learning* and *reinforcement learning*. Rational learning, also known as *Bayesian learning*, means that individuals form expectations of other players' future behavior by rationally integrating new information and prior beliefs (Flache & Dijkstra, 2015). In case of reinforcement learning, individuals learn by associating behavior with favorable or unfavorable outcomes. Actions linked to favorable outcomes will be repeated with greater likelihood whereas actions linked to unfavorable outcomes will more likely be shunned (Flache & Macy, 2002; Flache & Dijkstra, 2015). This way of learning links to classic psychological theories of classical and operant conditioning (Hughes et al. 2018) and to Thorndike's 'law of effect' (Thorndike 1927). In order to do theorize learning processes in the experimental SPG we implement, we must first specify two of its key properties. First, in the present context we are considering a *finitely repeated* SPG (Croson 2007, 2010). This feature is common knowledge among all group members, as is the number of rounds to be played. Second, after each round of interaction (in which all players simultaneously and in ignorance of what others are doing choose whether or not to invest) all

players learn their own payoff and whether the public good was produced. Hence, players do not learn which of their fellow group members invested or not. Given these general features of the situation, we can theorize the learning process. When individuals have participated in the first round of interaction and are presented with a certain outcome in terms of their own payoff and whether the public good is produced or not, they form expectations about their group mates' behavior and chances of success for the next round. Based on these expectations, they decide whether or not to adjust their behavior in order to control the group outcome and their own payoff in the next round of social interaction.

Current learning models such as reinforcement learning (Camerer & Weber, 2012), belief learning(Gächter and Renner 2010) and experience weighted attraction learning (Camerer et al., 2003) show that outcomes in previous rounds serves as guidelines for actions in future rounds (Camerer & Fehr, 2006).

For this research we choose a simple "counterfactual reinforcement-learning" principle as the basis of our theoretical reasoning: in the current round players choose the behavior that would have been a best response in the previous round, given their beliefs about what happened in the previous round. This learning principle is akin to rational learning in that beliefs are formed based on evidence from previous interactions. It falls short of being fully rational because not the entire history of interaction, but rather just the latest round, is used to form beliefs. Apart from the fact that players do not know exactly what every other player did the previous round, our learning principle is very close to Cournot best-response behavior (Ho, Cambrer, and Weigelt 1998). From the perspective of each player there are a four possible histories of the previous round that inform decision making in the current round (see Table 1): 1) a *punishment history*, in which an individual does not invest and the public good is not produced; 2) a *sucker history*, in which an individual invests but not enough others invest and therefore no public good is produced; 3) a *free-rider*

history, in which the individual did not invest, but enough others did and so the public good is produced; and, 4) a *reward history* in which the individual invests and the public good is produced.

Table 1 SPG Previous Round Histories

Player History	Player invests	Enough other players invest	Good is produced	Player gets payoff
Punishment history	No	No	No	No
Sucker history	Yes	No	No	No
Free-rider history	No	Yes	Yes	Yes
Reward history	Yes	Yes	Yes	Yes

In terms of payoffs for self, the free-rider history ranks highest, followed by the reward history, the punishment history, and the sucker history, respectively. In terms of learning the free-rider history provides definite information that enough others invested to produce the public good. Likewise, the sucker history is proof of the fact that an insufficient number of others pulled their load. Thus, in both cases best responding to last round's outcomes leads to non-contribution in the current round. Moreover, this best response behavior is optimal *regardless of the player's SVO*: given both histories contribution *would not have (free-rider history)* or *cannot have (sucker history)* affected the payoffs of others and *would only have (free-rider history)* or *only has (sucker payoff)* depressed the payoff of self. Hence, irrespective of a player's SVO, the free-rider and sucker histories are predicted to lead to a decreasing probability of contribution in the current round. The reward and punishment histories are more ambiguous from a learning perspective. In the former, the player cannot be sure whether withholding her contribution would not have yielded a higher payoff. In

the latter the player cannot know for sure whether her contribution would have pushed the group over the threshold. Thus, these histories leave room for believing one's contribution will be impactful in terms of payoffs for self and other. Therefore, we predict SVO to have an effect after these histories have played out. In particular, we predict prosocial players to have higher probabilities of investing following these histories, than other SVO types. Based on this logical analysis, we present our final four hypotheses:

Hypothesis 3*: A player's investment probability in any round but the first is affected by the outcome of the previous round. In particular, for all SVO types the investment probability is decreased after an occurrence of the free-rider history (H3a) and the sucker history (H3b). Following the reward history (H3c) and punishment history (H3d), prosocials have a higher probability of investing than other SVO types.*

2.4 The Role of Information on Efficacy Heterogeneity

Research has established that there is a positive relationship between efficacy and investment in public goods (Kerr, 1996; Dijkstra & Oude Mulders, 2014), meaning that individuals who regard their contribution valuable and/or necessary, and thereby feel more efficacious, are therefore significantly more likely to cooperate and invest in the public good (Kerr, 1996). Furthermore, experimental studies indeed confirm that heterogeneity serves as a point of departure in singling out certain coalitions of potential investors more prominent or focal than others (Dijkstra & Bakker, 2017; Dijkstra et al, 2019). Moreover, compared to heterogeneous groups, homogenous groups where individuals have exactly the same efficacy, have more problems overcoming social dilemmas (Przepiorka & Diekmann, 2013). The relationship between heterogeneity in efficacy and

successful collective action requires that individuals involved have information about each other's efficacy, and many laboratory studies that mimic collective action games, in fact provide their subjects with *complete information.* However in real life, individuals in collective action endeavors, do not always have access to complete information. The question then becomes, does this relationship between heterogeneity and collective action success hold when individuals are shy off this information? The second factor we add to our theoretical framework is the degree if information groups have about the efficacy of others in their group. We directly adopt the manipulation of Dijkstra and Bakker (2017) and implement a *complete information condition* where players know their own efficacy and the efficacy of their group members, and an *incomplete information condition* where players only know their own efficacy. Below we discuss and theorize on each treatment we consider.

2.4.1 Heterogeneity and Complete Information

Heterogeneity in efficacies can serve as a point of departure for the solution of the coordination problem as it can render certain coalitions of potential investors more 'prominent' or more 'obvious' than others. Indeed, experimental research into the *volunteer dilemma* shows how heterogeneity in costs alleviates the coordination problem, since the individual with the lowest costs of investment is the natural candidate to volunteer (Diekmann, 1985). Similarly, the differential shares in the SPG make certain *investment profiles* (specifying an investment decision for each group member) stand out, compared to others. In other words, heterogeneity in efficacies potentially provides the group of individuals with certain *focal points* (Schelling, 1980). In the context of the SPG, focal points are investment profiles that individuals will tend to use as their guidelines because they have characteristics that make players *focus their attention* on them and

expect others to do the same. For instance, in the SPG focal points could be coalitions of potential investors whose added shares are *at* or *close to* the threshold and/or those which produce the public good with a minimum number of investors. These would naturally draw the attention of all individuals, and everyone would expect this to be the case. Hence, coalitions with added shares shy of the threshold, coalitions with added shares far over the threshold, and coalitions with more players than necessary would be disregarded, alleviating the coordination problem. Applied to our experimental game, under complete information, the focal point reasoning singles out an investment profile in which the share 1 and the share 50 players (have positive probabilities to) invest, whereas the share 20 players do not invest; this investment profile puts the group right over the threshold of public good production. Of course, any of the share 20 players could have gotten the job done together with the share 50 player, but the {share 1, share 50} coalition is conspicuous for putting the group just over the threshold of 51. Moreover, since there are three share 20 players, the problem with any {share 20, share 50} coalition is which of the three share 20 players to include. Hence, both the heterogeneity of efficacies as well as the fact that multiple players have the same share seem to make the coordination problem easier for the group. Repeated play would argue that groups with complete information quickly settle on a successful coalition producing the SPG and stay there forever, since both investors and non-investors are continually positively reinforced by group success, once focal combination is spotted, that strategy is played forever. The above makes clear that the power of focal points depends on information.

2.4.2 Heterogeneity and Incomplete Information

In absence of information on the efficacy distribution in group, there are no focal points to guide collective success. Players do know that efficacies sum to 100 and they know their own efficacy.

Here we expect individuals will behave according to the efficacy-cooperation heuristic; the higher ones efficacy, the higher ones probability to invest. Share 50 players are the most likely candidates to invest, and share 1 players probably opt out. For share 20 players we expect that they may enter the situation with a more gambling attitude (i.e. using mixed strategies) (Harsanyi and Selten 1988).

2.4.3 Homogeneity and Complete Information

Whereas in heterogeneous groups we expect that the provision of complete information will render focal coalitions easier, compared to a situation of no or less shared information, we expect quite the contrary for homogenous groups. We argue that providing more shared information about the distribution of individual efficacies can harm collective efficacy. This argument is based on the fact that revealing information about the efficacy distribution inevitably reveals other aspects of the situation, which may more than outweigh the positive effect on cooperation of the presence of a focal point. This puts the informed group at a *dis*advantage compared to a group with less shared information. Groups with complete information, would witness continued internal strife since the positive and negative reinforcements from success and failure are balanced by easily available counterfactual reasoning (‘We produced the SPG, but looking at the efficacy distribution I fail to see why *I* had to do all the work’, or ‘we could have succeeded as a group if only some of the others had pulled their load’). Some studies with homogenous groups in complete information conditions show that groups can learn to take turns (Diekmann and Przepiorka 2016; Przepiorka et al. 2020).

2.4.4 Homogeneity and incomplete information

For homogenous groups in incomplete information conditions we expect similar decision behavior as for that individuals in heterogeneous groups. In the absence of information players will employ the efficacy-cooperation heuristic, and may be likely to invest compared to a complete information condition.

2.4.5 Hypotheses on the role of information on efficacy heterogeneity

Flowing from our theory above we derive the following hypothesis:

Hypothesis 4: *Heterogeneous groups in complete information conditions achieve more collective actions success then heterogeneous groups in incomplete information conditions*

Hypothesis 5: *in complete information conditions, heterogeneous groups achieve more collective action success than homogeneous groups.*

Hypothesis 6: *the difference in success probabilities between homogenous groups is larger under complete information than incomplete information*

In the next chapter we describe the operationalization of variables, the design of our experiments, data collection procedures, and analyses techniques to test hypotheses and answer the research questions.

Chapter 3[3]

[3] Parts of this chapter are used in two journal articles that resulted from this dissertation in order to submit it to international peer-reviewed journals. The first article co-authored with Jacob Dijkstra and is titled: Social Value Orientation and Learning in Repeated Step-Level Public Goods Games: An Experimental Investigation. This article is currently under review.
The second article is co-authored with Jacob Dijkstra and is titled: Efficacy Heterogeneity and Information in Repeated Step-Level Public Goods Games. This article is in preparation for submission

3 Research Designs and Methods

3.1 Overview

In this chapter we discuss the two experiments and accompanying analysis techniques to answer research questions and test hypotheses. For each experiment we briefly describe the purpose, the questions to answer and hypothesis test. Furthermore, we describe the experimental designs, sampling, data collecting and analysis techniques.

3.2 Experiment 1: SVO in repeated SPG's

3.2.1 Purpose and hypotheses to test

The purpose of experiment one is investigate the role of SVO and test my hypotheses to answer the research question. Here a short recap. With respect to the role of SVO in repeated SPG games we ask: *How does the SVO – behavior link change over the course of repeated interactions, and how does this relationship influence collective action success?* Based on theory and literature we derived the following hypotheses: Hypothesis 1: SVO predicts individual behavior in the onset of repeated interactions in the SPG. Especially, prosocial individuals have a higher investment probability than others. Hypothesis 2: The impact of SVO on investment in the SPG decreases over multiple interactions. Hypothesis 3: A player's investment probability in any round but the first is affected by the outcome of the previous round. In particular, for all SVO types the investment probability is decreased after an occurrence of the free-rider history (H3a) and the sucker history (H3b). Following the reward history (H3c) and punishment history (H3d), prosocials have a higher probability of investing than other SVO types.

3.2.2 Design and measures[4]

For the design of this experiment, we adopt the experimental design from Dijkstra and Bakker (2017). The experiment is computer-mediated and programmed using the Z-tree software (Fischbacher 2007), and consists of three independent parts; i) an SVO questionnaire, ii) a one-shot SPG[5], and iii) a repeated SPG. Below we discuss these parts in detail. The design consists of a 2 x 2 x 2 x 2 structure in which 'SVO first' (SVO questionnaire first/SPG games first), 'repeated first' (repeated game first/one-shot game first) and 'information' (complete/incomplete)[6], are between subject factors and 'iteration' (repeated/one-shot) is a within-subject factor. This yields a total of 8 between-subject treatments.

The SVO part

To elicit participants' SVO, we use the 9-item Triple-Dominance Measure (Van Lange 1999; Van Lange et al. 1997). Participants get to make nine decisions. Each decision involves a choice as of how to distribute a number of points between themselves and an imaginary other person (see table 2). Each decision involves three alternative distributions of points. Each alternative distribution is associated with one of three Social Value Orientations (pro-social, individualists and competitive). Competitive alternatives maximize the difference between points for self and other (option A in Table 2 below), individualistic alternatives maximize points for self (option B), and pro-social alternatives yield more equal distributions of points across self and other (option C). In our

[4] All elements and organization of the experimental session underwent thorough ethical review and obtained approval by the ethical committee of university of Groningen. Ethical approval was obtained before conducting the study.

[5] The one-shot SPG was not part of our focus and is discussed in: Dijkstra & Bakker, 2017.

[6] The manipulation of the between-subjects treatment on information is not under investigation in this dissertation and is discussed at length in Dijkstra, Bouman, Bakker & van Assen, (2019), however, we control for this factor in our statistical models.

experiment the SVO decisions were not incentivized, and participants would not earn any money based on their decisions.

Table 2 SVO item example

	A	B	C
You receive	480	540	480
Other receives	80	280	480

The SPG part

Participants are randomly assigned to a group of 5 before playing the SPG game. Table 3 summarizes the game in how own behavior and behavior of others in the group affect outcomes. In each group, each player receives an initial endowment of 10 points. Each player decides (anonymously and in ignorance of what others are choosing) whether to invest in the public good or not. If a player decides to invest, one loses their 10 points. In the event that the SPG is produced all players receive 15 points. Investors thus end up with 15 points while non-investors end up with 25 points. If the SPG is not produced no points are awarded, with investors ending up with 0 points and non-investors with 10. The rules determining SPG production are as follows. In addition to the endowment of 10 points, each player is assigned a *share,* where the share stands for a relative impact that a player has in producing the public good. The share distribution is as follows: one player has a share of 50, one player has a share of 2, and three players have a share of 16. It is common knowledge that the shares of all 5 players sum to 100. The SPG is produced if and only if the shares of the investors sum to at least 51. Players have the same shares throughout the entire

experiment. After all group members have made their decisions, participants are informed whether the SPG is produced. Participants are not told which of their fellow group members had invested. The SPG is repeated for six rounds with the same group of participants, and this fact is common knowledge.

Table 3 Payoffs of individual in SPG depending on own behavior and behavior of others

	Behavior	
Own behavior	Sum of shares < 51	Sum of shares ≥ 51
Invest	0	15
Not invest	10	25

3.2.3 Procedure

The procedure of the experiment will be as follows: upon arrival at the lab participants are provided with written and oral instructions by the experiment leader. On the test and an informed consent form on paper, and are randomly assigned to a workspace with computer. Computers are separated with wooden partitions to create individual spaces and prevent participants to peak on another person's computer screen. After participants have read instructions, asked questions and signed informed consent forms, we start the experiment. The experiment consists of three parts tasks that participants complete in randomized order, namely the SPG one-shot, the SPG repeated, and the SVO questionnaire. In the SPG tasks, groups consisting of 5 individuals are randomly assigned to one of the experimental conditions and assigned a share (efficacy) and receive instructions on the rules and the procedure of the game. Participants have to decide independently and simultaneously

between investing or not investing. After all individuals have made their decisions, In the they are presented a summary with the outcomes of the round. Participants learn after each round whether the public good is produced, and which players with which shares invested. Note that participants cannot actually identify others in any way. The one-shot SPG lasts for 1 round and the repeated SPG lasts for 6 rounds. In the SVO task participants are first asked to complete the SVO triple-dominance measure, in which they make a series of 9 decisions in which they are asked how they would divide an initial allocation of monetary units between themselves and another person.

After the tasks are completed, participants are paid their show-up fee.

3.2.4 Dataset

The experiment was conducted in the experimental Sociological Laboratory at the University of Groningen in 2017 and comprised eight session with fifteen participants in each session. The N=120 participants in the sessions where undergraduate students from various disciplines, and where approached via the online requirement system of the Sociological Laboratory of the University of Groningen.

3.2.5 Data analysis approach

To test hypotheses We estimate a series of multilevel logistic regressions with invest (0/1) as the dependent variable and random terms for group and subject. We use a Bayesian approach and code and estimate the models in the BUGS language called from R (Gelman & Hill, 2007; R Core Team, 2013). In chapter 4 we discuss the results from this experiment, the analyses techniques to test hypotheses tests and model specifications are discussed alongside the results to improve readability and avoid repetition.

3.3 Experiment 2: Information on efficacy Heterogeneity

3.3.1 Purpose and hypotheses to test

The purpose of experiment one is investigate the role of information on efficacy heterogeneity. Here a short list of the research question and hypotheses for which the experiment is designed.

Research question: *How does the distribution of individual efficacies and the degree of information on efficacy distributions influence collective action success?*"

Hypothesis 4: Heterogeneous groups in complete information conditions achieve more collective actions success then heterogeneous groups in incomplete information conditions

Hypothesis 5: in complete information conditions, heterogeneous groups achieve more collective action success than homogeneous groups.

Hypothesis 6: the difference in success probabilities between homogenous groups is larger under complete information than incomplete information

3.3.2 Design and measures[7][8]

For the design of this experiment, we adopt the experimental design from Dijkstra and Bakker (2017), and add an additional treatment. The experiment is programmed with o-Tree (Reference) and consisted of two independent parts.

The first part consists of a repeated SPG game, where groups of 5 participants interact in the same group for 15 consecutive rounds. The SPG has two treatments; Treatment one consists of a manipulation in the degree of homogeneity. In the *homogenous treatment* investments of each member in the group has the same efficacy in public good production. In the *heterogeneous treatment* group members have differential efficacy levels. Treatment two manipulates the degree of information that group members have about each other's efficacy levels. In case of the *complete information treatment*, group members know their own efficacy and also the efficacies of their group members. In case of an *incomplete information condition* each individual within a group only know their own efficacy. We programmed four variations of the game to which groups of individuals are randomly assigned. 1) a SPG with a homogenous efficacy distribution and complete information. 2) a SPG with a homogenous efficacy distribution and incomplete information. 3) a SPG with a heterogeneous efficacy distribution. 4) a SPG with a heterogeneous efficacy distribution and complete information.

The second part consists of a questionnaire. The questionnaire starts with SVO slider measure developed by Murphy, Ackermann and Handgraaf (2011). SVO has been shown to be highly stable as an individual difference with a test-retest reliability of r = 0.915 (Murphy et al,

[7] A complete worked out version of the experiment is attached to the dissertation in appendix 1

[8] All elements and organization of the experimental session underwent thorough ethical review and obtained approval by the ethical committee of university of Groningen. Ethical approval was obtained before conducting the study.

