University of Groningen

Sustainable cooperation in small groups

Titlestad, Kim Nicole

DOI:
[10.33612/diss.95433751](https://doi.org/10.33612/diss.95433751)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2019

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Titlestad, K. N. (2019). *Sustainable cooperation in small groups: dynamic interaction and the emergence of norms*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.
<https://doi.org/10.33612/diss.95433751>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Sustainable cooperation in small groups

Dynamic interaction and the emergence of norms

Kim Nicole Titlestad

This research was supported by the Erasmus Mundus Action 2 Inspire project

VIAPPL Logo by Michael Quayle

Cover Design by Susie Wang & Kim N. Titlestad

Printed by Ridderprint BV, www.ridderprint.nl

ISBN 978-94-034-1860-5 (printed version)

ISBN 978-94-034-1859-9 (electronic version)

© 2019 by K.N Titlestad.

university of
 groningen

Sustainable cooperation in small groups

Dynamic interaction and the emergence of norms

PhD thesis

to obtain the degree of PhD at the
University of Groningen on the authority of the
Rector Magnificus Prof. C. Wijmenga
and in accordance with the decision by the College of Deans.

This thesis will be defended in public on

Thursday 19 September 2019 at 16.15 hours

by

Kim Nicole Titlestad
born on 1 September 1989
in Pietermaritzburg, South Africa

Supervisors

Prof. T. Postmes

Prof. T.A.B Snijders

Assessment committee

Prof. B. Simpson

Prof. R. Spears

Prof. R. Wittek

Table of Contents

Chapter 1:	General introduction	7
Chapter 2:	The dynamic emergence of cooperative norms in a social dilemma	17
Chapter 3:	Social categories and interpersonal ties - pathways to cooperation	53
Chapter 4:	When social categories and interpersonal ties fail to produce cooperation	91
Chapter 5:	The role of communication in fostering cooperative norms	127
Chapter 6:	General discussion	155
	Supplementary information	173
	References	175
	Dutch summary	189
	Acknowledgements	197

Chapter 1: General Introduction

Cooperation is now, and always has been, fundamental to social life. The success of human evolution is based on effective cooperation within and between groups (e.g., Boyd & Richerson, 2009). The ability to cooperate and exchange allowed humans to diversify their skills and, as a whole, become collectively more productive. In a globalized world which faces many roadblocks to cooperation, it is more crucial than ever to understand how to develop cooperative social norms that create cooperative communities.

Evolutionary biologists see cooperation among kin as promoting the fitness of the species by ensuring that one's genes promulgate into future generations. Humans may be unique however, in the capacity to cooperate with complete strangers (Fehr & Fischbacher, 2004; Gintis, Bowles, Boyd, & Fehr, 2003). For example, global communities have been formed through industrialization and globalization where cooperation occurs on a large scale. Related to this development, there has been a widespread civilizing process and the rise of citizenship in which shared norms have developed around when and how to cooperate. Of course, there is also an inherent tension between cooperation and competition – which we see in displays of ingroup favouritism, prejudice and inequality which, in the extreme, can lead to outbreaks of war and even genocide.

Recently, there has been increasing importance placed on understanding the evolution and maintenance of cooperative societies. This is due to, among other things, the rise of social inequalities, polarization of ideologies and extremism, political manipulation through social media algorithms, all of which challenge and sometimes threaten to erode existing cooperative social structures (for example, Inglehart & Baker, 2000; Putnam, 2001; Woolley & Howard, 2018). In the face of all this societal change and in view of tension within human society between cooperative and competitive tendencies, how can cooperation be maintained and nurtured? Currently, research addresses the conditions and variables that exist in cooperative societies. However, less research has been done to understand how societies form that build and sustain cooperative relations over time. Therefore, in this dissertation, we study the emergence and maintenance of cooperation in emergent and dynamic, albeit small, groups. This approach to studying cooperation allows us to understand *how these cooperative communities evolve* as well as provide insight into how they can be sustained over time.

In the remainder of this introduction, we will first give an overview of the theoretical foundation upon which this thesis is built. As each empirical chapter is written as a standalone paper, there are many overlaps in the introductions for each chapter. Therefore, we will keep this theoretical background succinct. Next, we briefly address the methodological approach used, and finally provide an outline of the chapters that follow.

Theoretical Background

Cooperating in a group can be a risky enterprise: Engaging in an activity or investing in a shared resource which serves the group or society as a whole, may not satisfy a person's immediate self-interest. For example, one may be able to accrue greater disposable income if one manages to evade the taxation authorities and yet still benefit from government expenditures, such as infrastructure. Indeed, early researchers in the field of economics foresaw this potential barrier to cooperation and assumed that rationally speaking, under conditions in which it is in one's personal interest *not to cooperate*, people would free-ride off the group or society whenever they were given an opportunity to do so (Edwards, 1962). However, in the years since, evidence to the contrary has moved us away from this simplistic assumption of humans as rational "homo economicus"; in other words, away from the idea of egoist rationality (Ledyard, 1995). The assumption that individuals will act out of pure self-interest without considering what people around them may do has been replaced by the assumption of social rationality (i.e., goal directed behavior that is influenced by social conditions). Social rationality argues that people gain adaptive advantages from living in groups and are strongly influenced by one another (see for example, Lindenberg, 2015b). Therefore, considering what is best for the individual, and thus what their "rational" behavior should be in a given circumstance, becomes problematic if one does not consider an individual's place in an interconnected web of human relations. This paradigm shift has helped us to advance the understanding of when and how cooperation occurs, for example the role that social goals and social norms play in influencing an individual's choice to cooperate or defect (Diekmann & Lindenberg, 2015). Given that cooperation is in many circumstances very functional for societies as a whole, it is important for us to identify the factors that account for its emergence over time; and how it can be sustained in ever expanding and diversifying societies.

Social Norms for Cooperation

Why do people cooperate? There are many circumstances where outcomes can be maximized when people cooperate and work together. In other words, there are many things that people cannot do well alone – from building the pyramids in Egypt to running a multinational corporation. The next important question is: When do people cooperate? People often come into a situation with a set of expectations for how others might behave and how they personally should behave. We broadly refer to these expectations as social norms. Bicchieri (2005) argues that social norms can, in part, be distinguished from descriptive

norms because following the former often requires that an individual goes against their narrow self-interest for the sake of joint gain (for example, one is expected to reciprocate a favour or act fairly, even if there is a personal cost to it). In this thesis, we are primarily interested in how social norms for cooperation *emerge and come into being in the first place*.

One contribution to the social rationality explanation of human behavior is a large body of research on social value orientation which suggests that people have set preferences to act in particular ways across many circumstances (Messick & McClintock, 1968). Some people may be individualistic, competitive and “proself”, while others may be altruistic, cooperative and “prosocial”. These individual preferences, or social goals, are mostly seen as fairly stable individual differences and thus a potential shortcoming is that these individual predispositions do not adequately consider the role of situational and environmental factors that may influence one’s behavior in a given circumstance (Diekmann & Lindenberg, 2015).

In addition to individual preferences, there has also been a fair amount of research focus on how *generic norms* may guide behavior such as cooperation, in group settings. Generic norms refer to norms that already exist in society and which people draw upon to inform their behavior in a given setting. For example, most societies have generic norms for direct reciprocation – where one directly returns a favour to someone, and where not doing so may be considered impolite and dishonorable. Further, many societies also have generic norms for indirect reciprocation – which occurs in larger systems where reputation gained from past interactions informs how third parties treat you. In other words, if one is perceived as helpful, one will receive more help in the future – but not necessarily from the people one has helped previously. Both direct and indirect reciprocation are normative systems that can increase cooperation in society as a whole (for a discussion see Diekmann & Lindenberg, 2015).