2011). Example of SVO question is was shown in table 3. The questionnaire continues with the HEXACO questionnaire (Ashton and Lee 2009) that assesses personality traits underlying cooperative behavior. The HEXACO questionnaire that can assess major dimensions of personality such as BIG-5 (Zillig, Hemenover, and Dienstbier 2002) and includes scales such as Honesty-Humility that indicate ones fairness principles. An example of an HEXACO-60 item is: *'I do only the minimum amount of work needed to get by',* answer options are on a 5-point Likert scale ranging from, 1) strongly disagree to 5) strongly agree[9].

The SPG and the questionnaire tasks are presented to participants in randomized order. Below we first describe each part and follow up with a description of the procedure of an experimental session. We finalize the paragraph with a description of the data and brief overview of analysis techniques to test the hypotheses.

The questionnaire task

Participants answer 6 SVO items and 60 HEXACO items. The full questionnaire is added in appendix 1.

The SPG task

The central element of the experiment is the repeated SPG as described in the theoretical section. Individuals in the game are referred to as 'players', and this SPG has five of them. Each player has an endowment of 10 points and decides (anonymously and in isolation) whether to invest or keep one's entire endowment. Investing means a player loses their 10 points. In the event that the SPG

[9] The HEXACO results are not discussed in this dissertation as the scientific study of personality traits is beyond the scope of the dissertation's research questions.

is produced all players, regardless of their investment, receive 15 points. Thus, investors end up with a total of 15 points (for a net gain of 5) while non-investors end up with a total 25 points (for a net gain of 15). If the SPG is not produced no points are awarded. In that case, investors end up with 0 points (for a net loss of 10), whereas non-investors simply keep their endowment of 10 points (neither gain nor loss). To produce a public good, enough individuals (a critical mass) must invest. *In the heterogeneous SPG condition:* The rules determining SPG production with heterogeneous players are as follows. Each player is assigned a *share* between 1 and 50, modelling their efficacy. It is common knowledge that the shares of all five players sum to 100 and that no single player has a share greater than 50. The share distribution is such that one player has a share of 50, one player has a share of 1, and three players have a share of 20. The SPG is produced only if the shares of the investors are 51 or more. A successful group of investors must include the player with a share of 50. *In the homogenous SPG condition* : All players are each assigned a *share* 20, modeling their efficacy. It is common knowledge that the shares of all five players sum to 100. The SPG is produced only if the shares of the investors are 51 or more. A successful group of investors must include at least three investors.

3.3.3 Procedure

The procedure of the experiment will be as follows: upon arrival at the lab participants are provided with written and verbal instructions by the experiment leader. Participants receive a informed consent form on paper, and are randomly assigned to a workspace with computer. Computers are separated with wooden partitions to create individual spaces and prevent participants to peak on another person’s computer screen. After participants have read instructions, asked questions and signed informed consent forms, we start the experiment.

The experiment consists of two tasks that participants complete in randomized order, the collective task, and the questionnaire, this randomization is to conform to experimental conventions but also to completely anonymize participants and ensure that they cannot be identified and protect their privacy. These two tasks are as follows:

In the *collective task* groups consisting of 5 individuals are randomly assigned to one of the experimental conditions and assigned a share (efficacy) and receive instructions on the rules and the procedure of the game that matches their experimental condition. Next, participants play the game, in the same group, in the same treatment repeatedly for 15 rounds. The task for each participant in each round is as follows: Participants have to decide independently and simultaneously between investing or not investing. After all individuals have made their decisions, they are presented a summary with the outcomes of the round. In the complete information conditions, participants learn after each round whether the public good is produced, and which players with which shares invested. Note that participants cannot actually identify others in any way.

In the *questionnaire task* participants are first asked to complete the SVO-slider measure in which they make a series of 6 decisions in which they are asked how they would divide an initial allocation of monetary units between themselves and another person. Participants know that it’s a hypothetical question and that they are not actually earning anything. Subsequently they are asked to complete the questionnaire.

3.3.4 Sampling and data collection

The experiment was conducted at the Experimental Laboratory at the University of Groningen, The Netherlands. We conducted 4 experimental sessions resulting in a sample of $N = 140$ participants in total on April 29th 2019, December 3rd 2019, February 27th 2020 and March 4th 2020.

Participants were students from the University of Groningen. Participants were recruited through the university's educational program "Testdays" [10]. Participation was completely voluntary. After participation, everyone had the opportunity to ask questions and obtain a report on the results. I also provided students with a written report with a debriefing on the experiment.[11]

3.3.5 Data analysis approach

Using the *lme4 package* in R (Bates et al, 2015; R Core Team, 2013) we test hypotheses by estimating a series of multilevel logistic regressions with invest (0/1) as the dependent variable and random terms for group and subject. In chapter 5 we discuss the results from this experiment, the analyses techniques to test hypotheses tests and model specifications are discussed alongside the results to improve readability and avoid repetition.

[10] https://www.rug.nl/research/department-of-sociology/organisation/test-days?lang=en

[11] See experiment materials in appendix 1

Chapter 4[12]

[12] This chapter is transformed into a research article and submitted to an international peer-reviewed journal. The manuscript is co-authored with Jacob Dijkstra and is titled: Social Value Orientation and Learning in Repeated Step-Level Public Goods Games: An Experimental Investigation. The manuscript is currently under review.

4 Results I. The role of SVO and Learning in Repeated SPG's

4.1 An overview

In this chapter we report the results regarding my research question on the role of SVO in repeated SPG's. Below we first start with a short recap of the study. In the following paragraphs we report descriptive results, results from hypotheses tests and a conclusion answering the research question, discussing implications and propositions for future research.

4.2 Recap

How individuals value their own and others' outcomes from cooperation is conceptualized as their Social Value Orientation (SVO). Ample research demonstrates that SVO is a valid predictor of cooperative behavior across various empirical settings. However, once individuals interact repeatedly, the relative strength and stability of the SVO – behavior link are less clear cut. Therefore we ask: *How does the SVO – behavior link change in the course of repeated interactions?*

We postulate that learning mechanisms have a bearing on cooperative behavior and potentially override the influence of SVO. This is especially the case in cooperation situations in which thresholds exist, such that an individual cannot produce positive externalities for others unconditionally. When individuals share a cooperative future, they learn from past interactions, form expectations about their partners' future actions, and adjust their behavior aiming to control outcomes in the future. Hence, the impact of dispositional traits such as SVO should wane over time.

In a computerized experiment with a Step-Level Public Goods design (N=120), participants were randomly assigned to interact in groups of five and interacted for six rounds. SVO was measured with the 9-item Triple-Dominance Measure.

We used multi-level logistic regression models following a Bayesian approach to test hypotheses. We corroborate that SVO is predictive of behavior in the onset of collaboration. Yet, after the first interaction, the relationship between SVO and behavior virtually disappears. Instead, learning from results in past rounds steers decision behavior over the next.

4.3 Descriptive Results

Based on the 9-Item Triple dominance measure (Van Lange et al. 1997) for SVO in the sample of N = 120, 2 subjects were classified as *competitive*, 62 subjects were classified as *prosocial*, and 39 subjects were classified as *individualist*. The remaining 17 subjects were unclassified. A crucial assumption underlying our theory is that SVO is a stable personality trait. In particular, in order to test our hypotheses we assume that a subject's SVO is unaffected by the order of experimental tasks. Table 4 shows that this assumption is justified for our sample. It tabulates the distribution of SVO types in the half sample that first took the 9-item TDM and then played the SPG ("Before") and in the half sample that first played the SPG and then took the 9-item TDM ("After"). The two distributions are virtually identical (Fisher exact test, p = 1).

Figure 1 shows the number of group members that invest in the public good in each round, for the 24 groups separately. Although a downward trend is generally discernable, there appears to be considerable variance between groups.

Table 4 Distributions of SVO types of half samples who took 9-item TDM before SPG ("Before") and after SPG ("After"); N = 120

	SVO type			
	Competitive	Prosocial	Individualist	Unclassified
Before	1	30	19	10
After	1	32	20	7
Totals	2	62	39	17

Note: Fisher exact test for difference between distributions: p = 1.

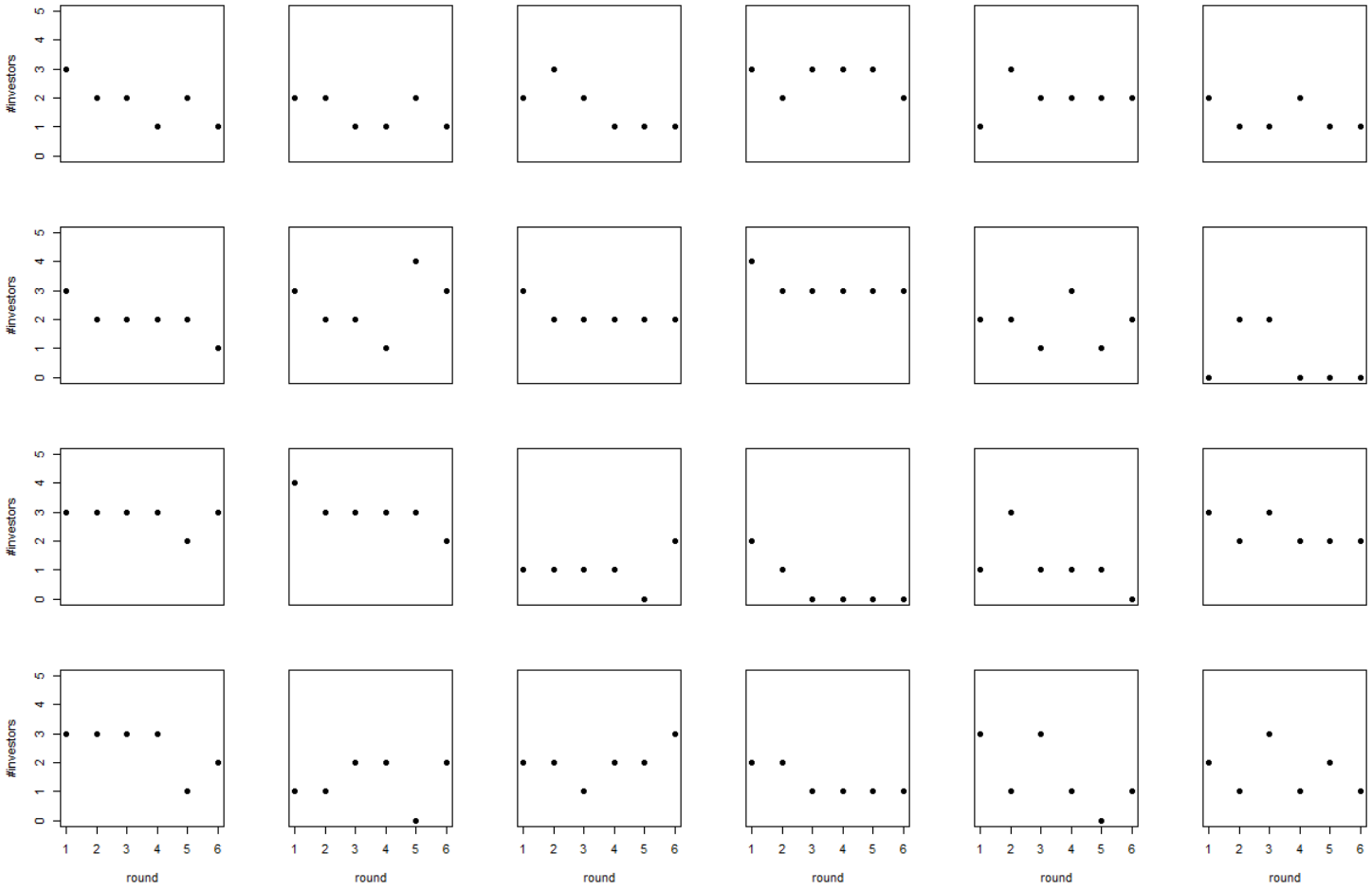

Figure 1. Number of investments in SPG per round, per group

To explore investment behavior on the subject level, table 5 breaks down number of rounds of investment per individual by SVO type. Looking at total investments across all SVO types, Table 2 shows that there were 39 subjects (32.5%) who never invested in the SPG, while 20 subjects (16.7%) always invested. From zero to five rounds of investment, the numbers clearly drop off from a high of 39 to a low of 7 subjects (5.8%). The sharp increase at 6 rounds of investment (to 20 subjects, or 16.7%) is due to the high number of prosocials showing unconditionally cooperative behavior. Looking at behavior for each of the SVO types, we do find however that even among prosocials a considerable number (16, 25.8%) never invested. In fact, the investment pattern across one to five rounds of investment looks similar across the SVO types (including the unclassified). Prosocials stand out however when it comes to the lower number of subjects that never invest (25.8%) and the higher number of unconditional investors (21%). Competitors were too few in number (2) to draw any meaningful conclusions about.

Table 5 Number of subjects (with % per row) investing in 0, 1, 2, …, 6 rounds out of 6, by SVO type

	Number of rounds invested						
SVO	0	1	2	3	4	5	6
Competitive	0	0	1 (50%)	0	0	0	1 (50%)
Prosocial	16 (25.8%)	12 (19.4%)	9 (14.5%)	7 (11.3%)	3 (4.8%)	2 (3.2%)	13 (21%)
Individualist	16 (41%)	5 (12.8%)	6 (15.4%)	1 (2.6%)	3 (7.7%)	4 (10.3%)	4 (10.3%)
Unclass.	7 (41.2%)	3 (17.6%)	1 (5.9%)	2 (11.8%)	1 (5.9%)	1 (5.9%)	2 (11.8%)
Totals	39 (32.5%)	20 (16.7%)	17 (14.2%)	10 (8.3%)	7 (5.8%)	7 (5.8%)	20 (16.7%)

4.4 Hypotheses tests

To test hypotheses we estimate a series of multilevel logistic regressions with invest (0/1) as the dependent variable and random terms for group and subject. We use a Bayesian approach and code and estimate the models in the BUGS language called from R (Gelman & Hill, 2007; R Core Team, 2013). We use independent, non-informative priors for all parameters and report posterior medians and symmetric posterior 95% probability intervals. To test the hypotheses, we evaluate the posterior probability intervals of the relevant (transformations of) parameters. This yields "Bayesian hypothesis tests" at a two-sided significance level of 0.05 (Gelman, Hwang, and Vehtari 2014). In our estimation I implement 3 chains with random starting values for each model and run for 20,000 iterations. All models we report have converged, with R-hat values of at most 1.1 for each parameter. Data, the codebook, and all BUGS and R code are available at the Open Science Framework© folder for this dissertation here.

To establish a baseline for hypotheses evaluation, we first estimate a model containing only control variables (Model 1 in Table 6). Model 1 contains dummies for share (with a share of 16 as the reference category), for the 9-item TDM being taken before playing the game or after ("SVO First"), for the repeated version of the SPG being played first or second ("Repeated First"), and for having complete information or not ("Info"). The posterior 95% probability intervals show that share 50 players are more likely to invest than others. All other posterior intervals contain the value zero. The random effects show that group-level variance is generally low and could well be zero.

Table 6 Bayesian Parameter Estimates From Multilevel Logistic Regressions; dependent variable is "invest" (0/1); independent, non-informative priors for all parameters; posterior medians, with (2.5%, 97.5%)-percentiles in brackets

	Model 1[a]	**Model 2[a]**	**Model 3[a]**
Intercept	-1.04 (-2.37, 0.26)	-1.51 (-3.36, 0.09)	-1.31 (-3.15, 0.42)
Control Variables			
Share 2	-0.77 (-2.34, 0.65)	-0.64 (-2.24, 0.90)	-0.63 (-2.25, 0.90)
Share 50	3.07 (1.69, 4.65)	3.42 (1.92, 5.14)	3.30 (1.83, 5.13)
SVO First	-0.79 (-2.18, 0.45)	-0.87 (-2.17, 0.41)	-0.85 (-2.18, 0.42)
Repeated First	0.01 (-1.11, 1.24)	0.03 (-1.34, 1.22)	-0.03 (-1.21, 1.35)
Info	-0.07 (-1.36, 1.14)	-0.48 (-1.84, 0.74)	-0.43 (-1.62, 0.86)
Periods 2 – 6		-0.07 (-0.94, 0.77)	
Theoretical Variables			
Prosocial		2.53 (0.97, 4.08)	2.11 (0.62, 3.69)
Prosocial-Periods interaction		-1.54 (-2.71, -0.32)	
Punishment history			0.16 (-0.89, 1.14)
Sucker history			-0.16 (-1.66, 1.24)
Free-rider history			-0.60 (-2.03, 0.89)
Reward history			-0.50 (-1.70, 0.62)
Prosocial-Punishment			-1.22 (-2.67, 0.23)
Prosocial-Sucker			-1.79 (-3.88, 0.28)
Prosocial-Free-rider			-2.06 (-4.02, -0.28)
Prosocial-Reward			-0.66 (-2.11, 0.83)
Random Effects			
Individual-level s.d.	2.61 (2.01, 3.42)	2.73 (2.09, 3.61)	2.67 (1.92, 3.64)
Group-level s.d.	0.42 (0.05, 1.35)	0.40 (0.02, 1.33)	0.47 (0.03, 1.45)
DIC	606.70	590.60	595.40

[a] 720 investment decisions, nested 120 subjects, nested in 24 groups

In the next step, we model the development of investments over the 6 periods and include effects for SVO. Given that the hypotheses distinguish prosocial players from the other SVO types, we compare prosocial subjects to all others (including unclassified subjects). First we estimated an intermediate model with a dummy for each period (Period 1 being the reference category), a Period 1 effect for prosocials, and 5 period-prosocial interactions for periods 2 through 6 (results not shown). This model showed the following: (i) all posterior 95% intervals for period effects of non-prosocial subjects covered the value 0, (ii) the posterior 95% interval for the prosocial dummy (modeling the Period 1 effect of prosocial SVO) was (1.09, 4.27) with a median of 2.57, and (iii) the posterior 95% intervals for the period-prosocial interactions were entirely below zero in periods 3, 4, and 6 (while the posterior medians of all 5 period-prosocial interactions were negative). The DIC of this intermediate model was 587.30.

The posterior median and 95% interval for the Period 1 effect of prosocial SVO corroborate Hypothesis 1. Using the joint posterior distribution of the parameters mentioned under points (i) and (iii) above we can estimate the comparative effects of prosocial SVO in each separate round. This will allow me to evaluate Hypothesis 2. Figure 2 plots the posterior medians and the 95% posterior probability intervals.