How does one know which norm to draw on in any given setting? According to goal framing theory, whether to cooperate or not in a particular context can be influenced by an overarching goal frame that guides an individual (Lindenberg, 2015b). Goal frames are activated by environmental cues and the particular goal frame activated informs the social heuristics, or rules, that an individual draws upon to guide their behavior in a particular situation. According to this theory, the three main goal frames are: hedonic, normative and gain goal frames (Lindenberg, 2015b, 2015a). Particular social situations activate certain goal frames to a greater extent than others – although multiple goal frames may operate, some in the background. This theory helps explain why the social framing of lab-based cooperation experiments can have frame-dependent outcomes for cooperative or competitive behavior (see

for example Liberman, Samuels, & Ross, 2004; and for meta-analytic results see Van Lange, Joireman, Parks, & Van Dijk, 2013). As an illustration, framing an experiment to participants in cooperative terms (e.g., as a “Community game”), versus competitive terms (e.g., “Wall Street game”), can increase cooperation through the provision of a normative goal frame as opposed to a gains goal frame.

The view that rational behavior needs to be consistent across settings has been challenged by this theory. The ability to switch between goal frames depending on the situation and then act accordingly shows that one’s behavior is not rational in the traditional sense but is highly context-dependent and requires sometimes effortful self-regulation on the part of the individual (Lindenberg, 2015a; Lindenberg & Steg, 2007). In particular, self-regulation is required when there is a conflict of goals: for example, suppressing falling asleep – guided by a hedonic goal – while pursuing the normative goal (e.g., writing a chapter for your thesis). Self-regulation also allows one to maintain a balance between goals (e.g., to avoid thesis-related burnout). Notably, self-regulation here does not simply refer to an individual’s stable, innate capacity because institutions, organizations and interpersonal relations can all have a large impact on one’s self-regulatory ability (Lindenberg, 2015a).

A potential shortcoming of both described conceptions of norms – generic norms (e.g., reciprocity or ingroup bias) as well as overarching goal frames *which activate* different types of norms – is that both are conceptualized as having a unidirectional influence on behavior. Generic norms are seen to “pre-exist” in society and are drawn on as guides for behavior; and similarly, goal frames are activated by features of the external environment and then an individual *adapts* their behavior to the particular goal activated. In both conceptions, an individual does not co-create the norm or set the goal frame with others through interaction. However, norms are by their nature emergent: Individuals play an active role in the creation, maintenance and change of social norms (see Reicher & Haslam, 2013). As such, social norms cannot simply be seen as manuals for behavior when they are “activated”, but rather, are phenomena which are shaped by people through their active engagement with others. Therefore, theories regarding the influence of generic norms and/or goal frames on cooperation may indeed operate within society once these norms and environments have already been formed—but they do not address how society forms in the first place nor how humans actively shape it.

Social Categorization and Inductive groups

Why do people show normative behavior in the first place? The presence or absence of social identification with a group may help to explain this. For example, there has been a lot of evidence to suggest that identifying as a member of a group or social category facilitates one's cooperation with others in that group (Brewer & Kramer, 1986; De Cremer, Van Knippenberg, Van Dijk, & Van Leeuwen, 2008; De Cremer & Van Vugt, 1999; Simpson, 2006; Wit & Kerr, 2002). The Social Identity Approach – an integration of social identity theory (Tajfel & Turner, 1979) and self-categorization theory (Turner, 1991; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) – seeks to explain how belonging to a group influences one's cognitive processes and behavior. When the broad social categories to which one belongs (e.g., nationality, race, gender etc.) become salient, one comes to see oneself as a group member. Under these circumstances, one's social identity, rather than personal identity, tends to guide one's thoughts and behaviour. Activated social identities influence one to act in support of the group, rather than out of self-interest (Tajfel, Billig, Bundy, & Flament, 1971; Turner, 1991; Turner et al., 1987). These identities also activate particular social norms associated with the group (Turner, 1991). Furthermore, norms which are integrated into social identities have a greater impact on behavior when social identity is salient; and high identifiers tend to experience more positive emotions related to the adherence of group norms (Christensen, Rothgerber, Wood, & Matz, 2004). In addition to cooperation, social identification with the group has been shown to be associated with a sense of belonging and group cohesion (Hogg, 1992; Turner et al., 1987), it promotes collective action (Van Zomeren, Postmes, & Spears, 2008) as well as ingroup favoritism (Tajfel et al., 1971). This theory of (inter)group relations also helps to explain how humans form cooperative relationships outside of familial ties – rather than one's sense of self simply extending to closely related individuals, through categorization, one's sense of identity can extend to ever broader groups.

But how do cooperative groups and societies *form in the first place*? The emergence of social identity may explain this process. According to the Interactive Model of Social Identity Formation (IMIF; Postmes, Haslam, & Swaab, 2005; Postmes, Spears, Lee, & Novak, 2005), while (pre-existing) social identities can be deduced from broad social categories, social identities can also be induced (and thereby developed) from the bottom up, through interpersonal interaction and communication over time. Small, interactive groups can develop the same properties as broad abstract categories (such as social identification, belongingness etc.), albeit through different pathways. In particular, in inductively formed groups, personal

value to the group and heterogeneity of group members is important, rather than the homogeneity emphasized by members of a shared social category. Here dynamic processes are of central importance to the group: Social norms of the group emerge dynamically through interaction over time, rather than being “turned on” by the saliency of a social category. This inductive process can explain how individuals come to share a sense of similarity and common social identity with one another which, in turn, enables the emergence of social norms for cooperation. An individual who sees oneself as a group member – with all the interdependencies that this entails – is “socially rational” and is capable of making choices in relation to others and cooperating with other group members.

The effects that the inductive route to social identification has on individual perceptions, behavior, and group level outcomes has been explored in areas relating to: individual distinctiveness (Jans, Postmes, & Van der Zee, 2012), group solidarity (Koudenburg, Postmes, Gordijn, & Van Mourik Broekman, 2015), and solidarity between actors and observers (Van Mourik Broekman, Gordijn, Koudenburg, & Postmes, 2018). However, currently there is not much research addressing how different forms of identification (through social categorization/deductive or inductive processes) are associated with cooperation. One aspect of cooperation that this thesis aims to address, is to what extent the pathway to social identification affects the trajectory of cooperation within groups. For example, can cooperation in inductive groups reach similarly high levels as that of deductive groups, given time for interaction to occur and social identities to emerge? Our starting assumption, taken from the Interactive Model of Social Identity Formation, is that while social categorization will facilitate early and relatively stable levels of cooperation, inductive processes will allow groups to develop the same cooperative norms, which become stable through interaction over time.

A Methodological Approach to Studying the Emergence of Cooperative Norms

In this thesis, we have employed dynamic Public Goods Games (PGGs) in order to study the emergence, or lack thereof, of cooperative norms in small interactive groups, while also manipulating whether groups of people interact as a deductive or an inductive group. PGGs allow people to contribute to a shared resource-pool which generates profit proportional to investments, but distributes returns *equally to all* regardless of individual investments (Olson, 1965). Therefore, groups do best when everyone cooperates, but individuals maximize profit – at least in the short-term *and* as long as others cooperate – by free-riding (i.e., not cooperating/defecting) (Samuelson, 1954). In the real world, public goods

include: public television and radio; material infrastructure (such as roads); intellectual property developed in groups etc. (Katz, Lazer, Arrow, & Contractor, 2004; Shankar & Pavitt, 2002). PGGs are useful because they conceptually reflect how public goods operate in the real world but allow us to study cooperation in a controlled environment.

We programmed a dynamic PGG in the Virtual Interaction Application (VIAPPL, see viappl.org). VIAPPL is an experimental platform designed to study social interaction and the evolution of group processes and norms (see Durrheim, Quayle, Tredoux, Titlestad, & Tooke, 2016). Participants interact in a controlled environment over a sequence of rounds and their interactions are recorded for analyses. Interaction is made up of exchange behavior and the sending and receiving of messages. In VIAPPL, the experimenter can design simple dyadic exchange games, common pool resource dilemmas and Public Goods Games (PGGs). Since VIAPPL was developed as a tool to study group processes, variables such as group size, group status, the number of groups, and whether participants can choose their groups or are randomly assigned can be manipulated. Questionnaires to measure social psychological constructs can be initiated at any point in the experiment. Finally, images can be imported and set as the background to the computer-arena; and the avatar images, which represent individual players or groups, can also be selected by the experimenter.