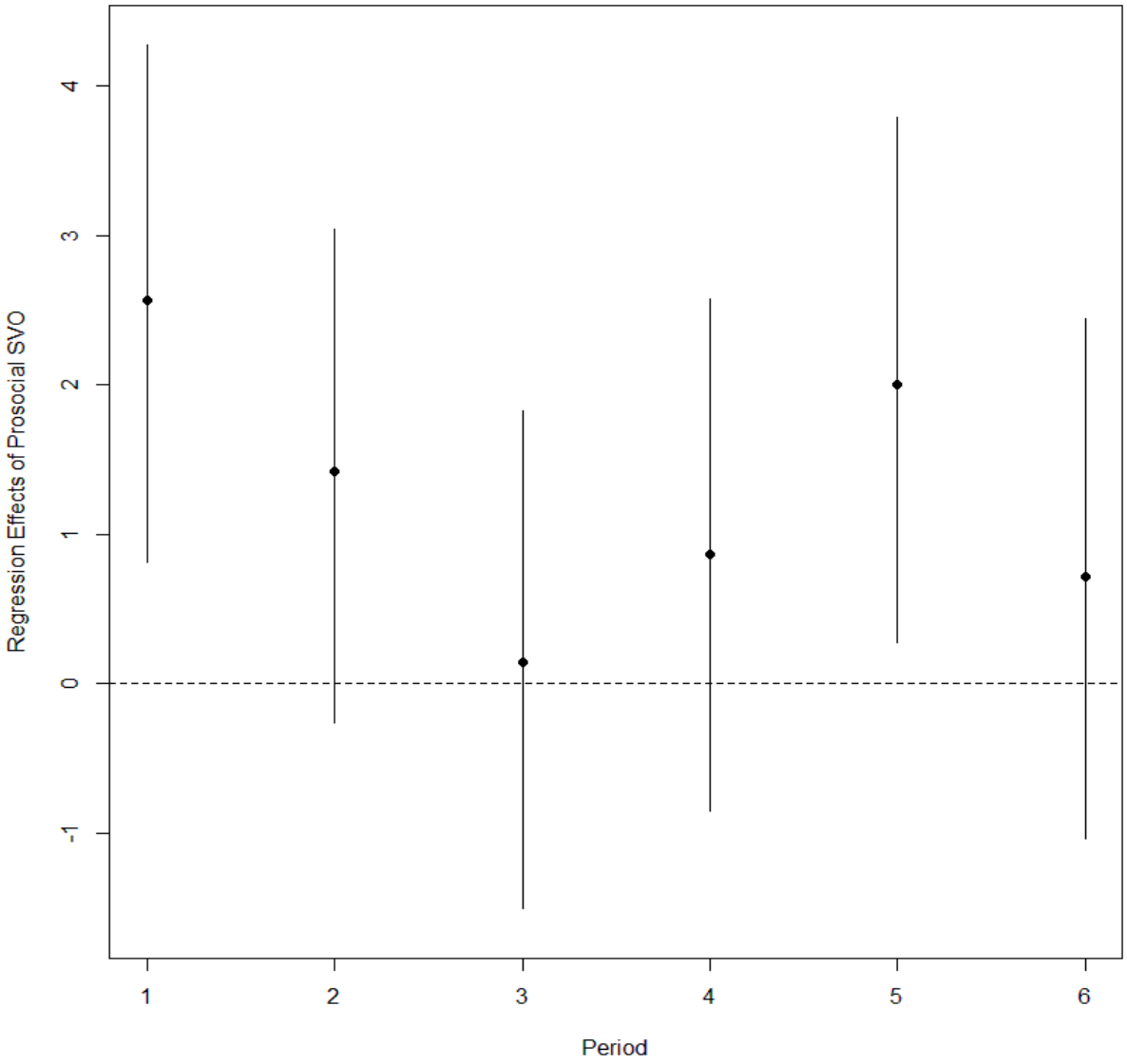

Figure 2 Regression effects of Prosocial SVO (compared to all other subjects) per period; posterior medians and 95% probability intervals

As predicted by Hypothesis 2, we see a sharp drop in the explanatory power of SVO after the first period. Of the 5 periods following Period 1, SVO is only predictive of investment behavior in the penultimate period. In all other periods the 95% probability intervals cover the value 0. All in all this pattern offers corroborative evidence in favor of Hypothesis 2.

To present a more parsimonious picture Model 2 in Table 3 lumps periods 2 through 6 together. Model 2 shows that non-prosocial subjects do not show a strong decline in investment probability going from Period 1 to periods 2 through 6 (posterior median = -0.07, posterior 95% interval (-0.94, 0.77)). Corroborating Hypothesis 1 Model 2 shows that a prosocial SVO is associated with an elevated investment probability in Period 1 (posterior median = 2.53, posterior 95% interval (0.97, 4.08)). As suggested by Figure 2, Model 2 shows that in subsequent periods the effect of prosocial SVO is much weaker (posterior median for the interaction = -1.54, posterior 95% interval (-2.71, -0.32)). To test Hypothesis 2 using Model 2, we use the joint posterior distribution of the parameter for the Period 1 effect of a prosocial SVO and the parameter for the interaction between prosocial SVO and periods 2 through 6. The effect in periods 2 through 6 has a median of 0.97 and a 95% posterior probability interval of (-0.22, 2.24), showing that prosocial become statistically indistinguishable from other SVO types and unclassified subjects after Period 1. This corroborates Hypothesis 2.

To evaluate Hypothesis 3, we create 1-period lagged variables indexing previous round history (cf. the four possible histories in Table 1). We include these history variables in Model 3 in Table 3. To solve convergence problems, we had to exclude the period dummies from this analysis. Note how the baseline of comparison in Model 3 is Period 1: the period without a history, scoring 0 on all history dummies. Hence, the estimated parameters for the history dummies estimate the response compared to the “historyless” Period 1. Also note how our approach of course implies that we are considering only 1-period histories. In particular, this means that we assume that a given

history has (on average) the same effect regardless of where it occurs in a sequence of histories and regardless of the content of that sequence (i.e., the other 1-period histories preceding it in the sequence).

The history effects in Model 3 show that for non-prosocial subjects previous period history hardly affects their investment decision: the 95% probability intervals for all four history dummies cover the value 0. Hence, non-prosocial subjects do not respond to the history of play. This is entirely consonant with the absence of period effects for non-prosocials in Model 2 and the intermediate model discussed above. The history-prosocial interactions furthermore indicate that prosocial subjects respond more negatively to all histories, although only the 95% probability interval for the prosocial – free-rider history interaction lies entirely below 0. To complete the picture and test Hypothesis 3, we use the joint posterior distribution of the history and history-prosocial interaction parameters to estimate the response of prosocials after each history. The posterior medians and 95% probability intervals of the history effects for prosocials are -1.08 (-2.05, -0.10) for the punishment history, -1.94 (-3.46, -0.49) for the sucker history , -2.64 (-3.86, -1.62) for the free-rider history, and -1.74 (-3.37, -0.22) for the reward history. These results are not in line with Hypothesis 3. Even though prosocials do indeed lower their investment probabilities after an occurrence of the free-rider (H3a) and sucker histories (H3b), the same is *not* true of non-prosocials. The 95% intervals on the history-prosocial interactions, moreover, show that prosocials do not have a higher investment probability than other subjects following the reward (H3c) and punishment (H3d) histories. Rather than referring to the subtle learning mechanism underlying Hypothesis 3, the data can more parsimoniously be summarized by saying that compared to non-prosocials, prosocials start with a higher inclination to invest and quickly learn to behave like anyone else regardless of the actual history of play. In this respect it is noteworthy that prosocials seem to respond particularly negatively following a free-rider history.

4.5 Conclusions

Previous research had taught me that SVO is a valid and powerful predictor of cooperative behavior in social dilemmas, specifically when individuals interact with each other in one-shot games across various experimental settings (Balliet et al. 2009; Bogaert et al. 2008; Pletzer et al. 2018). Now, we asked whether the link between SVO and cooperative behavior is still as strong when groups interact *in the same group* repeatedly. Drawing on social learning theories and paying close attention to the incentive structure of the situations that groups face, we hypothesized that in "critical mass" or threshold incentive structures SVO quickly loses predictive value in repeated interactions. Based on a set of simple assumptions about the learning process, we derived three hypotheses about how the SVO – behavior link develops over time. we employed a computerized experiment with a Step-Level Public Goods design (N=120) that also included a measurement of SVO to test our hypotheses. So, what has this study taught me about the link between SVO and cooperative behavior in SPG games when individuals interact in the same group repeatedly?

First, our experiment corroborates that SVO is a valid and strong predictor for cooperative behavior in social dilemmas in the onset of cooperation (H1). Prosocials are far more likely to invest in the first encounter than individuals with other SVOs. This is perfectly consistent with findings from a vast amount of previous research across social sciences.

Second, we theorized that when individuals interact in a situation with a threshold/critical mass structure, one's contribution to the public good does not necessarily yield positive externalities for others in the group. This particular feature of the situational structure renders SVO as a factor of lesser importance when the situation is repeated. Our experiment indeed shows that when individuals interact with each other repeatedly, the strong relationship between SVO and behavior fades (H2). This phenomenon sets in right after round 1: after the first round prosocials

are statistically indistinguishable from others. With this we also show how the impact of dispositional traits such as SVO can change over time as contextual structure and learning mechanisms gain a more profound influence. Future research could continue investigating the SVO-behavior link in linear public goods games and other structural conditions to gain more insight into how structural conditions hamper or foster the behavioral manifestation of prosocial preferences.

Third, our analysis of history effects showed that while prosocials start with much higher inclinations to invest, they quickly learn to behave like anyone else. Prosocials seem to respond particularly negatively to a free-rider history. In fact, prosocials decreased their investment probabilities after *any* previous round history and we found no evidence in favor of the specific learning hypotheses we derived (H3). What makes prosocials respond more negatively in general and to free-rider histories in particular, remains an open question. Following scholarship on prosocial behavior (Mischkowski, Thielmann, and Glöckner 2019), we speculate that prosocials react negatively because of inequality aversion and resentment (Dreber, Fudenberg, and Rand 2014). Future studies could dive deeper into what drives or depresses the display of prosocial behavior by eliciting motivational aspects that drive behavior and studying these in variations of public goods games, for instance comparing both threshold and linear public goods games.

All in all, the results suggest that SVO may not be a very powerful predictor of behavior in repeated settings. This implies an important caveat for those who wish to use SVO to predict behavior in real-life contexts. Whenever these contexts involve repeated interaction in which individuals can learn about the behavior of specific others with whom they are strategically interdependent (“group members”, say), the effects of the history of interaction may override the effects of SVO. Complicating matters, what counts as “repeated interaction in a fixed group of individuals” is much less clear-cut in real-life settings than in experimental ones. We speculate that

the ability to learn and form beliefs about the behavior of a well-defined group of others coupled with a significant degree of payoff interdependence with these others are important factors determining whether individual decision makers define their situation as “repeated”.

Thus, charitable giving (in which neither of these conditions is fulfilled to a meaningful degree) would hardly count as a repeated setting in this sense even if individuals repeatedly gave to the same cause. Therefore, SVO should be a good predictor of charitable giving, a fact borne out by research (Bekkers and Wiepking 2011; Van Lange et al. 2007). Other forms of collective action however, such as the founding of local community energy cooperatives (even if they appear rather unique on the face of it), are very likely construed by community members as part of a repeated interaction structure. In such a situation we would speculate SVO to have little value for predicting individuals’ contribution levels. Of course, these are mere extrapolations based on a single experiment.

Future research should identify the social conditions under which individuals define their cooperation problems as being embedded in a repeated interaction within the same group and should investigate the extent to which this (perceived or actual) repetition affects the SVO – behavior link.

Chapter 5[13]

[13] This chapter is transformed into a research article and submitted to an international peer-reviewed journal. The manuscript is co-authored with Jacob Dijkstra and is titled: Efficacy Heterogeneity and Information in Repeated Step-Level Public Goods Games.

5 Results II. The role of information on Efficacy Heterogeneity

5.1 An overview

In this chapter, we report the results regarding the research question on the role of information on efficacy heterogeneity. Below we first start with a short recap of the study. In the following paragraphs we report descriptive results, results from hypotheses tests, additional exploratory analyses and a conclusion answering the research question, discussing implications and propositions for future research.

5.2 Recap

Research has established that there is a significant positive relationship between efficacy and investment in public goods (Kerr, 1996; Dijkstra & Oude Mulders, 2014). Compared to a situation in which individuals all have the same efficacy, heterogeneity in efficacy can render certain coalitions of potential investors more 'prominent' or more 'obvious' than others. Experimental studies indeed confirm that heterogeneity serves as a point of departure in singling out certain coalitions of potential investors more prominent or focal than others (Dijkstra & Bakker, 2017; Dijkstra et al, 2019).

An important aspect of decision making in any type of situation is whether individuals possess *common knowledge* on the structure of the situation (Kagel & Roth, 2016; Camerer 2013), and in many laboratory studies that mimic collective action situations, in fact provide their subjects with *complete information.* However in real life, individuals in collective action endeavors do not

always have access to complete information. The question then becomes, does this relationship between heterogeneity and collective action success hold when individuals lack this information? Dijkstra & Bakker, (2017) performed an experiment using a step-level public goods game (Van de Kragt, Orbell, and Dawes, 1983) in which the degree of information was manipulated and find that the degree of information affects behavior significantly. However, they did yet look into how homogeneous and heterogeneous compare across information conditions. Given that both information an heterogeneity seem to play a significant role, it is important to investigate how these two key factors may interact.

To obtain more insight, we formulate the following research question: *"How do the distribution of individual efficacies and the degree of information on efficacy distributions jointly influence collective action success?*" we postulate that in homogeneous groups, complete information may harbor many social dilemmas and has a negative effect on public good production, whereas for heterogeneous groups, complete information can be seen as an amplifier of successful and efficient cooperation strategies.

We designed and conducted a computerized experiment with a Step-Level Public Goods design (N=140). We test hypotheses using a multi-level framework. In the following paragraphs we describe the results.

5.3 Descriptive results

The sample of this study consists of N=140 subjects. Participants were undergraduate sociology students from the University of Groningen.[8] Based on the SVO slider-measure (Murphy et al. 2011) in the sample of N = 140, 108 subjects were classified as *prosocial*, 31 subjects were classified as *individualist*, and 1 subjects was classified as *competitive*.

Figure 3 and figure 4 visualize how investment behavior and collective action success trend over time in our sample data. Figure 3 shows the number of group members that invest in the public good in each round, for the 28 groups separately. A downward trend is generally discernable in the number of investors per round. Figure 4 shows proportion of good production per round. Here we also see that as time progresses group success deteriorates.

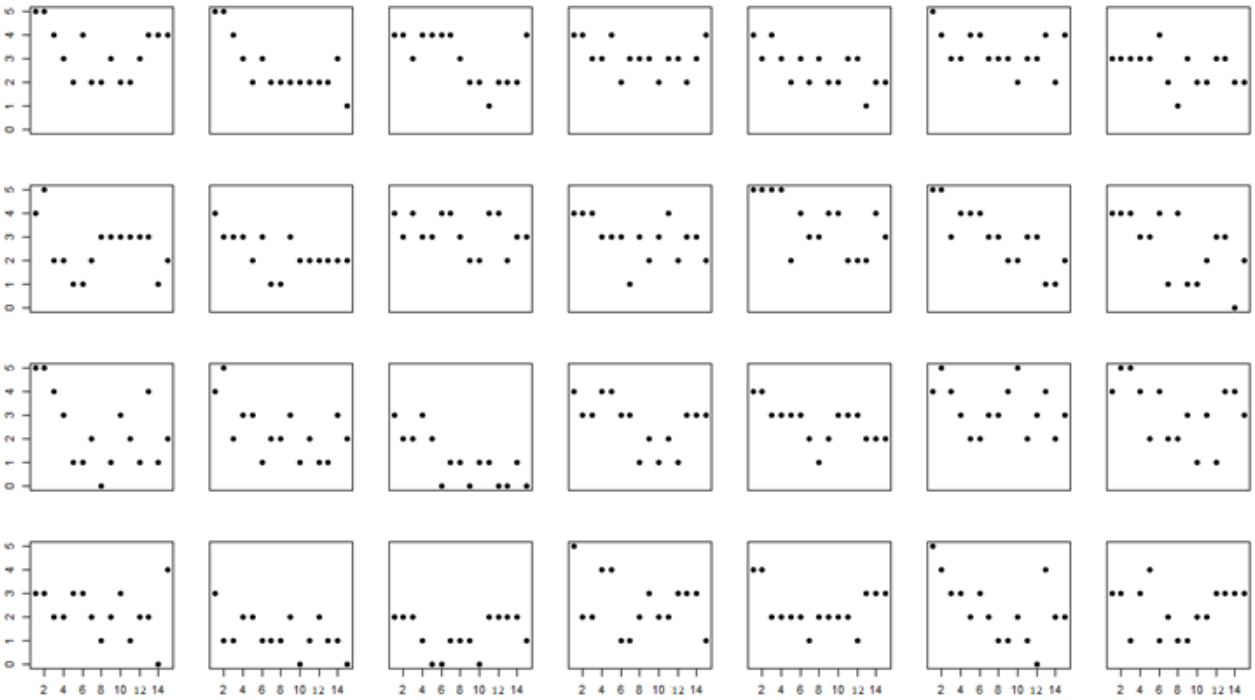

Figure 3. Number of investments in SPG per round, per group

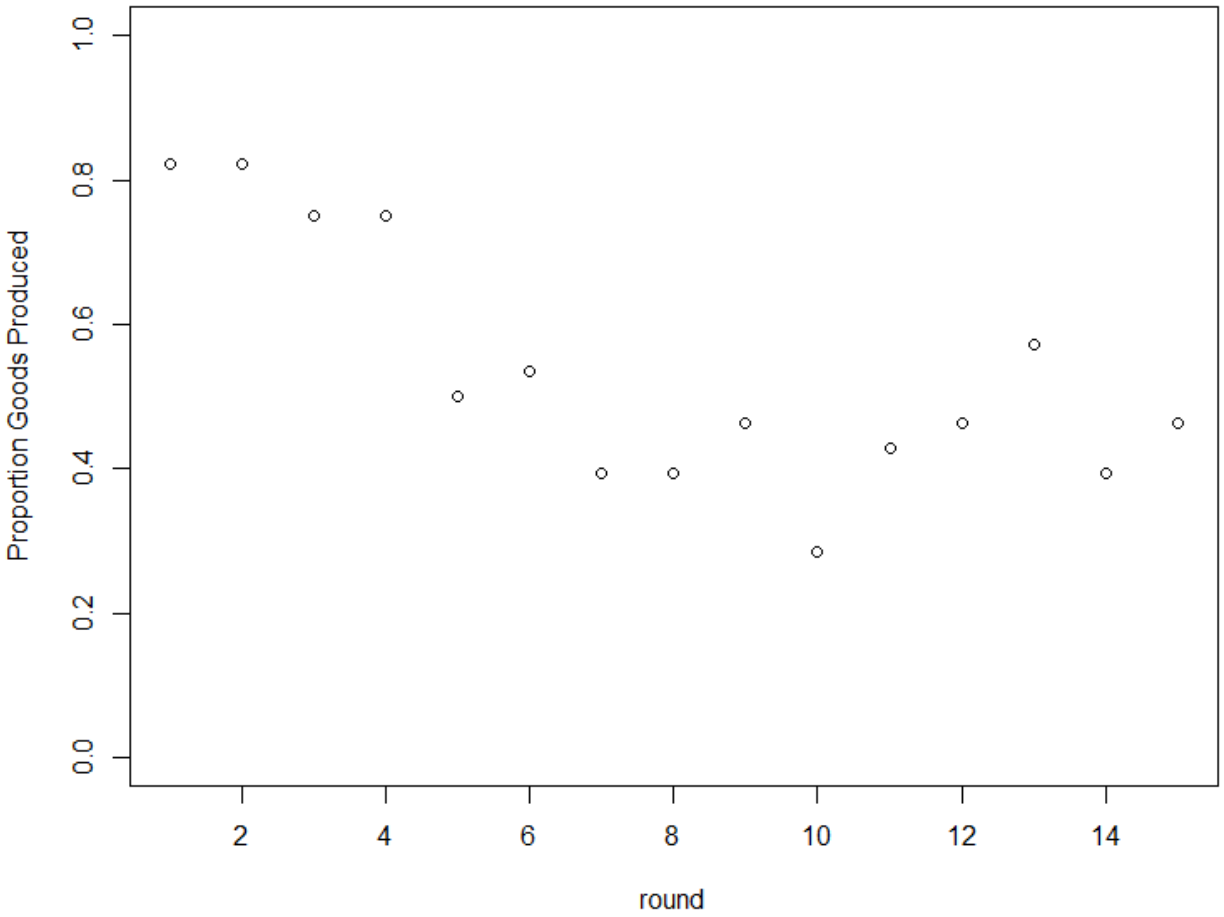

Figure 4 Proportion of public goods produced per round

5.4 Hypotheses tests

To test hypotheses we estimate a series of multilevel logistic regressions with good produced(0/1) as the dependent variable. Using the *lme4 package* in R (Bates et al, 2015) we employ a multi-level method as our data consists of individuals nested in groups and because of a repeated component where individuals carry experiences form one round to the next.

As our hypotheses are specified on differences between groups under different experimental conditions, we specify two levels of observation 1) Individual observations that are nested in 2) groups. To test the hypotheses we aggregate the data to group level indicators. Theoretical variables for the treatments are specified as fixed terms, and group ID is specified as random term. Period as is included as a control variable in a fixed term. To test hypotheses, we evaluate the coefficients of the relevant treatment variables. All models we report have converged. The data, codebook, all R code are available at the Open Science Framework© folder for this dissertation here.

To establish a baseline for hypotheses evaluation, we first estimate a model with only control variables and random effects for group (table 8, model 1). Model 1 contains a control variable for period. The baseline model shows that the predicted value for good produced is marginally positive, holding the control variables constant. Taking into account the role of period, the model indicates that with every increase of period (i.e. each round that the experiment progresses), the likelihood of public good production decreases.

In model 2 we include dummies for Complete Information (CIT) treatments, and set incomplete information (IIT) as reference category. We include the effect of heterogeneity by adding a dummy for the heterogeneous treatment (HET) and set homogenous treatment (HOT) as the reference category. For the treatment variables qe include both main effects and an interaction term. Model two allows me to test hypothesis 1 and 2. Results of model 2 do not to support

hypothesis 1 which argues that heterogeneous groups in complete information conditions achieve more collective actions success than heterogeneous groups in incomplete information conditions. The interaction effect coefficient is in the hypothesized direction, however, the model does not yield evidence for any significant effect of the treatments on public good production. Model 2 also fails to support hypothesis 2 stating that in complete information conditions, heterogeneous groups achieve more collective action success than homogeneous groups. Even though the coefficients of CIT are in the hypothesized direction there is no significant effect on public good production.

In model 3 we focus on the main effect of HET to test hypothesis 3. Model 3 also yields results that are not supportive of our third hypothesis arguing that the difference in success probabilities between homogenous groups is larger under complete information than incomplete information. These results indicate there is no support for the notion that the degree of heterogeneity and information on the degree of heterogeneity plays a significant role in a groups likelihood to produce public goods. These results are not in line with the theoretical framework and also contract current literature on the role of heterogeneity and information.

In the next section 5.5, we further investigate our data and focus on individuals decisions to invest in public good production over time. We do this to gain more understanding and to form a more substantive argument on how the results in this chapter differ from the results we found in chapter 4. Specifically, we turn to exploratory analyses from individual perspective, which entails introducing an additional level of analyses, namely, observations nested in individuals nested in groups. and report the results on the next pages

Table 7 GLM Mixed Effects Model. Multilevel Logistic Regression, Fit By Maximum Likelihood. Depended Variable is "Good produced(0/1)" (N=420 for 28 groups and 15 periods)

	Model 1	**Model 2**	**Model 3**
Intercept	1.38 (0.35)***	-0.15 (3.41)	3.44 (2.97)
Control Variables			
Period	-0.15 (0.028)***	-0.15*** (0.03)	-0.15*** (0.03)
Theoretical			
Variables			
CIT		3.59 (6.10)	*Ref*
IIT		*ref*	-3.58 (6.10)
HET		1.31 (8.11)	-2.99 (6.22)
HOT		*ref*	*ref*
CIT*HOT		-4.31 (13.74)	
IIT*HOT			4.30 (13.74)
Random Effects			
Group ID	1.61 (1.27)	1.52 (1.23)	1.52 (1.23)
Model Fit Indices			
AIC	501.9	506.4	506.4
BIC	514.0	530.7	530.7
Loglikelihood	-248.0	-247.2	-247.2
Deviance	495.9	494.4	494.4
df. residuals	417	414	414

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

5.5 The role of efficacy and information on individual level

5.5.1 The role of SVO, Efficacy, Period and Information on Investment behavior

The findings for our hypotheses tests did not turn out as we expected, and are also not very informative. To gain more insight in our data and what it could tell about factors important in collective action success and an individuals' investment behaviour, we turn to analyses on the individual level. The grouplevel analysis showed for instance, that SVO is of significant influence and also period and efficacies seem of significant influence. Therefore, we further explore what factors may influence an individual's likelihood to invest in the public good. Table 8 reports a series of multi-level logistic mixed effect models on individual level with the dependent variable invest(0/1). Also here we employ multilevel models because, observations are nested in individuals and individuals are nested in groups. Model 1 depicts a baseline model where I solely include a random term for each individual by means of a unique person identifier (person ID). Models with random terms for group id fail to converge. Model 1 shows that there is variance among individuals when it comes to likelihood of investing in the public good. This motivates us to further explore what is going on at an individual level.

Model 2 includes all control variables on individual level, namely, the Social Value Orientation (SVO) indicator dummies. Recall that SVO indicates how individuals prefer to cooperate in situation of interdependence and how they prefer to distribute payoffs from any surplus derived from collective action. The SVO slider measure used in experiment can indicate individuals as more prosocial, individualistic or competitive. In this model we included a dummy for prosocials and pooled individualists and competitive as the reference category. The results of model 2 show who individuals that are more prosocial are significantly more likely to invest in the

public good, keeping all else constant. In this experimental dataset, the role and influence of SVO is much more pronounced and in sharp contrast with in the results we obtained in experiment 1 and described in chapter 4. Because of this contraction, we conduct various additional analyses on SVO and discuss these in the next section (5.5.2).

Model 2 also includes dummies that indicate what *share* (level of efficacy) individuals were randomly assigned to in the game. Recall that in heterogeneous treatment share distribution{1,9,20,20,50} and in the homogenous treatment the share distribution {20, 20, 20, 20, 20}. For each possible share we add a dummy to the model, and set share 20 as reference category. Share seems to play a significant and decisive role. Looking at the role of efficacy we see that, individuals with a share of 1 are significantly less likely to invest. Also individuals with share 9 are significantly less likely to invest. The opposite is true for share 50 players. The likelihood that individuals with s hare 50 invest is significantly greater than share 20 players, holding all other components constant. Results regarding share are in line with theory and previous studies and clearly corroborate the efficacy-cooperation hypothesis in the literature. For the effect of period in model 2 we see that, over the course of interactions, investment becomes less likely. This result is also in line with theory and empirical findings in previous studies.

In model 3, we include dummies for our treatments. CIT is included as main effect and IIT as reference category. We include the effect of heterogeneity by adding a dummy for HET and set HOT as the reference category. For the treatment variables we include both main effects and an interaction term. Contrary to the analyses on group level, CIT poses as a significant and positive factor in one's likelihood to invest. Apparently this effect is not present or not statistically deductible on group level, but present on an individual level. To gain more insight, we conduct more analyses on the dependent variable invest by focusing on SVO*period interactions and analyses with subsets for HOT, HET, CIT and IIT. We discuss these in the next section.

Table 8 **GLM Mixed Effects Model From Multilevel Logistic Regression, Model Fit By Maximum Likelihood: Depended Variable Is "invest(0/1)" with standard errors in parentheses. (N=2100, from 140 individuals nested in 28 groups in 15 rounds)**

	Model 1	**Model 2**	**Model 3**	**Model 4***
Intercept	0.13 (0.15)	-0.33 (0.33)	-0.91* (0.40)	-0.03 (0.36)
Control variables				
Prosocials		1.97*** (0.34)	1.90*** (0.33)	1.90*** (0.33)
Individualists		*Ref*	*Ref*	*Ref*
Share 1		-1.05* (0.51)	-1.33* (0.58)	-1.33* (0.58)
Share 9		-0.73 (0.50)	-0.99 (0.56)	-0.99 (0.565)
Share 20		*Ref*	*Ref*	*Ref*
Share 50		1.56** (0.52)	1.31* (0.59)	1.31* (0.59)
Period		-0.13*** (0.01)	-0.13*** (0.01)	-0.13*** (0.01)
Theoretical variables				
CIT			0.88* (0.37)	
IIT				-0.031 (0.36)
HET				0.23 (0.46)
HOT			0.68 (0.48)	
CIT x HOT			-0.46 (0.56)	
IIT x HOT				0.46 (0.56)
Random effects				
Person ID	2.86 (1.69)	2.19 (1.48)	2.09 (1.44)	2.09 (1.44)
Model fit indices				
AIC	2429.5	2287.4	2286.0	2286.0
BIC	2440.8	2326.9	2342.5	2342.5
Loglikelihood	-1212.8	-1136.7	-1133.0	-1133.0
Deviance	2425.5	2273.4	2266.0	2266.0
Df Residuals	2098	2093	2090	2090

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

5.5.2 Additional exploratory analyses on SVO*period interactions and subsets

To further investigate the effects of SVO we start with a series of models for SVO in which we look into interactions of SVO and Period. We started by estimating models with dummies for period, and including prosocial period interactions, but these models failed to converge. Table 9 reports additional models in which we compare round 1 to later rounds and vise versa. In model 1 we estimate a model with a period dummy for all periods greater or equal to period 2 and a interaction of this dummy with prosocial. Here it can be seen that SVO is significant in period 1, and that the effect of SVO is smaller in later periods, but still significant. This does not mean that the effect of SVO after round 2 are significant. To check that we estimate model 2, in which we switch the reference category, that is, all periods after 1 become the reference category. Looking at the main effect for SVO in model two we can indeed see that all periods taken together after period 1 are indeed significant. This finding is in sharp contrast with our theory of the dissertation and opposite to what we found in the results reported in chapter 4.

In table 10 we report further analysis in which we further investigate the effect of SVO over the period by estimating three additional models in which we take subsets of period, each model takes a subset of 5 periods. In each model we can see that SVO remains significant. Additionally we take a look at the SVO*period interactions in subset of our treatment variables. Table 11 reports SVO*period interactions for subsets for our treatment variables heterogeneous efficacy distribution HET and homogenous HOT. Here we can also see that SVO remains significant, but there is a difference between HET treatments and HOT treatments in level of significance. The effect of SVO in HOT treatments is stronger. Table 12 reports SVO*period interactions for subsets of our treatment variables complete information CIT and incomplete information IIT. SVO remains significant for both subsets. However, we see that the effect of SVO is stronger in IIT then in CIT.

Table 9 Prosocial Period Interactions. GLM Mixed Effects Model From Multilevel Logistic Regression. Depended Variable Is "invest(0/1)" with standard errors in parentheses, (N=2100, from 140 individuals nested in 28 groups in 15 rounds)

	Model 1	**Model 2**
Intercept	0.24 (0.51)	-1.53 (0.31)
Individualists/ competitives	**ref**	**ref**
Prosocials	2.51 *** (0.63)	1.99*** (0.35)
period=>2)	-1.77*** (0.45)	
Period==1		1.77*** (0.45)
Prosocials*period>2	-0.52 (0.56)	
Prosocials*period==1		0.52 (0.56)
Random effects		
Person ID	2.45 (1.56)	2.45 (1.56)
Model fit indices		
AIC	2322.8	2322.8
BIC	2351.0	2351.0
Loglikelihood	-1156.4	-1156.4
Deviance	2312.8	2312.8
Df Residuals	2095	2095

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

Table 10. SVO in subsets of Period. GLM Mixed Effects Model From Multilevel Logistic Regression. Depended Variable Is "invest(0/1)" with standard errors in parentheses (N=2100, from 140 individuals nested in 28 groups in 15 rounds)

	Model 1 (m9) Subset = period 1-5	**Model 2 (m10)** Subset = period 6-10	**Model 3 (m11)** Subset = period 11-15
Intercept	0.65 (0.43)	-1.68*** (0.44)	-1.91*** (4.40)
Prosocials	2.05*** (0.43)	2.31*** (0.46)	1.99*** (0.43)
Individualists/ competitives	*ref*	*ref*	*ref*
Period 2	-0.49 (0.36)		
Period 3	-1.54*** (0.36)		
Period 4	-1.54*** (0.36)		
Period 5	-2.11*** (0.36)		
Period 6			
Period 7		-0.67* (0.31)	
Period 8		-0.76* (0.31)	
Period 9		-0.47 (0.31)	
Period 10		-0.71* (0.31)	
Period 11			
Period 12			-0.04 (0.31)
Period 13			0.37 (0.31)
Period 14			-0.00 (0.31)
Period 15			0.19 (0.31)
Random effects			
Person ID	2.80 (1.67)	2.90 (1.69)	2.83 (1.68)
Model fit indices			
AIC	747.0	810.3	829.1
BIC	778.9	842.2	861.0
Loglikelihood	-366.5	-398.2	-407.6
Deviance	733.0	796.3	815.1
Df Residuals	693	693	693

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

Table 11 SVO in subsets of HOT and HET. GLM Mixed Effects Model From Multilevel Logistic Regression. Depended Variable Is "invest(0/1)" with standard errors in parentheses N=2100, from 140 individuals nested in 28 groups in 15 rounds)

	Model 1 Subset for hot	**Model 2 Subset for hot**	**Model 3 Subset for het**	**Model 4* Subset for het**
Intercept	0.50 (0.78)	-1.20 * (0.49)	0.04 (0.66)	-1.81*** (0.39)
Individualists/ competitives	**ref**	**ref**	**ref**	**ref**
Prosocials	2.22* (0.97)	1.65 ** (0.56)	2.72*** (0.82)	2.27*** (0.44)
period>2)	-1.70 * (0.68)		-1.84** (0.60)	
Period==1		1.69* (0.68)		1.84** (0.59)
Prosocials* period>2	-0.57 (0.85)		-0.46 (0.75)	
Prosocials* period==1		0.57 (0.85)		0.46 (0.75)
Random effects				
Person ID	2.95 (1.74)	2.94 (1.7)	2.05 (1.43)	2.05 (1.43)
Model fit indices				
AIC	993.7	993.7	1336.7	1336.7
BIC	1017.7	1017.7	1362.2	1362.2
Loglikelihood	-491.9	-491.9	-663.4	-663.4
Deviance	983.7	983.7	1326.7	1326.7
Df Residuals	895	895	1195	1195

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

Table 12 SVO in subsets of CIT and IIT. GLM Mixed Effects Model From Multilevel Logistic Regression. Depended Variable Is "invest(0/1)" with standard errors in parentheses, for a subset of CIT and IIT (N=2100, from 140 individuals nested in 28 groups in 15 rounds)

	Model 1 Subset for CIT	**Model 2 Subset for CIT**	**Model 3 Subset for IIT**	**Model 4* Subset for IIT**
Intercept	0.50 (0.78)	-1.19* (0.49)	0.037 (0.66)	-1.8*** (0.39)
Individualists/ competitives	**ref**	ref	ref	ref
Prosocials	2.22* (0.97)	1.65 ** (0.56)	2.72*** (0.82)	2.27*** (0.44)
period=>2)	-1.70* (0.68)		-1.84** (0.60)	
Period==1		1.69 * (0.68)		1.84** (0.60)
Prosocials* period>2	-0.57 (0.85)		-0.46 (0.75)	
Prosocials* period==1		0.57 (0.85)		0.46 (0.75)
Random effects				
Person ID	2.94 (1.71)	2.94 (1.71)	2.05 (1.43)	2.05 (1.43)
Model fit indices				
AIC	993.7	993.7	1336.7	1336.7
BIC	1017.7	1017.7	1362.2	1362.2
Loglikelihood	-491.9	-491.9	-663.4	-663.4
Deviance	983.	983.	1326.7	1326.7
Df Residuals	895	895	1195	1195

Note: '***'indicates $p < 0.001$, '**' indicates $p < 0.01$, '*' indicates $p < 0.05$

5.6 Conclusions

In this chapter we investigated the research question: *"How do the distribution of individual efficacies and the degree of information on efficacy distributions jointly influence collective action success?*" Prior to testing we argued that in homogeneous groups, complete information may harbor many social dilemmas and has a negative effect on public good production, whereas for heterogeneous groups, complete information can be seen as an amplifier of successful and efficient cooperation strategies.

So what has this study demonstrated about the role of information on efficacy heterogeneity? First, the experiment corroborates the efficacy-cooperation hypothesis arguing that there is a significant positive relationship between efficacy and investment in public goods. This result is in line recent previous studies on the same topic (Dijkstra et al., 2019; Dijkstra & Bakker, 2017). Our data clearly shows that individuals with a higher efficacy (are significantly more likely to invest. Share (level of efficacy) seems to play a significant and decisive role. The experiment shows that the efficacy-cooperation link is not only present when all other factors are kept constant. This relationship is also significant when treatment effects such as heterogeneity and degree of information are included. Results regarding share are in line with theory and previous studies and clearly corroborate the efficacy-cooperation hypothesis in the literature (Bekkers and Wiepking 2011; Dijkstra and Bakker 2017; Kerr 1996)

Second, we do not find any support for our hypotheses that the degree of information influences the efficacy-cooperation link. These results are puzzling as previous research indicates that at least incomplete information had an effect on the amount of goods produced or investments of individuals. Theory and empirical results have shown so far that incomplete information should hamper heterogeneous groups in reaching efficient results, however, the results in this chapter do

not corroborate that. These results indicate that self-efficacy is a significant and decisive factor for the decision to invest, regardless of what others do, what the efficacy of others is, and how much you know about the other. Only for individuals with a share 1 in heterogeneous groups with complete information, there seems to be some influence on the decision to invest namely, a small positive effect indicating that for those particular players in that particular group structure, complete information has a reinforcing effect.

Third, our analysis on the aggregated data showed that SVO is a significant predictor and this is especially confusing in reference to the experimental results I obtained in chapter 4. We explored in various models from the individual level, and learned that SVO is a stable and positively significant predictor for an individuals likelihood to invest. Generally over time investment behavior declines and in chapter 4 we also saw that SVO would decline. In this chapter we see that SVO remains significant through the rounds until the end, even if period itself has a negative effect on investing. Our analysis with subsets for our treatment variables shows that, SVO remains a positive significant predictor and that the influence of SVO is more pronounced, that is, more significant in HOT and IIT conditions. This finding is somewhat inline with the theoretical framework of this dissertation and with the literature in general, in which we argue that when the situation becomes more ‘unclear’ and lacks any focality, individuals turn to their personal preferences as guideline for their behavioral tendencies. This finding is very important and interesting and should be investigated in future research. Specifically, future research should pay specific attention to the relation between the SVO-behaviour link across various the structural conditions.