While many traditional social psychological experiments exclude social interaction in order to make results more tractable (see Reicher & Haslam, 2013), VIAPPL reintroduces social interaction to social psychological experiments in computer-mediated format. The inclusion and study of social interaction – while introducing many complexities – more closely reflects real world social processes and allows us to study how people make choices *in relation to others*. The aim of this thesis is to study the emergence of cooperative norms and examine how groups of different kinds interact over time. As such, VIAPPL provides the ideal environment to study these processes.

In VIAPPL, we simulated small communities in which we could study cooperation in small interactive groups. With this set-up, interaction among actors occurred over time (i.e., people could contribute the public good over multiple rounds); an individual's actions could be monitored by all group members; and communication between group members was enabled. Designing the experiments with these key ingredients allows groups of participants to engage in exchange behavior as well as develop social relationships with one another. Given that the modern conception of cooperation is based on the idea of social rationality, allowing for social processes to occur during exchange can give us insight into how

cooperative norms emerge in groups. More details of the experiments can be found in Chapters 2-5 of this thesis.

Overview of the empirical chapters

In four empirical chapters, we aim to study the emergence of cooperation over time in small, interactive groups. We also aim to determine whether interactive groups develop their own social norms of cooperation and whether these norms differ between the two social identification pathways (i.e., deductive/social categories versus inductive/non-categorized groups/interpersonal tie groups). In Chapter 2 through 4 we study the behavioural patterns of cooperation in small groups, while in Chapter 5 we qualitatively explore the content of the communication that occurred within the groups.

Chapter 2

In Chapter 2, we study the differences in the emergence of cooperation after cueing different pathways to social identification (social categorization versus non-categorization). We then develop a statistical approach (namely, the multilevel latent class Markov model; see Van de Pol & Langeheine, 1990; Vermunt, Tran, & Magidson, 2008) which allows us to study the emergence of cooperative norms within interactive groups. Chapter 2 entails one large experimental study consisting of 40 groups of 6 participants (240 individuals in total) who interact in small groups in a dynamic Public Good Game. In the experiment, participants choose to invest in their group over time in a context in which they are given full feedback regarding their group members' investments and are allowed time to communicate between investments. Permitting interaction over time enables us to study the dynamic formation of social norms of cooperation.

Chapter 3

Chapter 3 conceptually replicates the results of Chapter 2 using a richer experimental manipulation. While we compared categorization to non-categorization in Chapter 2, in this Chapter, we compare the categorization condition to a more strongly inductive-type of social identity manipulation. With this in mind, we develop an Interpersonal Ties condition which emphasizes social support and interpersonal relations rather than broad social categories (i.e., the social categories condition). Besides strengthening the manipulation, a similar experimental procedure as Chapter 2 is followed, both in terms of the experiment as well as

the method of analysis. In this Chapter, we confirm and build on the results of Chapter 2 and go into more detail regarding the emergence of cooperative norms within groups.

Chapter 4

Due to the fact that in both Chapter 2 and 3 we see high levels of cooperation, in which participants often hit the ceiling for cooperation over the course of the game, in this chapter we aim to increase the variance in the initial starting values to see whether cooperation will still emerge. Therefore, we replicate the experiment in the South African context and change the incentive structure such that payoffs are dependent on the outcomes of the game. We conduct one large experiment of 300 participants (30 groups of 10) and follow an otherwise identical procedure to the study in Chapter 3. In contrast, however, we find different results compared to the previous two studies. Here both pathways to social identification fail to produce high levels of cooperation and instead, mostly unstable communities form in which strongly normative behavior does not arise as frequently.

Chapter 5

Chapters 3 and 4 followed similar experimental procedures but the cooperation levels that groups achieved were different. Since groups in both studies could be divided into those who align their behavior on high levels of cooperation (i.e., develop strong cooperative norms) and those that do not, here we aim to compare the content of the messages which were sent during social interaction in order to gain more insight into the types of communication that may facilitate or interfere with the emergence of cooperative norms. In this Chapter, we present a mixed-method approach – which includes both qualitative and quantitative analyses of the communication – to garner insight into the dynamic conditions under which cooperation may emerge more or less easily.

Chapter 2: The Dynamic Emergence of Cooperative Norms in a Social Dilemma

Chapter based on: Titlestad, K., Snijders, T. A. B., Durrheim, K., Quayle, M., Postmes, T. (in press). The dynamic emergence of cooperative norms in a social dilemma. *Journal of Experimental Social Psychology*.

Abstract

This paper addresses the formation of social norms of cooperation through interaction in repeated Public Goods Games, using novel multilevel techniques. Cooperation has traditionally been understood as the interplay of static factors such as shared social identity and pre-existing norms. This study investigates the dynamic emergence of cooperative norms in the presence or absence of social categorization. A small effect of categorization was found: Categorization helps initiate and maintain higher levels of cooperation. However, the differences in emergent cooperation between small groups were much stronger than the differences between the Categorization and Non-Categorization conditions. Using explorative analyses, three distinct classes of groups were found. Within groups, group members follow nearly identical rules for their choice of cooperative behavior. We argue that individual behavior converged because of the social interactions within these groups. Overall, the development of cooperation is best predicted by the process of norm formation that occurs when social identities emerge.

How does cooperation in small groups emerge? This paper takes a dynamic perspective on the formation of social norms for cooperation. We also consider how social categorization can influence this norm formation. We seek to understand how cooperation arises and is maintained in a social dilemma: drawing on advances both in experimental software and in multilevel latent class Markov models, we can analyze decision rules for cooperation and the emergence of individual behavioral patterns in conjunction with group norms.

The formation of cooperative norms in a small community, or society at large, has at least one fundamental hurdle: When there are collective goods – whether it be collective action, public television, farming collective lands, etc. (Katz et al., 2004; Shankar & Pavitt, 2002) – there may be free riding because collective goods are shared equally, regardless of personal contribution (Samuelson, 1954). Therefore, traditional game theory argues that in order to maximize one's (economic) self-interest, it is rational not to cooperate. For example, Hardin (1968) argued in the "Tragedy of the Commons" that everyone has an individual predisposition to take advantage of a common-pool resource, such as the environment, and therefore people are destined to undermine it – for example, through overgrazing or polluting. If this were true, all attempts at cooperation are ultimately doomed to fail or falter.

Such social dilemmas are commonly studied in Public Goods Games (PGG) (Olson, 1965). A PGG is essentially a simulated society in which participants decide how much to contribute to the Public Good – the socially optimal outcome is universal cooperation, the best individual outcome is defection while all others cooperate. Contrary to classic rational actor expectations, however, research suggests that cooperation in social dilemmas tends to be "irrationally" high: in the range of 40-60% of what one can contribute (for example, see Ledyard, 1995).

Why is "rational defection" so rare in these experiments? In his seminal work on the Prisoner's Dilemma, Robert Axelrod (1984) found that the most sustainable and profitable strategy in repeated interaction is tit-for-tat rather than self-interested defection. Tit-for-tat entails that people begin interaction by cooperating and then copy their interactant's subsequent behavior – i.e., conditional cooperation. Tit-for-tat was seen as: a) nice, as it starts with cooperation; b) forgiving, as one will cooperate again when the other player stops defecting; c) retaliatory, as it punishes non-cooperation; and d) clear, as it is easy to discern the interaction pattern. Tit-for-tat was thought to be evolutionary robust and could emerge in an environment of egoist players, optimizing each player's payoff. However, in reality one's

payoff is not necessarily instrumental (i.e., maximizing points) but might also have a relational value.

Building on the ideas of game theory, the interdependence perspective (Kelley et al., 2003; Kelley & Thibaut, 1978; Rusbult & Van Lange, 2008; Thibaut & Kelley, 1959) provides a framework to look at the effect of between-person processes on collective outcomes, where one's optimal outcome has strong relational considerations. These considerations are determined by personal characteristics and situational factors. Whether exchanges are seen as rewarding or not, depends not only on instrumental payoff but also on one's individually fixed preferences and expectations. Furthermore, interdependence theory assumes that an individual's behavior will – to greater or lesser extent – be influenced by the actions of others, given a particular interdependence structure. Examples of these structures include situations in which an individual has unilateral control over another's outcomes, or vice versa; or where both partners' actions have an effect on outcomes for both. In other words, the situation structure influences an individual's behavior in relation to those to whom one's outcome is tied. If levels of "rational defection" are rare in PGG's, interdependence theory suggests this may be because certain individuals value good relations more than profit. However, one potential issue for interdependence theory is that most research in this tradition focuses on dyads, which is quite far removed from the more complex dynamics of groups.