All in all, this chapter most clearly corroborates and emphasizes the significance of the efficacy-cooperation relationship. It does not seem to matter how efficacious your group members are, but if the efficacy of your investment seems to of great impact or hints to be more or less a

necessity relative to the terms that specify the public good production function, then you will invest. Furthermore, in situation that lack complete information or in situations that lack focality due to homogeneity, SVO gains importance in once decision to invest in the collective good.

In the next chapter I bring all findings in this dissertation together and draw overarching conclusions, discuss implications, limitations and elaborate on propositions for future research.

Chapter 6

6 Conclusions & Discussion

6.1 Overview

In this chapter we turn back to the overarching research question of the dissertation. The content of the chapter we summarize my findings and outline lessons learned from the studies. Thereby we try to lay out implications and propose direction for future research. The order of the chapter is as follows, we start by answering the overarching research question and how the theoretically derived hypotheses held in the face of the experimental data. We discuss the findings in a wider perspective as to yield implication of the answers for collective action endeavors in real life. We reflect upon the range of applicability, generalizability and replicability of these findings by discussing the limitations of the research. We finalize the dissertation with listing directions for future research.

6.2 Answers to the Research Questions and Implications

In this dissertation we had set out to deepen understanding of collective action and what factors foster or hamper collective success. Thereby we focused on types of collective action that are aimed at the production of public goods. More specifically we asked how Social Value Orientation (SVO) influences decision processes in individuals investment behavior in if groups work together over multiple interactions. Furthermore, we investigated how having information about the efficacy of group members investments in the collective good production influences one's decision to invest in the collective good themselves and how these aspects together further improve collective success. Combining these aspects yielded the following overarching scope: *How does Social Value Orientation and information on efficacy heterogeneity influence collective action success ?*

Building on theory and empirical evidence form previous studies on the role of SVO we derived hypotheses arguing that SVO is of importance at least in the beginning, but that is relative impact disappears when individuals can learn from each other over the course of accounts. Furthermore, we hypothesized specific learning patterns that apply to the structure of the experiments in this dissertation, but that generally follow Cournot best-response behavior model. My hypothesis on SVO partially hold in the face of data, namely; the results of both experiments have showed that the role of SVO in collective action success is not clear cut.

The first study revealed that SVO is at least important in the onset of collective collaborations. Substantively, it is clear that those who uphold prosocial preferences are more prone to decide to invest in the collective good than individuals who uphold other preferences. Intuitively, it seems that individuals use their own preferences as guideline when they do not have experience of information about the behavioral tendencies of their counter parts yet. That being said, after a first interaction, individuals seem to form an expectation about their cooperative partners and adjust their behavior to the moment, and while social learning mechanisms arise, the influence of SVO fades, directly after round one. These results are in line with our hypothesized answers.

In sharp contrast with study one, the second study shows that the influence of SVO actually does remain significant over the course of interactions. SVO was significant across all conditons and across all periods. For homogenous groups and incomplete information conditions the effect of SVO was even more significant.

In sum, the studies give a clear hint that SVO cannot be overlooked, thereby the dissertation complies with theory on SVO and corroborates plenty empirical studies (Balliet et al, 2019). However, this is not to say that the effect of SVO can be taken for granted over time and across conditions. Clearly, more research on the SVO-behavior link acros various structural conditions in

repeated interactions is necessary to further understand the specific influence and significance of SVO.

Turning to the aspect of information on efficacy heterogeneity in collective action, we derived hypotheses following from the efficacy-cooperation link and theories on the role of complete and incomplete information. The hypotheses generally stated that heterogeneity in groups generally servers as a natural coordination devise that greatly improves collective success. More specifically we claimed that complete information is more effective for homogenous groups and that incomplete information can efficiency for homogenous groups. In the results it we do not find clear cut evidence that heterogeneous groups perform better. We do also not support on how the degree of information influences collective action success.

We do corroborate that the efficacy-cooperation relationship remains true. In both studies, individuals with a higher efficacy in collective good production, are far more likely to invest, and significantly so. These findings are perfectly in line with previous research and the theoretical framework of the dissertation.

Finally, also in this dissertation across all investigations we find that over time, cooperation rates decline. Individuals become less and less cooperative over time.

Taking all aspects together it seems that the SVO-behavior link and the Efficacy-cooperation link survive the tests, and that information on counterparts was not relevant in these particular collective action studies. It seems that in these collective situations individuals plan strategies by positioning their own values and capacities relative to the success threshold and play less attention as of how to arrive to collective success by means of cooperation. The results imply that aspects SVO, self-efficacy and learning remain of significant importance for collective success. Any collective striving for success may want to zoom in on how to emphasize the significance and importance of each member and how it can be reached cooperatively. This

emphasis and encouragement may be even more necessary in the long-term, not only in the first interaction, but throughout the whole process.

6.3 Limitations of studies in the dissertation

The studies in the current dissertation have limited scope in a number of ways. Firstly, the experimental designs of the collective action situations employed very simplistic interaction situations, albeit with fair variation of experimental conditions.

Second, when it comes to generalizability, the artificial environment and simplicity of the decision situation does not take into account numerous factors that are known to be important in cooperative endeavors. For instance factors such as group identification, a sense of community or a sense of belonging, options for communication, explicit bargaining and trust formation are known influence collective success in real life settings, however, they are not present in these designs. Studies aiming at generalizability should consider complicating the model by adding one or more of these factors.

Third, cooperative partners in the experiments are other "players" in the computer game that have no face and cannot be recognized, and not really be 'bonded with in a meaningful way'. Perhaps the 'gaming' nature could make participants less 'serious' and 'engaged' with the collective task. This limitation may influence the generalizability of the results as well. However, we gain a lot of experimental control and are able to observe very simple interactions situation and test hypotheses very neatly, which allows to contribute to very simple but strong models to study cooperation and collective action, and every next study can try to further complicate aspects and work towards more realistic models.

Finally, samples used in the dissertation that almost purely consist of undergraduate sociology students. Even though it is not unreasonable to assume that other samples of individuals behave significantly different, we can only generalize these findings with a relatively large margin of error, unless we limit our findings to the world of undergrade sociology students only. More samples and larger samples are needed to further investigate how our hypotheses hold up across various populations.

6.4 Future Research

The results of the experiments and limitations of the study propose several directions for future research. Direct follow up studies could first of all continue investigating the SVO-behavior link across various structural conditions. One may wonder what structural aspects of situations are influencing the SVO-behavior relationship. As in the dissertation the significance of SVO disappear immediately after round 1 in study 1 and remained significant across all rounds and conditions in study 2. As many studies, including those in the dissertation strongly underline the relevance and importance of understanding SVO and the SVO-behavior link, this is a logical next step to take in future studies.

Another important question for future research that has been around from some and again comes forward very pronounced in this dissertation is how one can mobilize group members to 'stay cooperative' in the long term and foster sustainable cooperation (Axelrod, 1985). The phenomenon of de decay of cooperation is well studied in theory and end-game effects are a well-known concept (Axelrod, 1985). Several studies suggest that by imposing institutions and punishment already diminish the decay of cooperation significantly (Fehr and Schurtenberger 2018; Henrich et al. 2006; Van Miltenburg, Przepiorka, and Buskens 2017; Zhang, An, and Dong

2021). A future study could further complicate and improve my models by adding an institutional treatment.

Lastly, future studies can improve by taking a more realistic and detailed account for what hampers or facilitates collective action by employing lab in the field studies and by means of case studies in real life collective action groups to help collectives obtain more ongoing and long-term success.

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Summary of the dissertation

This dissertation is concerned with understanding collective action success and what factors foster or hamper the endeavour. Specifically, we focus on collective action that is aimed at the production of *public goods* and how groups overcome social dilemmas that are inherent to that. A social dilemma can be defined as a situation where individual and collective rationality are at odds. There two broad categories of social dilemmas.

The first category compiles *cooperation problems*, were each individual has the temptation to abstain from making contributions to public good production and aim for consumption of the good provided by others, that is, by means of free-riding. However, if all individuals act on their own interests, the public good is not produced. How individuals value their own and others' outcomes from cooperation is conceptualized as their Social Value Orientation (SVO). Research demonstrates that SVO is a valid predictor of cooperative behavior across various empirical settings. However, once individuals interact repeatedly, the relative strength and stability of the SVO – behavior link are less clear cut. In this dissertation SVO is one of the key explanans that are expected to play a role in collective action success.

The second category compiles *coordination problems.* In coordination problems, individuals find themselves in situations in which interests coincide, however, there are multiple choice options to reach that outcome and this can instigate a coordination problem. Previous research has shown that heterogeneity among cooperators can help in overcoming coordination problems. Group members typically differ in the *impact* their investments have on the likelihood of public good production. The impact an individual's behavior has on outcomes is generally referred to as their *efficacy.* Research has established a significant positive relationship between

heterogeneity in efficacy and successful collective action. However, this relationship requires that individuals involved have *information* about each other's efficacy. But it yet remains an open question how the degree of information of efficacy heterogeneity influences collective action success. The degree of information of efficacy heterogeneity constitute the second key explanantia of this dissertation.

The two main explanans - SVO and information on efficacy heterogeneity - in this dissertation focus on how on individual characteristics, group characteristics and the structure of the situation influence collective action success. Both elements are closely related to the two social dilemmas (cooperation and coordination problems) inherent to collective action Bringing both questions together constitute an overacting question for the dissertation: *How do social preferences and information on efficacy heterogeneity influence collective action success ?* A well-known model naturally reflecting public goods problems is the Step-Level Public Good design (SPG). we adopt the design in the dissertation and use it as theoretical framework to derive hypotheses to answer this research question. We test hypotheses in laboratory experiments and analyse data in a multilevel framework.

Each aspect of the research process, documentation of results and discussions on the implications of the findings are reported in this dissertation with a monographic structure. The structure is as follows:

In chapter 2, we lay out the theoretical framework of the dissertation and simultaneously discuss the state of the art in the literature with respect to our main questions and follow up with paragraphs on how SVO, and information on efficacy heterogeneity influence collective action within the SPG model. Furthermore, we discuss how current theories explain the dynamics and current knowledge of these elements in the model. Most importantly, in this chapter I derive the hypotheses of my theses on how SVO and efficacy heterogeneity influence collective action.

In chapter 3, we discuss research designs namely, two laboratory experiments and an overview of techniques we used to answer research question and test hypotheses that where derived in chapter 2.

In chapter 4, we report the results on the SVO-behavior link in repeated interactions. and the SVO-behavior link in repeated SPG's. In sum, we corroborate that SVO is predictive of behavior in the onset of collaboration. Yet, after the first interaction, the relationship between SVO and behavior virtually disappears. Instead, learning from results in past rounds steers decision behavior over the next.

In chapter 5, we report the results from hypotheses tests on the role of information on efficacy heterogeneity. In sum, the experiment corroborates the efficacy-cooperation hypothesis pertaining that there is a significant positive relationship between efficacy and investment in public goods. Our data clearly shows that individuals with a higher efficacy are significantly more likely to invest. We do not find any support for our hypotheses that the degree of information influences the efficacy-cooperation link. We find that SVO is a significant predictor of behaviour over all rounds and regardless of treatment, contradictory to results in chapter 4.

In chapter 6, we bring findings together and answer the overarching research question. Taking all aspects together it seems that the SVO-behavior link and the efficacy-cooperation link survive the tests, and that complete information on the degree of heterogeneity within the group is irrelevant in these particular collective action situations. The results imply that the aspects SVO, efficacy and learning mechanisms emerging by iteration remain of significant importance for collective success. Any collective striving for success may want to zoom in on how to emphasize the significance and importance of each member and how successes can be reached cooperatively.

The results of the experiments and limitations of the study propose several directions for future research. Direct follow up studies could first of all continue investigating the SVO-behavior

link and investigate this across various structural conditions. As many studies, including those in the dissertation strongly underline the relevance and importance of understanding SVO and the SVO-behavior link, this is a logical next step to take in future studies.

Lastly, future studies can improve by taking a more realistic and detailed account for what hampers or facilitates collective action by employing lab in the field studies and by means of case studies in real life collective action groups to help collectives obtain more ongoing and long-term success.

Sintesi della tesi

La tesi tratta il successo dell'azione collettiva e quali fattori ne favoriscono o ne ostacolano il raggiungimento. Nello specifico, la tesi si concentra sull'azione collettiva finalizzata alla produzione di beni pubblici e come i gruppi affrontano i dilemmi sociali che sono inerenti a tale argomento. Un dilemma sociale può essere definito come una situazione in cui la razionalità individuale e collettiva sono in contrasto. Esistono due grandi categorie di dilemmi sociali.

La prima categoria riguarda i problemi di cooperazione, vale a dire come ogni individuo ha la tentazione di astenersi dal dare contributi alla produzione del bene pubblico e puntare al consumo del bene fornito da altri, cioè attraverso il free-riding. Tuttavia, se tutti gli individui agiscono per i propri interessi, il bene pubblico non viene prodotto. Il modo in cui gli individui valutano i risultati propri e altrui prodotti dalla cooperazione è concettualizzato in termini di preferenze sociali (il termine ufficiale è ‘social value orientation, SVO)’. La ricerca dimostra come SVO sia un valido predittore del comportamento cooperativo in vari contesti empirici. Tuttavia, una volta che gli individui interagiscono ripetutamente, la forza relativa e la stabilità del legame SVO e comportamento appare meno evidente. In questa dissertazione SVO è uno degli fattori chiave che dovrebbero svolgere un ruolo nel successo dell'azione collettiva.

La seconda categoria riguarda, invece, i problemi di coordinamento. In qeusto caso, gli individui si trovano in situazioni in cui gli interessi coincidono; tuttavia, ci sono più opzioni di scelta per raggiungere il risultato auspicato e quanto detto può provocare un problema di coordinazione. Ricerche precedenti hanno dimostrato che l'eterogeneità tra i collaboratori può aiutare a superare i problemi di coordinamento. I membri del gruppo differiscono tipicamente nell'impatto che i loro investimenti hanno sulla probabilità della produzione di un bene pubblico. L'impatto che il comportamento di un individuo ha sui risultati è generalmente indicato con il

termine ‘efficacia’. La ricerca ha messo in risalto l’esistenza di una significativa relazione positiva tra eterogeneità nell'efficacia e azione collettiva di successo. Tuttavia, questa relazione richiede che le persone coinvolte abbiano informazioni sull'efficacia reciproca. Ma resta ancora una questione aperta, ovvero come il grado di eterogeneità delle informazioni sull'efficacia influenzi il successo dell'azione collettiva. Il grado di eterogeneità delle informazioni di efficacia costituisce la seconda spiegazione chiave di questa tesi.

I fattori di spiegazione principali - SVO e informazioni sull'eterogeneità di efficacia – nel lavoro in questione si concentrano su come le caratteristiche individuali, le caratteristiche del gruppo e la struttura della situazione influenzano il successo dell'azione collettiva.Tali elementi sono strettamente correlati ai due dilemmi sociali (problemi di cooperazione e coordinamento) che connotano l'azione collettiva. Nel presente lavoro il fuoco è rivolto a due interrogativi di centrale importanza; *In che modo le preferenze sociali e le informazioni sull'eterogeneità dell'efficacia influenzano il successo dell'azione collettiva*?

Un modello ben noto ampiamente utilizzato nel trattare il problema dei beni pubblici è lo Step-Level Public Good design (SPG). Tale modello viene utilizzato per definire un quadro teorico e per derivare ipotesi che verranno testate tramite esperimenti di laboratorio e con l’impiego di modelli multilivello.

Le varie fasi del processo di ricerca, i risultati ottenuti e le conseguenti implicazioni sono riportati in questa dissertazione seguendo la struttura logica della monografia. Più nello specifico, nel capitolo 2 espongo il quadro teorico della tesi e contemporaneamente discuto lo stato dell'arte rispetto alle nostre principali domande. Sempre in tale capitolo discuto come il fattore SVO e le informazioni sull'eterogeneità dell’efficacia influenzano l'azione collettiva all'interno del modello SPG. Inoltre, passo in rassegna come le teorie disponibili sono in grado di spiegare le dinamiche e

le attuali conoscenze di questi elementi nel modello. In aggiunta vengono derivate le ipotesi su come SVO e l'eterogeneità di efficacia influenzano l'azione collettiva.

Nel capitolo 3, discuto i progetti di ricerca, ovvero illustro due esperimenti di laboratorio e presento una panoramica delle tecniche che ho usato per rispondere alle domande di ricerca e testare le ipotesi derivate nel capitolo 2.

Nel capitolo 4, riporto i risultati sull'associazione tra SVO e comportamento negli SPG ripetuti. In altri termini, viene corroborata l'ipotesi che SVO è predittivo del comportamento all'inizio della collaborazione. Tuttavia, dopo la prima interazione, la relazione tra SVO e comportamento praticamente scompare. Di contro, l'apprendimento dai risultati nei round precedenti condiziona il comportamento decisionale rispetto a quello successivo.

Nel capitolo 5 riporto i risultati dei test di ipotesi sul ruolo delle informazioni sull'eterogeneità dell'efficacia. In sintesi, l'esperimento corrobora l'ipotesi di efficacia-cooperazione relativa all'esistenza di una significativa relazione positiva tra efficacia e investimento in beni pubblici. I miei dati mostrano chiaramente che le persone con un'efficacia maggiore hanno maggiori probabilità di effettuare investimenti. Non trovo alcun supporto per l'ipotesi che il grado di informazione influenzi il legame efficacia-cooperazione.

Nel capitolo 6, riprendo congiuntamente i risultati per rispondo alla domanda generale della ricerca. Da un'attenta valutazione dell'evidenza empirica sembra che le relazioni SVO-comportamento ed efficacia-cooperazione resistino ai test, e che un'informazione completa sul grado di eterogeneità all'interno del gruppo sia irrilevante in queste particolari situazioni di azione collettiva. I risultati implicano che gli aspetti SVO, efficacia e meccanismi di apprendimento che emergono dall'iterazione appaiano rilevanti per il successo collettivo. Qualsiasi ricerca collettiva per il successo potrebbe voler approfondire come enfatizzare il significato e l'importanza di ciascun membro e come raggiungere i successi in modo cooperativo

I risultati ottenuti confermano che gli aspetti strutturali della situazione possono esercitare un'influenza sulla relazione in questione; ciononostante sono necessarie ulteriori ricerche per capire come e in che misura. Poiché molti studi, inclusi quelli riportati nel presente lavoro di tesi, sottolineano in modo evidente quanto sia rilevante la comprensione della relazione tra SVO e comportamento, ragion per cui si rendono necessari ulteriori ricerche. Lavori futuri possono migliorare il processo conoscitivo prendendo in considerazione in modo più realistico e dettagliato ciò che ostacola o facilita l'azione collettiva, basandosi su studi sperimentali condotti sul campo e mediante studi di caso in gruppi di azione collettiva nel contesto della vita reale.