Nevertheless, Public Goods research has revealed many static factors that contribute to higher levels of cooperation. Of particular interest to social scientists are a shared social identity (e.g., Brewer & Kramer, 1986; Simpson, 2006) and differences in preferences and beliefs (e.g., social value orientation, Messick & McClintock, 1968).

Static views on Cooperation and Social Identity

Much of the traditional research using PGGs examines cooperation in one-shot experiments. There is an extensive literature on situational and personal factors that influence decisions to cooperate or defect in such settings. We refer to these as “static” factors, in the sense that their effects are assumed independent of (or exogenous to) the social interactions or exchanges within the PGG.

For example, cooperation tends to be high in groups that share a social identity. Shared social identities can be formed “deductively”, whereby group members infer a joint category membership because they exhibit shared characteristics or prototypical traits (Postmes, Spears, et al., 2005; Tajfel et al., 1971; Turner, 1985). In other words, group identity can form from the top down. Belonging to a shared social category (gender, race,

nationality etc.) or even “minimal” groups without meaning (Tajfel et al., 1971) can, for example, increase the sense of belonging and group cohesion (Turner et al., 1987) and promote ingroup favoritism (Tajfel et al., 1971).

Higher social identification with one’s group not only alters expectations about the behaviors of others: greater cooperation is mediated by one’s sense of self as a group member (De Cremer et al., 2008). Having a shared social identity appears to transform the goals of selfish individuals so that they cooperate rather than defect (De Cremer & Van Vugt, 1999; Turner, 1991). Accordingly, one can increase cooperation by categorizing people at the collective, rather than subgroup or individual level (Brewer & Kramer, 1986; Wit & Kerr, 2002; but see Jetten, Postmes, & McAuliffe, 2002, for exceptions). Group members, when they identify as a group and hence when shared identity is salient, tend to optimize ingroup outcomes and minimize ingroup inequalities (Simpson, 2006), both of which happen when all group members contribute maximally to the Public Good.

A large body of literature shows that levels of cooperation also depend on personal preferences. In interdependence theory, a personality difference that has received much attention is the distinction between those who are more individualistic, competitive and “proself” versus those who are more altruistic, cooperative and “prosocial” (social value orientation, SVO, Messick & McClintock, 1968; Van Lange, 1999). This explains about 9% of the variation in cooperation in social dilemmas (Balliet, Parks, & Joireman, 2009). Approaches to SVO tend to treat these preferences for cooperation or selfishness as fairly stable response styles (Messick, 1999). With respect to exchange decisions, these response styles may operate as social heuristics for behaviors that have become automated and intuitive because they were rewarding in the past (Jordan, Peysakhovich, & Rand, 2014) and therefore may spill over into novel situations (Peysakhovich & Rand, 2016). To our knowledge, how these personal response styles play out in dynamic settings, where individuals with different social heuristics interact for a prolonged series of exchanges, has not yet been explored.

Above the individual level, the decision whether or not to cooperate can also be influenced by the overarching goal frame salient in a particular context (Lindenberg, 2015a, 2015b), which also informs the social heuristics drawn on by the individual. Notably, Lindenberg (2015a, 2015b) draws a distinction between personal preferences and overarching goals, arguing that the latter are determined by the social environment. According to Lindenberg (2015a, 2015b), particular social situations activate certain goal frames to a greater extent than others (although others may still operate in the background). This explains why the social framing of cooperation dilemmas can have different outcomes for cooperative

or competitive behavior (see for example Liberman, Samuels, & Ross, 2004; Van Lange, Joireman, Parks, & Van Dijk, 2013). For example, framing a social dilemma in cooperative terms (“Community game”), versus competitive terms (“Wall Street game”), can increase cooperation by providing a normative goal frame (where collective gain is salient) versus a gains goal frame (where individual gain is salient). Beyond these situational goal frames, the level of within-game cooperation is also likely to be affected by the quality of interactions within the game. Here we might see the emergence of norms of an entirely different kind.

Dynamic views on Cooperation and Social Identity

The emergence of cooperation is increasingly being studied through iterative social dilemmas. Naturally, this shift in interest in the field focuses on how relations (or even societies) form that are more or less cooperative. This is highly relevant: variability in the levels of cooperation between societies tends to be high (e.g., Henrich et al., 2001), so it is important to understand what makes a society promote high levels of cooperation. As an overall trend, research suggests that cooperation is usually higher when there is a higher probability of interacting again in the future (Dal Bó, 2005), possibly due to the role of direct and indirect reciprocity where one expects present cooperative behavior to be returned in the future (Lindenberg, 2015b; Molm, Schaefer, & Collett, 2007). Factors that enhance the effect of reciprocity in cooperative situations include: homogeneity, smallness and stability of the group and its membership (Diekmann & Lindenberg, 2015).

Most findings from iterative PGGs show that contributions often start at around 50% of what one can possibly contribute and, although they tend to decline over time, the average contribution remains above zero (Barrera, 2014). Additional research considers factors preventing this tendency of decline. For example, studies have found that implementing a sanctioning system can mitigate a decline in cooperation (e.g., Barrera, 2014; Van Miltenburg, Buskens, Barrera, & Raub, 2014). Sanctioning is a form of negative feedback in response to defection, which ideally discourages future defection and encourages cooperation. Sanctioning can occur in multiple ways, through material or symbolic means – for example, monetary penalties or the communication of social disapproval (Barrera, 2014; Van Miltenburg et al., 2014).

Although cooperation can increase through learning and experience in some infinitely repeated games, this is not the case in all games (e.g., Dal Bó, 2005): the exact conditions that account for these group differences are not well understood. Therefore, it is valuable to study dynamic factors – rather than static factors only – that may increase cooperation. One of these

is the effect of communication in cooperation dilemmas. Communication increases cooperation (Chen & Komorita, 1994; Dawes, McTavish, & Shaklee, 1977) presumably because it provides the ability to: 1) enhance understanding of the PG situation; 2) coordinate actions; 3) create cooperative social norms; 4) form strategic agreements; 5) enhance trust in others; and 6) establish a social identity (X. Chen, 1996; Shankar & Pavitt, 2002). Communication is thus interactive and can help people to coordinate and support higher levels of cooperation within groups.

Another dynamic component is the in-game formation of either positive or negative social ties which depends on the nature of interaction with other players rather than exclusively on one's pre-interaction social value orientation. For example, Van Dijk, Sonnemans and van Winden (2002) found direct evidence for social ties (i.e., the extent to which two people care about the well-being of one another) forming over time in interaction. Once positive social ties are formed, it seems likely that they would have implications for future cooperation.

According to the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), communication and the formation of social ties both play a role in the induction of a shared identity. Research suggests that social interaction, the formation of personal relations, and coordinated action can all contribute to the emergence of group bonds. In this process, social identity is formed inductively (from the bottom up), rather than just deductively (inferred top-down based on predefined social categories). This is naturally a more emergent view of social identification, consistent with arguments that the agency of an individual in the group can promote identification (Reicher & Haslam, 2013); and that interpersonal network interactions foster group belonging and well-being (Easterbrook & Vignoles, 2013).

One study has shown some evidence that cooperation may be higher in groups that have formed a shared identity through induction (Jans et al., 2012), but only for heterogeneous rather than homogenous groups. The actual process of forming a shared identity during social exchange, and how this in turn influences cooperation over time, has not been studied as far as we know.