Appendices

1. Paper based version of experiment 2, approved by the ethical committee of RUG

Test day project proposal *adjusted* - Pilot of an experimental study on collective action problems

Jacob Dijkstra & Loes Bouman
University of Groningen, March 2019

Document overview

1. Aim purpose and design study

Many instances of collective action have a 'critical mass' structure, meaning that collective action is only successful if a sufficient number of group members participate. Coordination problems may arise in identifying the coalition of individuals who should invest. A critical insight is that group members typically differ in the impact their investments have on public good production and referred to as their efficacy. Heterogeneity in efficacy can render coalitions of potential contributors more 'prominent' than others, singling them out as focal points for coordination, using them as guidelines to converge expectations. However, expectations can only truly converge if they are based upon complete and non-ambiguous information of the situation or if there is ample opportunity to learn in repeated interactions. Although many studies underline the necessity of complete information for strategic decision making, others warn that complete information has backfire effect and generates gambling strategies tipping over to more selfish and defective behaviors resulting from pessimistic believes on the intentions of others that impede collective action. In the present study we aim firstly to investigate experimentally the effects of complete information and heterogeneity in efficacy distributions of group members and the role of their beliefs for decision behavior in collective action situations. Secondly, we investigate to what extent groups learn to develop complementary expectations over time (in repeated interactions) and whether there is a difference in success-rates between complete information conditions and incomplete information conditions. Additionally, we explore the role of individual differences personality traits, social value orientations (SVO) and how these may influence decision making in collective action and use this information as control factors. Using Step-level Public Goods games in an computerized laboratory experiment, subjects in groups of 5 repeatedly decide to invest in the public good. Subjects differential efficacies are manipulated as a between subjects' factor. In the homogeneous treatment individuals have the same efficacy, and in the heterogeneous treatment efficacies differ. Information is a between subject's factor manipulated as follows; a complete information treatment where subjects know the group's efficacy distribution, and an incomplete information treatment where subjects only know their own efficacy. SVO is treated as an observational factor and measured in the SVO slider measure developed by Murphy, Ackermann and Handgraaf (2011). SVO has been shown to be highly stable as an individual difference with a test-retest reliability of r = 0.915 (Murphy et al, 2011). Personality traits will be assessed using the validated HEXACO self-report questionnaire (Ashton, M. C., & Lee, K. (2009)

Experimental procedure (also see table 1)

The procedure of the experiment will be as follows: upon arrival at the lab students are provided with written and oral instructions by the experiment leader. On the test and an informed consent form on paper, and are randomly assigned to a workspace with computer. Computers are separated with wooden partitions to create individual spaces and prevent participants to peak on another person's computer screen. After subjects have read instructions, asked questions and signed informed consent forms, we start the experiment, which is programmed in o-tree. The experiment consists of two tasks that participants complete in randomized order, the collective task, and the questionnaire. These two tasks are as follow: In the collective task the groups of 5 individuals are randomly assigned to either of the experimental conditions and assigned a share (efficacy) and receive instructions on the rules and the procedure of the game that matches their experimental condition. Before the first round, subjects are asked a series of questions on; to what extent they rate their own investment as necessary, and to rate if they belief on the importance of investment for each other member, and also which members they expect to invest. Subjects play the game, in the same group, in the same treatment repeatedly for 15 rounds. The task for each subject in each round is as follows: Subjects have to decide independently and simultaneously between investing or not investing. After all individuals have made their decisions, they are presented a summary with the outcomes of the round. In the complete information conditions, subjects learn after each round whether the public good is produced, and which players with which shares invested. Note however that subjects cannot actually identify other subjects in the room, for they don't know/ are not informed on with whom they are exactly playing. In the questionnaire subjects are first asked to make a series of 6 decisions in which they are asked how they would divide an initial allocation of monetary units between themselves and another person. Subjects know that it's a hypothetical question and that they are not actually earning anything, and subsequently they are asked to complete a self-report regarding personality traits using the HEXACO questionnaire (Ashton, M. C., & Lee, K. (2009). After the questionnaire there is a 10-minute debriefing and discussion on the study. For a draft of experiment see the appendix on page 5).

Table 1. Experimental Procedure

Experiment stages	**Time in minutes**
Welcoming, general overview and instructions	5
Collective task . Main Experiment - Decision game 1	20
Questionnaire SVO and personality traits (HEXACO)	15
Debriefing of students and room for questions	10
Total time needed	50

2. Ethical concerns

Participants will be clearly informed on all aspects of the study with extended instructions, free of deception. Privacy and anonymity are secured by using randomization techniques that makes it impossible to link individuals with any data that is gathered in the study. Thus, after data have been collected, they are anonymous up to the session number. That implies that any data collected cannot be withdrawn after the fact, since researchers will be unable to identify the relevant participant in the data set. Participants will be made aware of the fact that (i) their participation is voluntary. If they wish to withdraw, we will ask participants to do it before hand. Withdrawal during the collective task is more problematic, if this happens we ask participants to simply click trough the experiment, so the experiment can continue. (ii) Data that has been collected cannot be withdrawn. Participants are neither incentivized nor exposed to any type of risk. Normally, participants in economic games studies are paid in accordance to their decisions, thus incentivized. As incentivization of any type is not permitted during the test-days, our study will merely be a pilot so see if our programs work properly, we are speaking in terms of points that participants can earn and clearly declare to the participants that there are no actual incentives, rewards or compensations rewarded.

3. Data storage

After analysis, data will be stored in a data package folder on the Y-drive, only accessible to Loes Bouman and Jacob Dijkstra. Anonymized data will be made available to other researchers upon request. Anonymization in this respect means that participants are only identifiable as participants in this particular test day event. Identifiers at a lower level (such as gender or year of study) are not available. Personality trait data will be a part of these anonymized data. Participants will be made aware of these procedures in advance of the study.

4. Facilities, materials and equipment

To run the experiment at the fall testday we can use Alleta Jacobs Hall at Zernike, examhall 2. Just like we did for the springtestday (April 29th, 2019)

For the Spring Testday 2019, all first and second-year Sociology students, who were enrolled in the courses *studiewerkgroepen* and *vaardighedentraject, were invited, and* 82 of them participated in the experiment.

For the Fall Testday 2019, the Testday coordinator created a list of students who attended courses SOBA115 and SOBA318, and excluded those who had participated in the previous experiment during the Spring Testday. Then, the names of people who are enrolled in both courses were removed. It resulted in 143 unique potential participants, who will be invited to participate in the Fall Testday 2019 via email.

The experimenter and an IT assistant will be present to setup equipment, welcome the students, run the study and debrief the students. Per session we need to have groups of 5.

5. Debriefing plan(testday lesson for students)

We will provide students with time for questions and a presentation on the study, incorporating time for discussion and questions. The setup of the debriefing session is presented in table 2.

Table 2.

Parts		Time
I.	Time for open questions and reactions on experiences	5
II.	Presentation of the study questions, aims and development of study in empirical circle.	5

Appendix – Draft of the study materials

Below we present **a draft** of our study.
For each part we explain the steps and decision or questions that students face in chronological order. As we are currently in process of designing and programming the experiment, we describe a template of the type of games we use, and questions that we like to ask. In the pilot, we use o-tree to implement the games and questions. Below we describe the texts that will appear on computer screens when students participate in the pilot experiment.

Content of the appendix

1. Informed Consent Form

Purpose of the research: The purpose of this study is to understand how people in groups make decisions regarding their investment in a group task.

Procedures involved in the research: The experiment contains two different tasks. A collective task and a questionnaire, which will be presented in random order. In the collective task you are randomly matched together in groups of five* and asked to imagine that you as a group are working on a project. The project can be realized by investments in the project by group members. You have to decide independently and simultaneously if you want to invest in the group project. If enough group members invest, the group project is realized. Thus, your task is to decide whether you want to invest in this group project. It is not possible to find out with whom you are in a group and communication is not allowed. Decisions are completely anonymous and confidential. Both participants and researchers are not able to retrace what decision is linked to which participant. In the questionnaire you first face a series of 6 decisions in which you are asked how you would divide an initial allocation of monetary units between yourself and another person. Note that these are hypothetical questions and that you are not actually earning anything. Neither participants nor researchers can find out what decision you personally made. Subsequently, you are asked to complete a questionnaire of 60 questions, in which a series of personal statements are presented, where you indicate on a scale from 1-5 how much you think the statement reflects your own personality. These two tasks will be carried out in a randomized order.
The experiment will be carried out in English to also reach both national and international participants.
* If there are not enough or if there is a surplus of participants that cannot make groups of 5 anymore, you will just complete the questionnaire task, where the questionnaire task consists of 100 questions instead of 60

Duration: 50-60 minutes

Statement of Confidentiality: Your participation in this research is strictly confidential and anonymous. No identity information is stored in the data file. Neither the researchers nor the other participants can link your decisions to you personally. If this research is published, it is not impossible to trace back what results belong to which participant. Because of this data structure, it is also not possible to retrieve or retract your data after the experiment has been conducted, as we will be unable to link you to the decisions you made.

Right to Ask Questions: Please contact Loes Bouman at L.Bouman@rug.nl with questions, complaints or concerns about the research. During the experiment you can ask questions at any time.

Compensation: No compensation is provided.

Voluntary Participation*: You do not have to participate in this research. You can only withdraw from participating before the study starts, by telling the person in charge. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive otherwise.
* Test-day participants can also decide to decline, however, as the test-days are mandatory for students in one way or another, it implies that declining participating in this experiment, results in an additional task or assignment at a later date.

- ☐ The researcher has explained the purpose of the study to me
- ☐ I have had an opportunity to ask questions about the study

Participant signature Date

……. ……

2. WELCOME text

Dear participant,

Thanks for participating in this experiment!
The complete session will last for 1 hour and proceeds as follows.

This experiment contains two different parts, a collective task and a questionnaire.
The collective task start with instructions after which you are asked to make a series of decisions, together these parts take about 20 minutes. In the questionnaire, you start with instructions after which you are asked to make a series 6 of decisions on how you would divide an amount of money between yourself and another participant (the decisions are hypothetical). Subsequently you are asked to review a series of personal statements. Therein you are asked to decide how much you agree or disagree with that statement. The questionnaire takes about 15 minutes to complete.
After you completed the experiment, we will proceed with an educational seminar disclosing the background, questions and design of the study and information on experiments in sociological research. This seminar takes about 10 minutes.

Please take into account the following:
1. We do NOT deceive you in any way during this experiment; thus, all the instructions are true;
2. In the collective task your decisions can earn you 'points'. Before you begin making choices, please keep in mind that there are no right or wrong answers - choose the option that you, for whatever reason, **prefer** most. What do the points mean? The more of them you accumulate, the better it is for you. Likewise, from the "other's" point of view, the more points s/he accumulates, the better fit is for him/her. The points you earn depends on how you decide, AND on what others decide.
3. points are of hypothetical meaning and will not be exchanged into any type of compensation.
4. All your decisions AND the amount of points you earn are ANONYMOUS; thus, neither the researchers NOR the other participants can link your decisions to you personally
5. It is not possible to retrieve or retract your data after the experiment has been conducted, as we will be unable to link you to the decisions you made.

If you have any questions during the experiment, please raise your hand and the instructor will help you.

Please wait for the experiment to start

3. THE COLLECTIVE TASK - General Instructions

The collective task

The computer has formed groups at random. You are now in a group with 4 other participants. It is not possible to find out with whom you are in a group and communication is not allowed.

Imagine that as a group, you are working on a group project. The project can be realized by investments in the project by group members.

Your task will be to decide whether you want to invest in this group project. Additionally, imagine that as a group you are presented with this task 15 times. Thus, you are asked to make 15 decisions.

The composition of the group does not change; thus, in all 15 rounds you are in the same group with the same other participants;

Please note that you will not know with whom you are actually playing, and that communication is not permitted.

Structure of the task

All of these participants, including you, get 10 points in each decision task,

In this part of the experiment you can decide whether you want to keep your 10 points or whether you want to invest your 10 points in your group project.

The other four people in your group **also** have to decide whether they keep or whether they invest their 10 points in the group project.

When you decide to keep your 10 points you actually get to keep them. When you decide to invest your 10 points in the group project, you lose them.

If enough members of your group invest their 10 points, the group project is produced. In this case, every group member gets an extra 15 points.

A set of rules that determine whether or not the group project is produced are explained in the next screen.

These outcomes depend on a set of rules. Press continue to learn the rules

-CONTINUE-

3.1 Screens Treatment 1 – Heterogeneous Shares(Efficacies) And Complete Information

THE COLLECTIVE TASK - Production rules of the group project

We now explain the rules that determine whether or not the group project is produced.

Each member of the group, including you, has a share of at least 1 and at most 50. The shares of the group members sum to 100.

The group project is produced when the sum of the shares of the group members who invested their 10 points is 51 or more .

Example 1. Suppose three of the 5 group members invest their 10 points in the group project. Suppose the shares of these 3 investors sum to 60. Then, the group project is produced and EVERY group member gets an extra 15 points.

Example 2. Suppose 2 of the 5 group members invest their 10 points in the group project. Suppose the shares of these 2 investors sum to 45. Then, the group project is not produced. The 2 investors lose their points and the 3 group members who did not invest keep their 10 points.

Remember that you will make this decisions 15 times.

In all 15 decisions your share will be the same; thus, if you have a share of 4 in decision one, you will also have a share of 4 in the other 14 decisions. This is also true for the other participants in your group.

After each decision you and the other group members are told whether or not the group project is produced. No one knows who of the group members has invested and who has not.

Press continue to learn your share

-CONTINUE-

THE COLLECTIVE TASK – Learning your share

In this decision you have a share of 2. One other group member has a share of 8. Two of the other group members have a share of 20 each. One other group member has a share of 50.

(OR: In this decision you have a share of 8. One other group member has a share of 2. Two of the other group members have a share of 20 each. One other group member has a share of 50.

(OR: In this decision you have a share of 20. One of the other 4 group members has a share of 2. One of the other 4 group members has a share of 8. One of the other 4 group members also has a share of 20. One of the other 4 group members has a share of 50.

OR: In this decision you have a share of 50. One other group member has a share of 2. Three of the other group members have a share of 16 each.)
--

before making your decision we ask you a few questions on your consideration.

Press continue to go to these questions

-continue-

THE COLLECTIVE TASK - Questions before your decision

Asking about beliefs
Before asking you to decide whether or not you will invest in the group project, we would like to ask you some questions about the expectations you have about the decisions of others and the outcome of the group project.

How likely do you think it is that your group member whose share is 2 will invest his or her 10 points? It is ... that an individual whose share is 2 will invest his or her 10 points.

- Impossible, 100% (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain, 100% (7)

How likely do you think it is that an individual whose share is 16 will invest his or her 10 points? It is ... that an individual whose share is 16 will invest his or her 10 points.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that an individual whose share is 50 will invest his or her 10 points? It is ... that an individual whose share is 50 will invest his or her 10 points.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent is your investment necessary to produce the group project? It is ... that my investment is necessary to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent is your investment sufficient to produce the group project? It is ... that my investment is sufficient to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent does your investment determine whether or not the group project is produced? It is ... that my investment determines whether or not the group project is produced.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that the group project will be produced within your group?It is ... that the group project will be produced in my group.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

Press continue to go make your decision

-Continue-

THE COLLECTIVE TASK - Decision situation – round #
The decision

Please make your decision now:

- **I keep my 10 points**
- **I invest my 10 point**

Press continue to find out the results

-Continue-

THE COLLECTIVE TASK – Decision Results – round #

PRODUCED screen

All participants see:

The group project has been produced!

The sum of shares was # and did exceed the minimum of 51

Players with share # invested.

You receive 15 points because the group project was produced.

- Participants see either A or B depending on their own

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

NOT PRODUCED screen

All participants see:

The group project has not been produced!

The sum of shares was # and did NOT exceed the minimum of #

Players with share # invested.

You do not receive points in this round

- Participants see either A or B

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

THE COLLECTIVE TASK – Conclusion

We have completed the collective task.

In total you have obtained <tot_points|1> points in part one.

-Continue-

3.2 Screens Treatment 2 – Homogenous Shares(Efficacies) And Complete Information

THE COLLECTIVE TASK - General Instructions

The collective task

The computer has formed groups at random. You are now in a group with 4 other participants. It is not possible to find out with whom you are in a group and communication is not allowed.

Imagine that as a group, you are working on a group project. The project can be realized by investments in the project by group members.

Your task will be to decide whether you want to invest in this group project. Additionally, imagine that as a group you are presented with this task 15 times. Thus, you are asked to make 15 decisions.

The composition of the group does not change; thus, in all 15 rounds you are in the same group with the same other participants;

Please note that you will not know with whom you are actually playing, and that communication is not permitted. We do this to ensure confidentiality and anonymity.

Structure of the task

All of these participants, including you, get 10 points in each decision task,

In this part of the experiment you can decide whether you want to keep your 10 points or whether you want to invest your 10 points in your group project.

The other four people in your group **also** have to decide whether they keep or whether they invest their 10 points in the group project.

When you decide to keep your 10 points you actually get to keep them. When you decide to invest your 10 points in the group project, you lose them.

If enough members of your group invest their 10 points, the group project is produced. In this case, every group member gets an extra 15 points.

A set of rules that determine whether or not the group project is produced are explained in the next screen.

These outcomes depend on a set of rules. Press continue to learn the rules

-CONTINUE-

THE COLLECTIVE TASK - Production rules of the group project

We now explain the rules that determine whether or not the group project is produced.

Each member of the group, including you, has a **share** of 20. The shares of the group members sum to 100.

The group project is produced when the sum of the shares of the group members who invested their 10 points is 60 or more.

For coordination purposes you will be assigned a player label

Remember that you will make this decisions 15 times.

In all 15 decisions your share will be the same; thus, for instance, if you have a share of 20 in decision one, you will also have a share of 20 in the other 14 decisions. This is also true for the other participants in your group.

After each decision you and the other group members are told whether or not the group project is produced. No one knows who of the group members has invested and who has not.

Press continue to learn your player label

-CONTINUE-

THE COLLECTIVE TASK – Learning your player number

In the collective task you are player A and you have a share of 20. Players B, C, D and E also have a share of 20.

Before making your decision we ask you a few questions on your consideration.

Press continue to go to these questions

-continue-

THE COLLECTIVE TASK - Questions before your decision

Asking about beliefs
Before asking you to decide whether or not you will invest in the group project, we would like to ask you some questions about the expectations you have about the decisions of others and the outcome of the group project.

To what extent is your investment necessary to produce the group project? It is ... that my investment is necessary to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent is your investment sufficient to produce the group project? It is ... that my investment is sufficient to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent does your investment determine whether or not the group project is produced? It is ... that my investment determines whether or not the group project is produced.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that the group project will be produced within your group?It is ... that the group project will be produced in my group.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

Press continue to go make your decision

-Continue-

THE COLLECTIVE TASK - Decision situation – round number here
The decision

Please make your decision now:

- **I keep my 10 points**
- **I invest my 10 point**

THE COLLECTIVE TASK – Decision Results – round #

PRODUCED screen

All participants see:

The group project has been produced!

The sum of shares was # and did exceed the minimum of 51

Players with label …. invested.

You receive 15 points because the group project was produced.

- Participants see either A or B depending on their own

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

NOT PRODUCED screen

All participants see:

The group project has not been produced!