In sum, while prior research has often explored static factors that influence cooperation (e.g. categorization, personal preferences, social heuristics, goal frames), more recently attention has turned to dynamic factors accounting for the emergence and maintenance of cooperation over time (e.g. induction, communication, social tie formation). There are many dynamic factors operating at the group and individual level that all seem to be

heavily influenced by the social environment. One approach to further this line of research is to determine how these factors operate together and arise simultaneously.

The present research

How do within-game cooperative norms emerge over time *in tandem* with dynamic factors, such as the induction of a shared identity? We introduce some methodological advances – in terms of experimental design and software, as well as statistical techniques – that enable us to study the emergence of groups and cooperative norms within groups over time. The study presented here is an experimental Public Goods Game where social interaction over time was possible and where we manipulated the presence or absence of social categorization.

Method

Participants and Design

Psychology students (N=240, 164 female, 74 male, two undeclared, $M_{age} = 20.32$) participated in return for course credit. Groups of six interacted for 1.5 hours. There were 2 conditions, Categorized versus Non- Categorized, with 20 groups each. For multilevel studies, power calculations require approximate knowledge of not only effect sizes but also intraclass correlation coefficients and other parameters (Snijders & Bosker, 2012). Given the novelty of the present research and thus not knowing which parameter values to expect, we had no reliable grounds for sample size calculations and decided to use what we expected would be a relatively high sample size at the experimental group level. The study was approved by the departmental Ethics Committee. We report all measures, manipulations, and exclusions in this study.

Procedure

A Public Goods game with communication was created on the experimental platform, the Virtual Interaction Application (VIAPPL, see viappl.org). Participants came to the lab in groups of 6. They were connected through the server and all interaction took place over VIAPPL, whilst they were physically present in the same room with screens partitioning individual computers. The game had four stages: 1) dyadic exchange and group formation; 2) Public Goods Game; 3) group reformation and, finally, 4) a second PGG. Before the experiment, the general rules of the PGG were explained (via instruction manuals, see Supplementary Information A) and a brief demonstration of the software was given.

To introduce dynamic interaction and to make the emergence of groups possible, participants were given the opportunity to build their own social psychological stimulus through interaction in the first stages of the experiment. A settler's metaphor was used for this: participants were asked to imagine that they had arrived on a newly discovered island where they would settle and farm the land. They were informed that there are other new arrivals on this island with whom they could communicate, interact, and form "farming co-operatives" in order to build their farms and start cultivating the land.

Dyadic Exchange. In order for participants to form farming co-operatives (or co-ops), participants could interact with each other beforehand. After the background story was presented, participants began a dyadic exchange task where they exchanged building materials with other participants to build their farmhouse. Each participant possessed one unique building material and there were six in total. They were asked to accumulate three additional materials during the task. Participants could message one another in order to coordinate their exchanges¹.

The outcome of dyadic exchange was symbolic as the 'houses' built had no carry-over into the following phases of the game. However, this task did provide participants with a history of interaction that could be a basis for forming co-ops. The feedback at the end of the task was identical for all participants – *"Well done! You built your farm as best you could. Now organize - through discussion - which co-op you want to join!"*. The message appeared regardless of how many materials the participant ended up with.

Group Formation. At this stage participants were given the opportunity to join one of three co-ops after communicating via instant messaging for 3 minutes². The choice of three co-ops instead of two, reflects the idea that groups often exist in complex formations, not purely in dichotomous terms (P. Kerr, Durrheim, & Dixon, 2017). Furthermore, we felt that two groups would make the choice for the Categorized condition too obvious so we allowed room for participants to make alternate groups, not simply recreate the assigned

¹ Since communication itself could not bind players to their choices, strategic patterns of behaviors had the potential to emerge – for example a player could promise to exchange with another player in order to get the second player's resource but then not follow through in the action round. We are interested not in these strategic patterns themselves (and therefore do not analyze them here), but rather how participants could use this information in their interactions in order to form the co-ops in the following phase of the game.

² Due to a limitation in the software at the time, participants had to indicate their choice twice. The second time they did so, the co-ops were set for the PGG. This was necessary to give participants who discovered they had not coordinated their selections well the opportunity to change their choices.

categories/groups (although they could form two groups and leave the third co-op empty). The only rule was that each co-op could have a maximum of 4 members; the 5th person who tried to join would be asked to make a different selection.

Public Goods Games. Two Public Goods Games were played. The first followed directly after group formation and lasted 12 rounds.³ The second game (10 rounds) was played after participants were allowed to reform co-ops (this time without making exchanges beforehand). Following general rules of PGGs (Olson, 1965), participants received an endowment of 10 tokens at the beginning of each round of the game. They then communicated for a short period of time (40 seconds) before individually deciding whether to contribute anything from 0 to 10 tokens to their co-op (they could not contribute to other co-ops). Unallocated tokens were automatically added to one's 'personal account'. At the end of each round, participants were paid out from their co-op; whereby the total funds in the co-op were multiplied by 1.2 and divided equally among the co-op members, regardless of how many tokens they had personally contributed. At the end of each round, each participant received an updated token balance: a 2 token increase per round + tokens not contributed to their co-op + their share of the co-op profit. The tokens had a symbolic value and did not relate to any payment at the end of the experiment but we encouraged participants to “*Try to collect 45 tokens or more!*”.

This set up presents a classic social dilemma where the socially optimal outcome – where all co-op members benefit equally and the total is maximal – is obtained if all members invest their entire endowment in their co-op at every round. However, individuals could potentially earn more tokens if the others in their co-op made high contributions and they would defect by investing less or nothing. Participants were provided with payoff examples in the instruction manual (see Figure 1).

³ To avoid end-game effects we did not inform the participants how many rounds there were in each PGG but rather told them that the computer would randomly determine the number.

Figure 1. Examples of payoff calculations given to participants

Participants were able to see how many tokens each other participant contributed to their co-op in the previous round. This was presented through a visual summary image at the end of each round (see Figure 2). In addition, all other participants' token balances were visible during the entire game. Participants could also see the amounts contributed in other co-ops.

Note: The avatar with the darker outline around it represented the individual player onscreen.

Figure 2. Visual Summary Image taken from one Experimental group in the Categorized Condition.

Post-Experimental Questionnaire. This was administered after completion of the second PGG. The questions referred to the second co-op that a participant had joined. We did not ask questions about the first co-ops to avoid priming effects in the second PGG.

Experimental manipulation. There were two experimental conditions: Categorized and Non-Categorized. In the Categorized condition, participants were randomly assigned to one of two groups – the Purple or Green group – at the beginning of the experiment. Each group was asked to imagine that they had arrived on the island as a group, on the same ship. The metaphor of common ships was meant to provide an abstract and minimal social category from which participants could deduce who should be in their co-ops. Group homogeneity was made salient by coloring the avatars, representing participants onscreen, purple or green. In minimal group studies such categorizations promote in-group bias (Tajfel et al., 1971). We expected categorization to influence the choice of co-op as well as subsequent cooperative behavior. In line with the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), this is a process in which group identity is deduced from a shared “history” of the group, group homogeneity and/or the presence of a distinct outgroup.

In the Non-Categorized condition, participants imagined that each had individually arrived on a different ship from a unique land. Individual heterogeneity was made salient by using uniquely colored avatars. By not providing a pre-assigned category, we reasoned that any groups that formed could only be “induced” – that is, formed only based on communication in the dyadic exchange stage. We assumed that the Non-Categorized condition offered more scope for an inductive group formation process in which personal value to the group may be acknowledged (here, through individual heterogeneity) and the co-ops are formed through interpersonal interaction. In addition, there is no distinct outgroup from the beginning of the manipulation, unlike in the Categorized condition.

In both conditions, participants were free to choose to form any co-ops they wished.

Dependent measures.

Co-op formation and change. This DV was measured by an individual’s choice of co-op membership, before the first and second PGG respectively. With it we could test 1) whether individuals in the Categorized condition were more likely to form a co-op with their categorical group (Green or Purple) and 2) the degree of change in co-op membership between PGGs (for both conditions).

Cooperation/amount contributed to the Public Good. The behavioral data from both PGGs represented the degree of cooperation with one's co-op. This was operationalized by the number of tokens contributed to the co-op at each round (an integer from 0 to 10).