The sum of shares was # and did NOT exceed the minimum of #

Players with label …. invested

You do not receive points in this round

- Participants see either A or B

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

THE COLLECTIVE TASK – Conclusion

We have completed the collective task.

In total you have obtained <tot_points|1> points in part one.

-Continue-

Instructions set treatment 3 - Heterogeneous and incomplete information

THE COLLECTIVE TASK - General Instructions

The collective task

The computer has formed groups at random. You are now in a group with 4 other participants. It is not possible to find out with whom you are in a group and communication is not allowed.

Imagine that as a group, you are working on a group project. The project can be realized by investments in the project by group members.

Your task will be to decide whether you want to invest in this group project. Additionally, imagine that as a group you are presented with this task 15 times. Thus, you are asked to make 15 decisions.

The composition of the group does not change; thus, in all 15 rounds you are in the same group with the same other participants;

Please note that you will not know with whom you are actually playing, and that communication is not permitted. We do this to ensure confidentiality and anonymity.

Structure of the task

All of these participants, including you, get 10 points in each decision task,

In this part of the experiment you can decide whether you want to keep your 10 points or whether you want to invest your 10 points in your group project.

The other four people in your group **also** have to decide whether they keep or whether they invest their 10 points in the group project.

When you decide to keep your 10 points you actually get to keep them. When you decide to invest your 10 points in the group project, you lose them.

If enough members of your group invest their 10 points, the group project is produced. In this case, every group member gets an extra 15 points.

A set of rules that determine whether or not the group project is produced are explained in the next screen.

These outcomes depend on a set of rules. Press continue to learn the rules

-CONTINUE-

THE COLLECTIVE TASK - Production rules of the group project

We now explain the rules that determine whether or not the group project is produced.

Each member of the group, including you, has a share of at least 1 and at most 50. The shares of the group members sum to 100.

The group project is produced when the **sum of the shares** of the group members who invested their 10 points is 51 or more .

Example 1. Suppose three of the 5 group members invest their 10 points in the group project. Suppose the shares of these 3 investors sum to 60. Then, the group project is produced and EVERY group member gets an extra 15 points.

Example 2. Suppose 2 of the 5 group members invest their 10 points in the group project. Suppose the shares of these 2 investors sum to 45. Then, the group project is not produced. The 2 investors lose their points and the 3 group members who did not invest keep their 10 points.

Remember that you will make this decisions 15 times.

In all 15 decisions your share will be the same; thus, if you have a share of 4 in decision one, you will also have a share of 4 in the other 14 decisions. This is also true for the other participants in your group.

After each decision you and the other group members are told whether or not the group project is produced. No one knows who of the group members has invested and who has not.

Press continue to learn your share

-CONTINUE-

THE COLLECTIVE TASK – Learning your share

In this decision you have a share of 2. (or 16, 16, 16, 50)

Before making your decision we ask you a few questions on your consideration.

Press continue to go to these questions

-continue-

THE COLLECTIVE TASK - Questions before your decision

Asking about beliefs
Before asking you to decide whether or not you will invest in the group project, we would like to ask you some questions about the expectations you have about the decisions of others and the outcome of the group project.

How likely do you think it is that an individual whose share is 2 will invest his or her 10 points? It is ... that an individual whose share is 2 will invest his or her 10 points.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that an individual whose share is 16 will invest his or her 10 points? It is ... that an individual whose share is 16 will invest his or her 10 points.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that an individual whose share is 50 will invest his or her 10 points? It is ... that an individual whose share is 50 will invest his or her 10 points.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent is your investment necessary to produce the group project? It is ... that my investment is necessary to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent is your investment sufficient to produce the group project? It is ... that my investment is sufficient to produce the group project.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

To what extent does your investment determine whether or not the group project is produced? It is ... that my investment determines whether or not the group project is produced.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

How likely do you think it is that the group project will be produced within your group?It is ... that the group project will be produced in my group.

- Impossible (1)
- Very unlikely (2)
- Unlikely (3)
- A 50/50 chance (4)
- Likely (5)
- Very likely (6)
- Certain (7)

Press continue to go make your decision

-Continue-

THE COLLECTIVE TASK - Decision situation – round number here
The decision

Please make your decision now:

- **I keep my 10 points**
- **I invest my 10 point**

THE COLLECTIVE TASK – Decision Results – round #

PRODUCED screen

All participants see:

The group project has been produced!

The sum of shares was # and did exceed the minimum of 51

You receive 15 points because the group project was produced.

- Participants see either A or B depending on their own

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

NOT PRODUCED screen

All participants see:

The group project has not been produced!

The sum of shares was # and did NOT exceed the minimum of #

You do not receive points in this round

- Participants see either A or B

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

THE COLLECTIVE TASK – Conclusion

We have completed the collective task.

In total you have obtained <tot_points|1> points in part one.

-Continue-

Instructions set treatment 4 - homogenous shares and incomplete information

THE COLLECTIVE TASK - General Instructions

We are about to start with the first part.

The task

The computer has formed groups at random. You are now in a group with 4 other participants. It is not possible to find out with whom you are in a group and communication is not allowed.

Imagine that as a group, you are working on a group project. The project can be realized by investments in the project by group members.

Your task will be to decide whether you want to invest in this group project. Additionally, imagine that as a group you are presented with this task 15 times. Thus, you are asked to make 15 decisions.

The composition of the group does not change; thus, in all 15 rounds you are in the same group with the same other participants;

Please note that you will not know with whom you are actually playing, and that communication is not permitted. We do this to ensure confidentiality and anonymity.

Structure of the task

All of these participants, including you, get 10 points in each decision task,

In this part of the experiment you can decide whether you want to keep your 10 points or whether you want to invest your 10 points in your group project.

The other four people in your group **also** have to decide whether they keep or whether they invest their 10 points in the group project.

When you decide to keep your 10 points you actually get to keep them. When you decide to invest your 10 points in the group project, you lose them.

If enough members of your group invest their 10 points, the group project is produced. In this case, every group member gets an extra 15 points.

A set of rules that determine whether or not the group project is produced are explained in the next screen.

These outcomes depend on a set of rules. Press continue to learn the rules

-CONTINUE-

THE COLLECTIVE TASK - Production rules of the group project

We now explain the rules that determine whether or not the group project is produced.

Each member of the group, including you, has a share of 20. The shares of the group members sum to 100.

The group project is produced when the sum of the shares of the group members who invested their 10 points is 51 or more .

Example: Suppose three of the 5 group members invest their 10 points in the group project. Suppose the shares of these 3 investors sum to 60. Then, the group project is produced and EVERY group member gets an extra 15 points.

Remember that you will make this decisions 15 times.

In all 15 decisions your share will be the same; thus, if you have a share of 20 in decision one, you will also have a share of 20 in the other 14 decisions. This is also true for the other participants in your group.

After each decision you and the other group members are told whether or not the group project is produced. No one knows who of the group members has invested and who has not.

Press continue to learn your share

-CONTINUE-

THE COLLECTIVE TASK – Learning your share

In this decision you have a share of 20.

Before making your decision we ask you a few questions on your consideration.

Press continue to go to these questions

-continue-

THE COLLECTIVE TASK - Questions before your decision

Asking about beliefs
Before asking you to decide whether or not you will invest in the group project, we would like to ask you some questions about the expectations you have about the decisions of others and the outcome of the group project.

To what extent is your investment necessary to produce the group project? It is ... that my investment is necessary to produce the group project.

- o Impossible (1)
- o Very unlikely (2)
- o Unlikely (3)
- o A 50/50 chance (4)
- o Likely (5)
- o Very likely (6)
- o Certain (7)

To what extent is your investment sufficient to produce the group project? It is ... that my investment is sufficient to produce the group project.

- o Impossible (1)
- o Very unlikely (2)
- o Unlikely (3)
- o A 50/50 chance (4)
- o Likely (5)
- o Very likely (6)
- o Certain (7)

To what extent does your investment determine whether or not the group project is produced? It is ... that my investment determines whether or not the group project is produced.

- o Impossible (1)
- o Very unlikely (2)
- o Unlikely (3)
- o A 50/50 chance (4)
- o Likely (5)
- o Very likely (6)
- o Certain (7)

How likely do you think it is that the group project will be produced within your group?It is ... that the group project will be produced in my group.

- o Impossible (1)
- o Very unlikely (2)
- o Unlikely (3)
- o A 50/50 chance (4)
- o Likely (5)
- o Very likely (6)
- o Certain (7)

Press continue to go make your decision

-Continue-

THE COLLECTIVE TASK - Decision situation – round number here
The decision

Please make your decision now:

- **I keep my 10 points**
- **I invest my 10 point**

THE COLLECTIVE TASK – Decision Results – round #

PRODUCED screen

All participants see:

The group project has been produced!

The sum of shares was # and did exceed the minimum of 51

You receive 15 points because the group project was produced.

- Participants see either A or B depending on their own

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

NOT PRODUCED screen

All participants see:

The group project has not been produced!

The sum of shares was # and did NOT exceed the minimum of #

You do not receive points in this round

- Participants see either A or B

A: You keep your 10 points because you did not invest in the project

B: You lose your 10 points because you invested in the project

All participants see as summary of all their points accumulated so far:

In total you have obtained <tot_points|1> points in the collective task so far

THE COLLECTIVE TASK – Conclusion

We have completed the collective task.

In total you have obtained <tot_points|1> points in part one.

Press continue to start with the allocation task

-Continue-

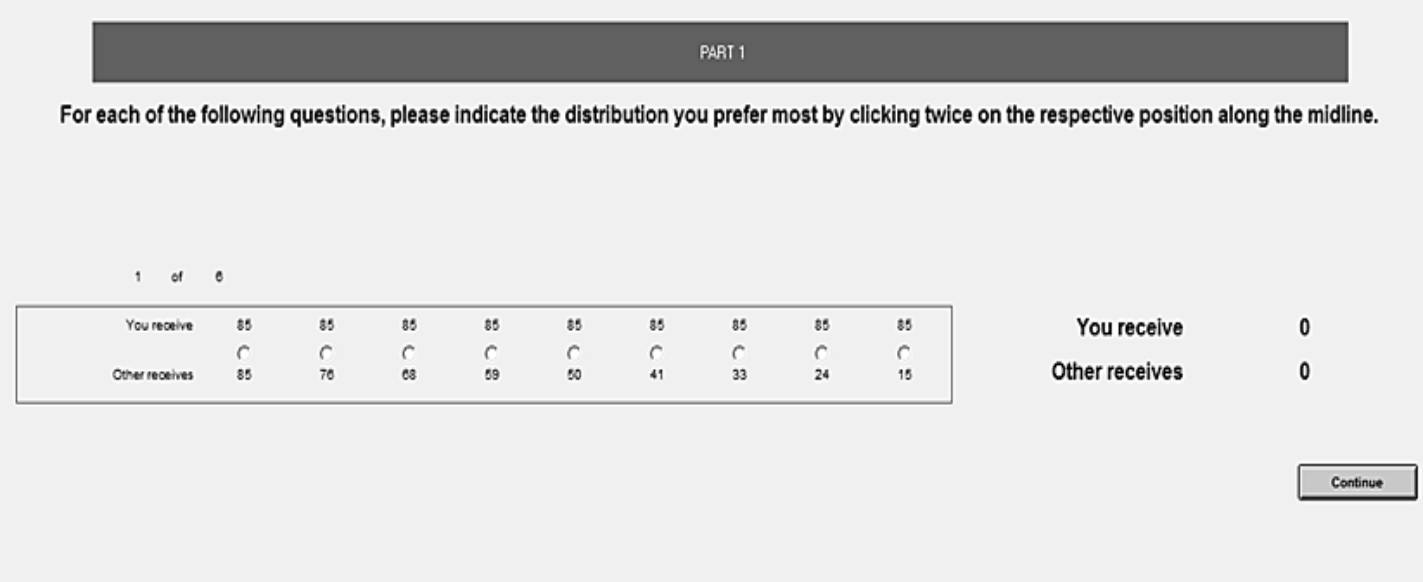
4. The questionnaire task - SVO questions and Hexaco Questionnaire 60 questions version

In this part you are asked to make 6 decisions.

In each decision round, you decide how you would prefer to divide an amount of money between you and the other person.
In each round you are matched with another individual.
Note that you just indicate how you would prefer to divide money.
Your not actually having and are not getting real money.

Figure 1.1 shows how the decision situation in one of the six rounds looks like.

Figure 1: Example decision situation in the allocation task



Once you read the instructions carefully and are ready to start, please continue on your computer screen. If you have any questions, please do not hesitate to raise your hand.

On the following pages you will find a series of statements about you. Please read each statement and decide how much you agree or disagree with that statement. Then write your response in the space next to the statement using the following scale:

5 = strongly agree
4 = agree
3 = neutral (neither agree nor disagree)
2 = disagree
1 = strongly disagree
0 = prefer not to answer

Please answer every statement, even if you are not completely sure of your response.

Please provide the following information about yourself.

Age: _____ years

1 _____ I would be quite bored by a visit to an art gallery.
2 _____ I plan ahead and organize things, to avoid scrambling at the last minute.
3 _____ I rarely hold a grudge, even against people who have badly wronged me.
4 _____ I feel reasonably satisfied with myself overall.
5 _____ I would feel afraid if I had to travel in bad weather conditions.
6 _____ I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed.
7 _____ I'm interested in learning about the history and politics of other countries.
8 _____ I often push myself very hard when trying to achieve a goal.
9 _____ People sometimes tell me that I am too critical of others.
10 _____ I rarely express my opinions in group meetings.
11 _____ I sometimes can't help worrying about little things.
12 _____ If I knew that I could never get caught, I would be willing to steal a million dollars.
13 _____ I would enjoy creating a work of art, such as a novel, a song, or a painting.
14 _____ When working on something, I don't pay much attention to small details.
15 _____ People sometimes tell me that I'm too stubborn.
16 _____ I prefer jobs that involve active social interaction to those that involve working alone.
17 _____ When I suffer from a painful experience, I need someone to make me feel comfortable.
18 _____ Having a lot of money is not especially important to me.
19 _____ I think that paying attention to radical ideas is a waste of time.
20 _____ I make decisions based on the feeling of the moment rather than on careful thought.
21 _____ People think of me as someone who has a quick temper.
22 _____ On most days, I feel cheerful and optimistic.
23 _____ I feel like crying when I see other people crying.
24 _____ I think that I am entitled to more respect than the average person is.
25 _____ If I had the opportunity, I would like to attend a classical music concert.
26 _____ When working, I sometimes have difficulties due to being disorganized.
27 _____ My attitude toward people who have treated me badly is “forgive and forget”.
28 _____ I feel that I am an unpopular person.
29 _____ When it comes to physical danger, I am very fearful.
30 _____ If I want something from someone, I will laugh at that person's worst jokes.

Continued…

31 _____ I've never really enjoyed looking through an encyclopedia.
32 _____ I do only the minimum amount of work needed to get by.
33 _____ I tend to be lenient in judging other people.
34 _____ In social situations, I'm usually the one who makes the first move.
35 _____ I worry a lot less than most people do.
36 _____ I would never accept a bribe, even if it were very large.
37 _____ People have often told me that I have a good imagination.
38 _____ I always try to be accurate in my work, even at the expense of time.
39 _____ I am usually quite flexible in my opinions when people disagree with me.
40 _____ The first thing that I always do in a new place is to make friends.
41 _____ I can handle difficult situations without needing emotional support from anyone else.
42 _____ I would get a lot of pleasure from owning expensive luxury goods.
43 _____ I like people who have unconventional views.
44 _____ I make a lot of mistakes because I don't think before I act.
45 _____ Most people tend to get angry more quickly than I do.
46 _____ Most people are more upbeat and dynamic than I generally am.
47 _____ I feel strong emotions when someone close to me is going away for a long time.
48 _____ I want people to know that I am an important person of high status.
49 _____ I don't think of myself as the artistic or creative type.
50 _____ People often call me a perfectionist.
51 _____ Even when people make a lot of mistakes, I rarely say anything negative.
52 _____ I sometimes feel that I am a worthless person.
53 _____ Even in an emergency I wouldn't feel like panicking.
54 _____ I wouldn't pretend to like someone just to get that person to do favors for me.
55 _____ I find it boring to discuss philosophy.
56 _____ I prefer to do whatever comes to mind, rather than stick to a plan.
57 _____ When people tell me that I'm wrong, my first reaction is to argue with them.
58 _____ When I'm in a group of people, I'm often the one who speaks on behalf of the group.
59 _____ I remain unemotional even in situations where most people get very sentimental.
60 _____ I'd be tempted to use counterfeit money, if I were sure I could get away with it.
61 _____ **I completed this questionnaire with care**

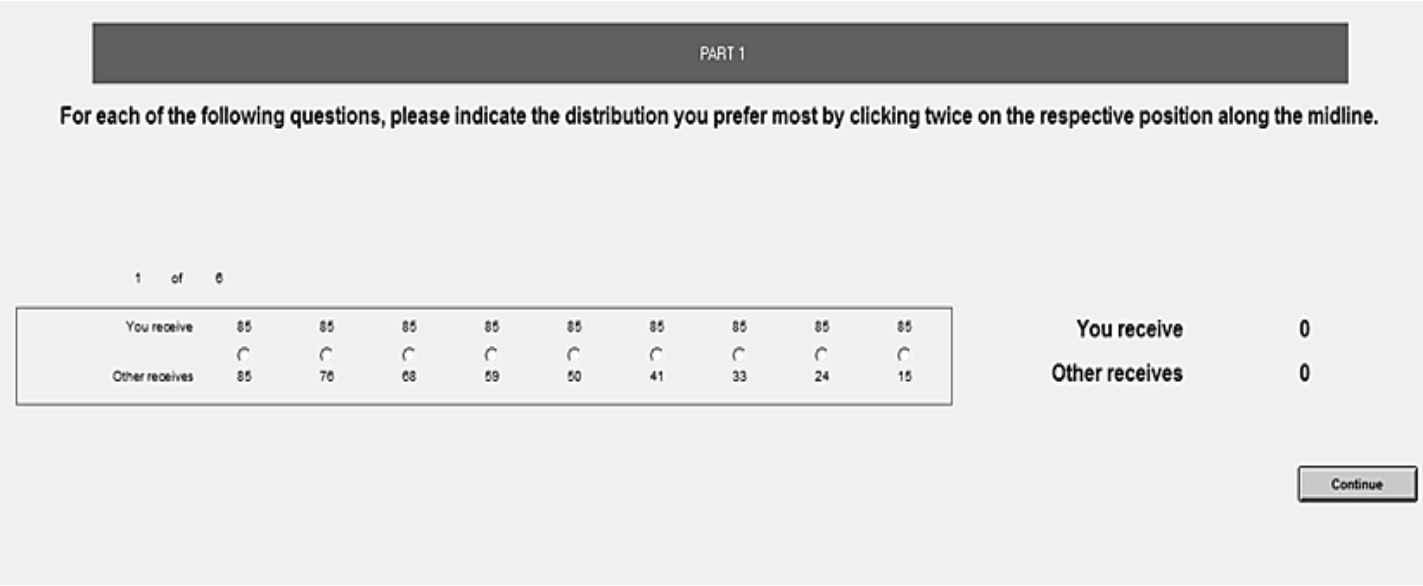
5.The questionnaire task - SVO questions and Hexaco Questionnaire 100 questions version

In this part you are asked to make 6 decisions.