Social psychological measures. To better understand why participants cooperated or not, we included several variables which are of theoretical interest and which could be linked to the behavioral data. Items were measured on a 7 point Likert scale from 1 = "strongly disagree" to 7 = "strongly agree". The primary constructs we measured were: social identification (e.g., "During the game, I identified with other members of my co-operative"; adapted from Leach et al., 2008; 6 items, $\alpha=0.82$); belongingness (e.g., "During the game I felt connected with one or more members in my co-operative"; Van Beest & Williams, 2006; 4 items, $\alpha=0.86$) and the entitativity of the co-op (e.g., "This co-operative acted as a unit"; Brooke, Postmes, Jetten, & Dyson, 2009; Jans, Postmes, & Van der Zee, 2011; 4 items; $\alpha=0.89$). We also measured perceived trust (e.g., "I trusted that other members of my co-operative would follow through on what they said in their messages"; 2 items, $\alpha=0.75$) and satisfaction with the co-op (e.g., "I wanted to exit my co-operative", reverse scored; 4 items, $\alpha=0.85$). To avoid interrupting the game or priming participants, these were all measured after the second PGG and thus referred to the second co-op only.

In addition, identification with (4 items, $\alpha=0.84$) and perceived entitativity of (4 items, $\alpha=0.90$) the entire group of participants was measured because a game-like experience could bond all participants, regardless of co-op membership. By including these measures we could distinguish 'game feelings' from feelings toward the co-op, which we were interested in. Items for game social identification include, for example: "I identified with all the other participants in the game"; and for game entitativity: "All the participants of this game were in agreement on how to behave". Social identification with, and perceived entitativity of the co-op were only slightly correlated with the game experience ($r = 0.30$ and 0.36 respectively). This weak correlation rules out the possibility that bonding within the game as a whole could account for effects within co-ops. Game identification and entitativity are not used in further analysis.

Finally to tap into inductive identity we measured personal value to the group (e.g., "My co-op could not have functioned without me"; adapted from Koudenburg et al., 2015); however, the scale had low reliability (3 items, $\alpha=0.55$) and was not used in the analysis. We also measured ingroup bias towards the other co-ops in the game but the low reliability (3

items, $\alpha=0.57$) also excluded this measure from further analysis. The descriptive statistics for each measure can be found in Table A1 in Supplementary Information A.

Discussion content. In this paper, we do not analyze the content of the messages as it is beyond the scope of this article and will be the subject of future work. However, we would like to provide some relevant descriptive information. Messages were no longer than 100 characters, although an unlimited number of messages could be sent between contribution rounds. Across the two PGGs, 224 out of 240 participants sent at least one message to their co-op. Across the 224, the mean number of messages sent was 15.3 and 12.3 in the first and second PGG, respectively. The mean number of characters per message was 21 and 24, with a maximum of 48 and 37 messages sent per PGG. There were no differences in the quantity of communication between conditions.

Hypotheses

Hypothesis 1. For the Categorized condition, participants on the same “ship” (representing a social category) have a higher probability of being in the same co-op, compared to random selection. Since no one in the Non-Categorized condition shared a ship, this condition is not a suitable comparison and so we test this hypothesis through simulations for the Categorized condition. Of course, if this hypothesis is supported, this logically implies differences between experimental conditions.

Hypothesis 2. At the end of the cooperation, co-ops in the Categorized and Non-Categorized condition will have similar levels of social identification, entitativity, belongingness etc. This expectation is based on the theory that shared identities and solidarity emerge through cooperative interactions, even in the absence of *a priori* social categorizations (Jans et al., 2012; Postmes, Spears, et al., 2005). Note that this research hypothesis of “no difference” is a statistical null hypothesis.

Hypothesis 3. On average, contributions to the co-op will be higher in the Categorized compared to the Non-Categorized condition. Differences between conditions will be stronger in earlier phases of the game. Cooperation within co-ops in the Non-Categorized condition is expected to emerge over time, in line with Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005) (see Figure 3).

Figure 3. Expected Levels of Cooperation over time

Analysis Approach and Results

Co-op formation and change: Hypothesis 1

Method. Were participants in the Categorized condition more likely to form co-ops with their category (Green or Purple group)? We tested independence between pre-assigned categories and co-ops in this condition to find out.

We calculated the Jaccard similarity coefficient⁴ between the adjacency matrices for belonging to the same category and belonging to the same co-op (Batagelj & Bren, 1995; Jaccard, 1900). A coefficient of 1 indicates complete overlap (i.e., social categories are identical to co-ops), while 0 indicates that every pair in the same social category is in different co-ops. The null hypothesis was tested by a permutation test, comparing the observed Jaccard coefficient with the distribution of Jaccard coefficients between the observed co-ops and randomly chosen, equally sized groups⁵. If the observed Jaccard value is significantly high in this comparison, this is a sign that individuals were more likely to join a co-op with their own category members rather than with other category members.

Stability of the co-ops (in both conditions) over the course of the experiment was also tested. Participants selected co-ops before the first PGG and before the second PGG, therefore co-op membership could change. Stability was likewise measured by Jaccard's similarity index

⁴ This coefficient is defined as the proportion of the pairs that are linked in both categories and co-ops, among the pairs that are linked in at least one of these.

⁵ Note that the Green and Purple groups also were of equal size

and a permutation test, described above. Higher Jaccard indices for co-op change over time indicate that co-op members tended to stick together, while indices of 0 mean that co-ops changed completely.

Results. First, we tested whether in the Categorized condition, participants in the same pre-assigned categorical group are more likely to be in the same co-op. The results from the permutation test showed that participants were more likely to form co-ops with their categorical group members compared to random choice, in both Co-op Formation phases ($p < 0.001$ for both, see Table 1). Therefore Hypothesis 1 is supported.

Table 1

Co-op Selection: Categorized condition

Co-op Formation Phase	Random mean Jaccard (with s.e.)	Observed mean Jaccard
First PGG	0.27 (0.04)	0.53
Second PGG	0.28 (0.05)	0.56

As an illustration: if, for example, in the Categorized condition the first co-op is formed by all members of one category and one member of the other category, and the second co-op by the remaining two members of the second category, then $J=4/9=0.44$. Note that the proportions of games in which categories were exactly the same as co-ops were 0.10 and 0.15, for the first and second PGG respectively.

Table 2

Co-op change between PGGs: Both conditions

Condition	Random mean Jaccard (with s.e.)	Observed mean Jaccard
Categorized	0.28 (0.04)	0.56
Non- Categorized	0.25 (0.04)	0.54

Next, we tested the degree of change in co-ops between PGGs for both conditions. As shown in Table 2, the observed mean Jaccard coefficients were around 0.5 for both conditions – meaning that about 50-60% of the pairs stayed together. The results of the permutation tests

for both conditions were significant ($p < 0.001$), indicating significant similarity in co-op membership between the two PGGs.

Social Psychological Effects: Hypothesis 2.

Method. To test for differences between the Categorized and Non-Categorized condition in the measured social psychological variables, we ran a multilevel, multivariate model (Snijders & Bosker, 2012) using runMlwin in R (Version 2.36) (Leckie & Charlton, 2013; Rasbash, Charlton, Browne, Healy, & Cameron, 2009). We examined the effect of experimental condition (Categorized vs. Non-Categorized) on several dependent variables: social identification, belonging, entitativity, trust and satisfaction with the co-op. Correlations are reported in Table A2 of Supplementary Information A.

This model takes into account the dependencies between measured variables (i.e. responses, Level 1), as well as possible similarities among participants (Level 2) in the same co-op (Level 3). Co-ops from the second PGG define the nesting level at Level 3. Adding a fourth level (i.e., experimental group) caused convergence issues and was dropped from the final model.