In each decision round, you decide how you would prefer to divide an amount of money between you and the other person.
In each round you are matched with another individual.
Note that you just indicate how you would prefer to divide money.
Your not actually having and are not getting real money.

Figure 1.1 shows how the decision situation in one of the six rounds looks like.

Figure 1: Example decision situation in the allocation task



Once you read the instructions carefully and are ready to start, please continue on your computer screen. If you have any questions, please do not hesitate to raise your hand.

On the following pages you will find a series of statements about you. Please read each statement and decide how much you agree or disagree with that statement. Then write your response in the space next to the statement using the following scale:

5 = strongly agree
4 = agree
3 = neutral (neither agree nor disagree)
2 = disagree
1 = strongly disagree
0 = prefer not to answer

Please answer every statement, even if you are not completely sure of your response.

Please provide the following information about yourself.

1 _____ I would be quite bored by a visit to an art gallery.
2 _____ I clean my office or home quite frequently.
3 _____ I rarely hold a grudge, even against people who have badly wronged me.
4 _____ I feel reasonably satisfied with myself overall.
5 _____ I would feel afraid if I had to travel in bad weather conditions.
6 _____ If I want something from a person I dislike, I will act very nicely toward that person in order to get it.
7 _____ I'm interested in learning about the history and politics of other countries.
8 _____ When working, I often set ambitious goals for myself.
9 _____ People sometimes tell me that I am too critical of others.
10 _____ I rarely express my opinions in group meetings.
11 _____ I sometimes can't help worrying about little things.
12 _____ If I knew that I could never get caught, I would be willing to steal a million dollars.
13 _____ I would like a job that requires following a routine rather than being creative.
14 _____ I often check my work over repeatedly to find any mistakes.
15 _____ People sometimes tell me that I'm too stubborn.
16 _____ I avoid making "small talk" with people.
17 _____ When I suffer from a painful experience, I need someone to make me feel comfortable.
18 _____ Having a lot of money is not especially important to me.
19 _____ I think that paying attention to radical ideas is a waste of time.
20 _____ I make decisions based on the feeling of the moment rather than on careful thought.
21 _____ People think of me as someone who has a quick temper.
22 _____ I am energetic nearly all the time.
23 _____ I feel like crying when I see other people crying.
24 _____ I am an ordinary person who is no better than others.
25 _____ I wouldn't spend my time reading a book of poetry.
26 _____ I plan ahead and organize things, to avoid scrambling at the last minute.
27 _____ My attitude toward people who have treated me badly is "forgive and forget".
28 _____ I think that most people like some aspects of my personality.
29 _____ I don’t mind doing jobs that involve dangerous work.
30 _____ I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed.

Continue…

31 _____ I enjoy looking at maps of different places.
32 _____ I often push myself very hard when trying to achieve a goal.
33 _____ I generally accept people's faults without complaining about them.
34 _____ In social situations, I'm usually the one who makes the first move.
35 _____ I worry a lot less than most people do.
36 _____ I would be tempted to buy stolen property if I were financially tight.
37 _____ I would enjoy creating a work of art, such as a novel, a song, or a painting.
38 _____ When working on something, I don't pay much attention to small details.
39 _____ I am usually quite flexible in my opinions when people disagree with me.
40 _____ I enjoy having lots of people around to talk with.
41 _____ I can handle difficult situations without needing emotional support from anyone else.
42 _____ I would like to live in a very expensive, high-class neighborhood.
43 _____ I like people who have unconventional views.
44 _____ I make a lot of mistakes because I don't think before I act.
45 _____ I rarely feel anger, even when people treat me quite badly.
46 _____ On most days, I feel cheerful and optimistic.
47 _____ When someone I know well is unhappy, I can almost feel that person's pain myself.
48 _____ I wouldn't want people to treat me as though I were superior to them.
49 _____ If I had the opportunity, I would like to attend a classical music concert.
50 _____ People often joke with me about the messiness of my room or desk.
51 _____ If someone has cheated me once, I will always feel suspicious of that person.
52 _____ I feel that I am an unpopular person.
53 _____ When it comes to physical danger, I am very fearful.
54 _____ If I want something from someone, I will laugh at that person's worst jokes.
55 _____ I would be very bored by a book about the history of science and technology.
56 _____ Often when I set a goal, I end up quitting without having reached it.
57 _____ I tend to be lenient in judging other people.
58 _____ When I'm in a group of people, I'm often the one who speaks on behalf of the group.
59 _____ I rarely, if ever, have trouble sleeping due to stress or anxiety.
60 _____ I would never accept a bribe, even if it were very large.

Continue…

61 People have often told me that I have a good imagination.

62 I always try to be accurate in my work, even at the expense of time.

63 When people tell me that I'm wrong, my first reaction is to argue with them.

64 I prefer jobs that involve active social interaction to those that involve working alone.

65 Whenever I feel worried about something, I want to share my concern with another person.

66 I would like to be seen driving around in a very expensive car.

67 I think of myself as a somewhat eccentric person.

68 I don't allow my impulses to govern my behavior.

69 Most people tend to get angry more quickly than I do.

70 People often tell me that I should try to cheer up.

71 I feel strong emotions when someone close to me is going away for a long time.

72 I think that I am entitled to more respect than the average person is.

73 Sometimes I like to just watch the wind as it blows through the trees.

74 When working, I sometimes have difficulties due to being disorganized.

75 I find it hard to fully forgive someone who has done something mean to me.

76 I sometimes feel that I am a worthless person.

77 Even in an emergency I wouldn't feel like panicking.

78 I wouldn't pretend to like someone just to get that person to do favors for me.

79 I've never really enjoyed looking through an encyclopedia.

80 I do only the minimum amount of work needed to get by.

81 Even when people make a lot of mistakes, I rarely say anything negative.

82 I tend to feel quite self-conscious when speaking in front of a group of people.

83 I get very anxious when waiting to hear about an important decision.

84 I'd be tempted to use counterfeit money, if I were sure I could get away with it.

85 I don't think of myself as the artistic or creative type.

86 People often call me a perfectionist.

87 I find it hard to compromise with people when I really think I'm right.

88 The first thing that I always do in a new place is to make friends.

89 I rarely discuss my problems with other people.

90 I would get a lot of pleasure from owning expensive luxury goods.

Continue…

91 _____ I find it boring to discuss philosophy.

92 _____ I prefer to do whatever comes to mind, rather than stick to a plan.

93 _____ I find it hard to keep my temper when people insult me.

94 _____ Most people are more upbeat and dynamic than I generally am.

95 _____ I remain unemotional even in situations where most people get very sentimental.

96 _____ I want people to know that I am an important person of high status.

97 _____ I have sympathy for people who are less fortunate than I am.

98 _____ I try to give generously to those in need.

99 _____ It wouldn't bother me to harm someone I didn't like.

100 _____ People see me as a hard-hearted person.

101_____ I completed this questionnaire with care

2. Invitations to subjects experiment 2

Invitations for students were carried out by the testday coordinators. On the next page I include the information page that was included in the invitation.

Testdays Information document on for students

Purpose of the research: The purpose of this study is to understand how people in groups make decisions regarding their investment in a group task.

Procedures involved in the research:
Upon arrival at the examhall in Zernike you receive written and oral instructions on the study and test. You receive an informed consent form on paper distributed by the experiment leader and assistants. You are randomly assigned to a workspace with computer. After you have read instructions, asked questions and we collected all signed informed consent forms, we start the experiment

The experiment contains two different tasks. A collective task and a questionnaire, which will be presented in random order. In the collective task you are randomly matched together in groups of five* and asked to imagine that you as a group are working on a project. The project can be realized by investments in the project by group members. You have to decide independently and simultaneously if you want to invest in the group project. If enough group members invest, the group project is realized. Thus, your task is to decide whether you want to invest in this group project. It is not possible to find out with whom you are in a group and communication is not allowed. Decisions are completely anonymous and confidential. Both participants and researchers are not able to retrace what decision is linked to which participant.

In the questionnaire task you first face a series of 6 decisions in which you are asked how you would divide an initial allocation of monetary units between yourself and another person. Note that these are hypothetical questions and that you are not actually earning anything. Neither participants nor researchers can find out what decision you personally made. Subsequently, you are asked to complete a questionnaire of 60 questions, in which a series of personal statements are presented, where you indicate on a scale from 1-5 how much you think the statement is true for you.

* If there are not enough or if there is a surplus of participants that cannot make groups of 5 anymore, you will just complete the questionnaire task, where the questionnaire task consists of 100 questions instead of 60

Duration: 45-60 minutes

Statement of anonymity and confidentiality: Your participation in this research is strictly confidential and anonymous. No identity information is stored in the data file. Neither the researchers nor the other participants can link your decisions to you personally. If this research is published, it is not impossible to trace back what results belong to which participant. Because of this data structure, it is also not possible to retrieve or retract your data after the experiment has been conducted, as we will be unable to link you to the decisions you made.

Right to Ask Questions: Please contact Loes Bouman at L.Bouman@rug.nl with questions, complaints or concerns about the research. During the experiment you can ask questions at any time.

Compensation: No compensation is provided.

Voluntary Participation*: You do not have to participate in this research. You can only withdraw from participating before the study starts, by telling the person in charge. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive otherwise.
* Test-day participants can also decide to decline, however, as the test-days are mandatory for students in one way or another, it implies that declining participating in this experiment, results in an additional task or assignment at a later date.

3. Debriefing document for subjects experiment 2

Debriefing for participants of the Sociology Testdays

Dear students,

You have participated in one or more of the testdays on: April 29th 2019, December 3rd 2019, February 27th 2020 or March 4th 2020. Now that all sessions are over, I can finally -and as promised- debrief you on the details of the study, so you can learn more about the background of a sociological lab experiment. Herewith, I also like to take the opportunity again to thank you and express my appreciation for your participation, effort and patience in the testday sessions. The goal of this debriefing is to inform and share with you what research questions, theories and reasoning where behind the tasks that you completed. It may give more of an idea what experimental sociological research could look like, and how the tasks that you have completed in the session where developed beforehand and what methods or measurements where used. Recently, I wrote a short article about the topic in our faculty journal SoAP on pages 28-29, you find the journal here, it's written and Dutch and explains the topic of the testday sessions and my PhD research in an intuitive way. I would advise to read this article first. For those who would be interested in more, below I share with you an abstract of the original research proposal and design (written in English). Currently, I am analyzing data and preparing a report and manuscript. If you like to know more about the study feel free to contact me on l.bouman@rug.nl.

Many thanks again for your participation!

Kind regards,
Loes Bouman

Abstract of testday research proposal

Background, aim and design

Many instances of collective action have a 'critical mass' structure, meaning that collective action is only successful if a sufficient number of group members participate. Coordination problems may arise in identifying the coalition of individuals who should invest. A critical insight is that group members typically differ in the impact their investments have on public good production and referred to as their efficacy. Heterogeneity in efficacy can render coalitions of potential contributors more 'prominent' than others, singling them out as focal points for coordination, using them as guidelines to converge expectations. However, expectations can only truly converge if they are based upon complete information of the situation or if there is ample opportunity to learn in repeated interactions. Although many studies underline the necessity of complete information for strategic decision making, others warn that complete information has backfire effect and generates gambling strategies tipping over to more selfish and defective behaviors resulting from pessimistic believes on the intentions of others that impede collective action.

In the present study we aim firstly to investigate experimentally the effects of complete information and heterogeneity in efficacy distributions of group members and the role of their beliefs for decision behavior in collective action situations. Secondly, we investigate to what extent groups learn to develop complementary expectations over time (in repeated interactions) and whether there is a difference in success-rates between complete information conditions and incomplete information conditions. Additionally, we explore the role of individual differences in personality traits, social value orientations (SVO) and how these may influence decision making in collective action and use this information as control factors. Using Step-level Public Goods games in an computerized laboratory experiment, subjects in groups of 5 repeatedly decide to invest in the public good. Subjects differential efficacies are manipulated as a between subjects' factor. In the homogeneous treatment individuals have the same efficacy, and in the heterogeneous treatment efficacies differ. Information is a between subject's factor manipulated as follows; a complete information treatment where subjects know the group's efficacy distribution, and an incomplete information treatment where subjects only know their own efficacy. SVO is treated as an observational factor and measured in the SVO slider measure developed by Murphy, Ackermann and Handgraaf (2011). SVO has been shown to be highly stable as an individual difference with a test-retest reliability of $r = 0.915$ (Murphy et al, 2011).

Personality traits will be assessed using the validated HEXACO self-report questionnaire (Ashton, M. C., & Lee, K. (2009)

Experimental procedure

The procedure of the experiment will be as follows: upon arrival at the lab students are provided with written and oral instructions by the experiment leader. On the test and an informed consent form on paper, and are randomly assigned to a workspace with computer. After subjects have read instructions, asked questions and signed informed consent forms, we start the experiment, which is programmed in o-tree. The experiment consists of two tasks that participants complete in randomized order, the collective task, and the questionnaire. These two tasks are as follows: In the collective task the groups of 5 individuals are randomly assigned to either of the experimental conditions and assigned a share (efficacy) and receive instructions on the rules and the procedure of the game that matches their experimental condition. Before the first round, subjects are asked a series of questions on; to what extent they rate their own investment as necessary, and to rate if they belief on the importance of investment for each other member, and also which members they expect to invest. Subjects play the game, in the same group, in the same treatment repeatedly for 15 rounds. The task for each subject in each round is as follows: Subjects have to decide independently and simultaneously between investing or not investing. After all individuals have made their decisions, they are presented a summary with the outcomes of the round. In the complete information conditions, subjects learn after each round whether the public good is produced, and which players with which shares invested. Note however that subjects cannot actually identify other subjects in the room, for they don't know/ are not informed on with whom they are exactly playing. In the questionnaire subjects are first asked to make a series of 6 decisions in which they are asked how they would divide an initial allocation of monetary units between themselves and another person. Subjects know that it's a hypothetical question and that they are not actually earning anything. Subsequently they are asked to complete a self-report regarding personality traits using the HEXACO questionnaire.

Acknowledgements

Thank you for the love! – Mother's Finest ©

This dissertation is the result of a thought provoking journey across many places that I have been able to finished because of the support, inspiration and contribution of many people. First of all, I would like to thank my supervisors and dissertation readers.

Dear Jacob Dijkstra, Ha Jacob! All that I have learned during the PhD, all the places that I have been and the place where I am now, that is all in one way or another made possible thanks to you. I am extremely indebted for having you as a supervisor and science partner, and I owe a lot of my successes and happiness to you. We met in 2015 in a research masters' course on theory building. You were teaching the classes on theoretical foundations of collective action. I was already into the topic, but after seeing you talking about collective action and observed your way of designing experiments and how you presented them to the audience, I directly decided that I should find a way to work with you. And not only because you are an expert on the topics that I find among the most interesting, also how you are as a teacher, researcher and as a person. You have a great sense humor, a wonderful personality and also a lot of empathy. I remain deeply impressed by your passion for research, your vast knowledge in sociology, statistics and R. What impresses me most are the many ways in which you can explain simple data cleaning techniques and extremely difficult mathematical models, in many many different ways and remain energetic, funny and upbeat. As a supervisor you have been a true mentor but also a caring friend. You inspired me, gave me all the freedom to pursue my academic interests and improve my skills. You were always there for me and showered me with lots of encouragement, compliments and even more support. The absolute highlight of my PhD research consists of our meetings, in which we spend countless of hours behind my laptop learning to conduct bootstrap simulations in R, power analyses, bayesian analyses and various

other techniques. Aside from the long hours spending on statistics and programming in R I just had an awesome time chatting with you about music, listening to long guitar solos, AC/DC, Mother's Finest and talking about playing music together. We almost managed playing on stage together, but then corona happened. Anyway, I hope our collaborations will keep on going, and that we also make it to the stage someday.

Dear Mario Lucchini, we met during the a statistics course. I saw in you immediately an inspiring mentor. We discussed lots of research ideas on charitable giving, your work on altruism and blood donation, and shared interests in statistics and evolutionary psychology, genomics and applications of neuroscience in sociology. Your supervision I experienced as adept and empathic. You have a lot of faith in my abilities and supported me to pursue my academic interests, which I regard as an extreme privilege. I'll regard our skype session in which we discussed my research but ended playing songs from Jimi Hendrix, Pink Floyd, and enclosed the session with singing together "*the house of the rising sun*" by The Animals as the absolute highpoint of our interactions!

Dear Serafino Negrelli, I am really thankful that you are one of my dissertation readers! At the various meetings that we sat down to discuss the dissertation progress with the dissertation committee, I was always very impressed and extremely thankful for your insightful comments and critical questions. I have also really enjoyed following courses your on how to conduct case studies.

After my supervisors and dissertation committee members there are plenty of people that I owe my gratitude too. Wojtek Przepiorka, you also belong at the top of my acknowledgment list as well. You where my first academic mentor in the research master Sociology and Social Research and inspired me to pursue a research topic related to the volunteers dilemma, collective action and social preferences. I am happy we managed to continue working together and managed to turn my master thesis into a publication and join

forces with Erik de Kwaadsteniet. Erik I take this space to thank you as well. Your knowledge on social dilemmas, tacit coordination and experimental social psychology has inspired me and I am very grateful for that.

From the Univeristy of Milano-Bicocca: Maurizo Pisati I first like to thank you. Your coordination of the doctoral program had helped me especially in the beginning of the dissertation. We had very nice meetings in which you helped me remind what research topic I was interested in and really supported me in developing my own ideas for the dissertation. You really believed in me and supported me in following my academic dreams. I thank the PhD representatives for being so active in improving and facilitating support for PhD's. I would like thank my fellow ASEP cohort mates Matteo, Dareen, Tomasso and Sofia for an amazing first year of the PhD, I really missed you guys when we all went for our abroad research visits!

Livia, I also want to thank you for being an awesome PhD fellow and my amazing friend, you were in another PhD program of the sociology department, but I always felt like we created our own research group in Bicocca. Our shared interest for long discussions on quantitative methods, statistics, evolutionary psychology and experimental methods where very inspiring to me and I also just really enjoyed hanging out with you. Our time together in Belgium was extremely awesome and inspiring. If we manage to write up one of the papers that we designed, that would make me super happy, also just because we get to spend some time together and share our interests.

Lorenzo, I also owe a lot of gratitude to you. When I arrived in Milan, you where one of the first colleagues I met in the office and we became very close immediately. We had awesome times together and due to your support both in learning Italian, help with all kinds of forms, making my way in the city and so on, I felt at home much sooner.

Pryanka, I was always very inspired by your work ethic, we frequently shared our work for feedback and you helped me in navigation through various bureaucratic systems in Bicocca.

I also own thanks to my housemates Massimo and later Fulvio, and my triathlon mates, especially my bike buddy Guillia.

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Vincenz, we started working together by helping each other with each other's experiments when I was still a research master between 2015-2017. We bonded quickly, most notably over biking and experimental research. We both went to Milan in 2017, but to different universities, you started your postdoc at Bocconi and I my PhD at Bicocca. I have super enjoyed our swimming sessions in the centre of Milan, train rides to Florence for conferences talks many talks on running races. Funnily enough two year later, we are in the same department again and this time in Groningen.

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