Results. We had not expected notable differences between conditions and the results largely support this expectation (Hypothesis 2). Comparing the null model to the model with the experimental condition, showed the multivariate test was significant ($\chi^2(5) = 13.9$, $p = 0.02$), therefore the univariate results are considered. However, there were no significant univariate differences at all. There were no significant differences between conditions for social identification ($\beta = -0.250$, $SD = 0.197$, $z = -1.27$, 95% CI $(-0.637, 0.136)$, $p = 0.20$), entitativity ($\beta = -0.133$, $SD = 0.219$, $z = -0.60$, 95% CI $(-0.564, 0.299)$, $p = 0.55$), trust ($\beta = -0.217$, $SD = 0.191$, $z = -1.14$, 95% CI $(-0.592, 0.157)$, $p = 0.25$), satisfaction with the co-op ($\beta = 0.002$, $SD = 0.222$, $z = 0.01$, 95% CI $(-0.432, 0.0437)$, $p = 0.99$) or sense of belonging to the co-op ($\beta = -0.323$, $SD = 0.181$, $z = -1.79$, 95% CI $(-0.7677, 0.031)$, $p = 0.07$). The null findings make the multivariate significance difficult to interpret.

The Effect of Categorization versus Non-Categorization on Cooperation: Hypothesis 3.

Method. Changes in the level of cooperation – as inferred from the amount contributed to the co-op at each round – was analyzed by two different methods. First, we present longitudinal multilevel models, followed by a more detailed analysis using a dynamic

latent class model. The former method is more traditional and easier to grasp, giving important descriptive insights. However, it also revealed that model assumptions of heteroscedasticity were not met; therefore, it cannot conclusively test hypotheses. We do present model-based standard errors here to give readers an indication of the uncertainty in the estimates. The second analysis gives more fine-grained results.

First, we tested a longitudinal, polynomial multilevel model (Snijders & Bosker, 2012) in which rounds/time (Level 1) is nested in participants (Level 2), in co-ops (Level 3), in experimental groups (Level 4). Splines – i.e., functions that allows for the pattern of growth to change direction or speed at specified points – improved model fit (Snijders & Bosker, 2012). Analyses were conducted using the lme4 package (Bates, Mächler, Bolker, & Walker, 2015) in R (R Core Team, 2016). Data from the first and second PGG were modelled separately since co-op membership (and therefore the nesting structure) could change from the first to the second PGG. We base our reported model on model-building criteria and did not use hypothesis testing. The assumption of homoscedasticity of the residual variance is not tenable for this dataset as many people repeated their behavior from round to round. Nevertheless, this model gives good descriptive insights.

Results.

Cooperation in the First PGG. We investigated the difference in cooperation over time between the two conditions. The intra-class correlation showed that 37% of the unexplained variation in cooperation lies at the co-op level; 59% at the round level; only 4% lies at the experimental group level and 0% at the individual level. The best fitting model was a quadratic model with a spline function⁶ and random slopes for round at the co-op level. Details can be found in Table A3 in Supplementary Information A.

Results suggest a negative effect of condition on cooperation ($\beta = -0.77$, $SE = 0.42$) with slightly higher cooperation in the Categorized compared to the Non-Categorized condition. There was also a negative interaction between round and condition ($\beta = -0.10$, $SE = 0.06$). The corresponding curves of model predictions for both conditions over time are shown in Figure 4: Cooperation increases over time in both conditions until round 4, after which cooperation in the Categorized condition continues to increase slightly whereas cooperation in

⁶ The spline has a node at round 4. This means that the function is quadratic for rounds up to 4, as well as quadratic from round 4 onward, and smooth, but the coefficient for the squared term changes value at round 4.

the Non-Categorized condition declines slightly. Higher overall cooperation in the Categorized condition is in line with Hypothesis 3, however the time pattern is not (cf. Figure 3) since cooperation in the Non-Categorized condition declined after round 4. As seen in Figure 5, most of the variation occurred between individual co-ops, much more so than between conditions.

Figure 4. Average cooperation over time

Figure 5. Co-op Cooperation over time

Cooperation in the Second PGG. For the interested reader, and to avoid too much repetition, full results for the second PGG can be found in Supplementary Information A. The overall pattern of results was similar: overall cooperation was slightly higher in the Categorized compared to the Non-Categorized condition, although in both conditions cooperation started higher and dipped slightly toward the end.

In summary, overall cooperation was rather high in both conditions, and the condition did not have a strong effect on cooperation. Descriptively, there were higher levels of cooperation in the Categorized compared to the Non-Categorized condition, in both PGGs. This is in line with Hypothesis 3. However, the variance components and the plots suggest much variability between co-ops in the degree to which cooperation emerged. This variability is further investigated after the interim discussion.

Interim Discussion: The Role of Categorization on Cooperation

The discussion of this paper is in two parts. In this section, co-op formation and the role of categorization on overall cooperation are discussed. In the next section, we elaborate on the results from the second half of our analyses and make concluding remarks.

First, in reference to the co-ops formed in the Categorized condition, we found that participants mostly self-selected their co-ops along category lines. While nothing in the experimental set-up forbade participants from forming any co-op they liked, perhaps with minimal information in a novel setting, they did what they thought was expected by the experimenter. However, the dyadic exchange rounds with communication before the PGG did provide interaction with all other participants (not just categorical group members). In addition, participants could join one of three co-ops, instead of two – designed to reduce the perceived demand that participants should form co-ops along category lines (20% of the time, three co-ops were formed). Although some co-ops formed exactly according to their pre-assigned categories (12.5% of the time), most did not. Therefore, the formation of groups was likely a considered choice on the part of participants, although not purely cued by categorization. Nevertheless, since categorization did significantly impact co-op selection, this implies a logical difference between experimental conditions, although perhaps not very strong.

Following group formation, cooperation in the first PGG was high in both conditions – even higher than the usual 40-60% of cooperation found in most public goods research (Ledyard, 1995). High levels of cooperation were probably due to the framing of the experiment – as building a community of farmers, after arriving on a deserted island –,

repeated interaction, and the ability to communicate (allowing organisation, pledging, sanctioning, etc.).

In the Categorized condition, we see that overall, there are slightly higher levels of cooperation that increase over time. Deductive groups, formed in a top-down manner by emphasizing category similarity (here via shared avatar color and background story), may have an easier time cooperating at higher levels from the beginning of interaction, thus cooperation has a stronger basis for growing over time, with little indication of decline. We initially expected that cooperation in categorized groups, starting at a higher level, would eventually decline as time went on (see Figure 3) but found that categorization seems to prevent decline, in the first PGG at least. This suggests that for sustainable cooperation, having a group categorization could be beneficial.

In the Non-Categorized condition, although cooperation is still relatively high, and increases for a time, the trend toward the end of the interaction in the first PGG is downward. We expected that once non-categorized groups were given time to interact, cooperation would increase steadily rather than decrease. Previous research has shown that inductively formed groups – in which heterogeneity is salient and personal value highlighted – show equally high levels of social identification and solidarity as deductive groups, even though the pathway to identification and solidarity may be different (Jans et al., 2012; Koudenburg et al., 2015; Postmes, Spears, et al., 2005). However, by looking closely at the between-group variation of cooperation at the co-op level, we see that while some co-ops in the Non-Categorized condition did continuously increase in cooperation over time, there was a set of others that did not, and there appears to be more variation between co-ops in this condition compared to the Categorized condition. Thus cooperation appears to depend more strongly on within-group processes in the Non-Categorized than in the Categorized condition. Perhaps inductive groups have a harder time maintaining cooperation compared to groups with a shared social category, but this largely depends on how the inductive group processes unfold.

Finally, in both conditions, there was little change in co-op membership between the first and second PGG – which makes sense considering the high levels of cooperation. Evidently, there is no need to leave a co-op that is collaborating well together. Furthermore, the slight decrease in cooperation in the Non-Categorized condition, toward the end of the first PGG, was not stark enough for participants to change co-ops more compared to the Categorized condition, suggesting that cooperation can still reach high levels in inductive groups. Related to this finding, there were no ultimate differences in one's sense of identification, group belonging and entitativity between experimental conditions at the end of

interaction (i.e., end of the second PGG). This supports the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005) which posits that inductively formed groups can develop the same social psychological outcomes as deductively formed groups, although the pathway may be different.

The multilevel growth model, reported above and discussed here, provides a good description of how cooperation develops in the Categorized and Non-Categorized conditions. But for the purpose of testing hypotheses, it is not reliable because our data violated the assumption of homoscedasticity. Specifically, a sizeable proportion of individuals gave the same contribution round after round (i.e., repetition) while others hit the ceiling of cooperation; and this tended to be a shared behavior in some co-ops. These “zero variance” behaviors are a meaningful feature of the kinds of cooperative behaviors we are seeking to describe; but having a high proportion of them is extremely unlikely under the assumptions of the multilevel model. Therefore, the standard errors of these results cannot be trusted entirely. More importantly, our analysis revealed a considerable amount of between-co-op variability in cooperation *within* conditions that could not be well represented by a standard longitudinal multilevel model. To address these issues, we present the results of a more statistically complex model below. This model allows us to classify similar kinds of decision rules; individuals; and co-ops, regardless of the experimental conditions and comprises a more fine-grained exploratory approach to analyzing these data.

Classifying Cooperative behavior, types of individuals, and types of co-ops

Method

The second analysis of amount contributed to the Public Good over time regards these amounts as resulting from a process of decisions made by participants. Technically, we use multilevel latent class Markov models (Lukočiene, Varriale, & Vermunt, 2010; Paas, Vermunt, & Bijmolt, 2007; Van de Pol & Langeheine, 1990; Vermunt, Tran, & Magidson, 2008) implemented in Latent Gold (Version 5.1) (Vermunt & Magidson, 2016).

In the model specified, decisions about the contributions are represented as regression models, operating round by round, where the amount contributed is the dependent variable and the explanatory variables are the participant's own contribution in the previous round and the mean contribution of the participant's co-op in the previous round. It is assumed that participants' decision rules can be classified in a few types (“latent classes”), and each type embodies one decision rule, defined by the regression coefficients and the residual variance in

the regression model. The type of decision rule followed by any given participant may change over time. Because of the experimental design, the model has three levels of latent classes, as follows.

1. The first level is round, with a regression model for the amount contributed. The explanatory variables are the lagged contributions of self and co-op, and a dummy for the first round, necessary because then there are no lagged contributions. The parameters of this regression model embody the decision rule about cooperative behavior and are selected from K_1 latent classes. These classes are dynamic, meaning that they can change from round to round.
2. The second level is the individual, which is also in a latent class selected from K_2 latent classes of individuals. These are constant over time. The latent class of the individual probabilistically determines the latent classes at the round level.
3. The third level is the co-op, in a latent class selected from K_3 latent classes of co-ops, likewise constant over time. The latent class of the co-op probabilistically determines the latent classes of the individual.

To specify the dynamic classes at Level 1, we need initial probabilities and the transition probability matrix specifying the probabilities p_{hk} that in round $t+1$ the class is k , given that in round t it was h . These initial probabilities and transition matrices depend on the latent class of the individual and are estimated from the data.

The numbers of latent classes K_1 , K_2 , and K_3 at the three levels are determined by a combination of goodness of fit and interpretability. Results of the estimation then include the set of decision rules employed (latent classes of regression models), the estimated class of each individual (determining the decision rules they generally employ), and the estimated class of the co-ops (determining their composition of classes of individuals). For a more technical treatment of the method, the interested reader is referred to Supplementary Information A where we provide more detailed background to the latent class Markov model, provide model specifications, further discuss our predictors and covariates for the model, as well as outline the process of model development.

Results

Separate models were applied to the first PGG and the second PGG data as the nesting factor (i.e., co-op) could be different between games. We selected labels to describe the classes at each level, to aid with interpretation.

Cooperation in the First PGG. The estimated model (see Supplementary Information A, Table A7, for model building details) specified 4 classes of decision rules (Level 1) that participants drew on to decide how much to cooperate in a given round. Furthermore, individual participants could be classified into three classes (Level 2) which overlapped almost perfectly with three classes of co-ops (Level 3).

Level 1: Decision rules for cooperation. We labelled the four decision rules as: Maximum Cooperation (the ceiling of cooperation), Nearly-There (close to Maximum Cooperation), Repetition (repeating one's behavior from the previous round) and Reaction (responding to the contributions of the co-op), named in accordance with the interpretation below. Table 3 presents for each decision rule the overall relative frequency with which it is applied, the mean amount that resulted from its application, and the parameters of its linear regression model. The history of the game was found to be an important predictor in the decision regarding how much to cooperate with one's co-op. Both own lagged amount and the lagged amount of the co-op can significantly distinguish among decision rules (own lag: $\chi^2(3) = 88820.06, p < 0.001$; co-op lag: $\chi^2(3) = 126.11, p < 0.001$). The four decision rules are significantly different from one another for the first round of the game, predicting different levels of cooperation from the outset ($\chi^2(3) = 16.02, p = 0.001$). The four transition probability matrices are also significantly different ($\chi^2(12) = 153.28, p < 0.001$). The transition probabilities themselves are given in Table 4. We now discuss the four decision rules.

The first decision rule, Maximum Cooperation, was the most common, guiding participant decisions on how much to cooperate 56% of the time. If someone applied this decision rule they would contribute the full endowment of 10 tokens to the PG. Due to this ceiling effect, the amount to contribute when using this decision rule could not be predicted by the history of the game ($b = 0$, for both own lag and co-op lag, Table 3) and the residual variation is almost nil ($\sigma^2 = 0.001$), meaning that the rule – when used – was almost deterministic. In terms of stability, Maximum Cooperation was likely to remain the participant's decision rule in the following round, with an 86% probability (see Table 4).

Table 3

Decision Rules: Regression Results for First PGG

	Maximum Cooperation	Nearly- There	Repetition	Reaction
Overall relative frequency	56%	8%	11%	26%
Mean Amount	10	8.23	6.89	4.95
Intercept	10	6.740	0	3.093
First Round	0	0.224	0	-0.791
Lagged amount (own)	0	0.017	1	-0.364
Lagged amount (co-op)	0	0.185	0	0.631
Residual variance	0.001	0.239	0.007	4.914

Note: The numbers reported in rows 3-6 are regression coefficients

First Round is the dummy for time was a binary variable 1 at the first round and 0 for all other rounds. The results of the dummy are not discussed here.

The second most common decision rule, occurring 26% of the time, was Reaction ($M_{\text{amount}} = 4.95$). To give some insight into the coefficients, the regression model can be roughly approximated, for rounds 2 and further, by $(1/3)*7 + (1/3)*\text{self-lagged} + (1/3)*(2*(\text{co-op-lagged} - \text{self-lagged}))$. Interpreting this, the value of 7 and the own previous contribution may be regarded as providing reference values, and the third contribution is a reward for the co-op or a punishment – as the case may be – for the deviation between the contributions of co-op and self. If, in the previous round, the co-op average was higher than own contribution, it is a reward – the new amount contributed is higher than the reference value. If the co-op average was lower, then punishment follows – the new amount contributed is less than the reference value. In this decision rule the residual variation was highest ($\sigma^2 = 4.91$, Table 3). Reaction was more likely to remain the decision rule in the following round (58%) rather than transitioning to other decision rules, although it was less stable than Maximum Cooperation (see Table 4).

Table 4

Transition Probability Matrices of the Decision Rules

		Decision Rule			
		Maximum Cooperation	Nearly-There	Repetition	Reaction
Previous Decision Rule	Maximum	0.86	0.05	0.00	0.09
	Cooperation	0.59	0.07	0.22	0.12
	Nearly there	0.19	0.18	0.28	0.35
	Repetition	0.19	0.08	0.15	0.58
	Reaction				

Note: The numbers presented in the table are the probabilities of each decision rule transitioning into each of the other decision rules in the following round. Row sums are 1.000, because these are the total probabilities of the previous decision rule transitioning into anything.

Although not part of the definition of this decision rule, it is interesting to see descriptively in which situations it was applied. The frequency of applying Reaction was a decreasing function of the previous average contribution by the co-op, decreasing from about 64% for low contributions (0-5 tokens) to 3% for very high contributions (10 tokens). Participants were more likely to be reactive to contributions by fellow co-op members, and base their behavior on a comparison between own and others' contributions, in stages where the contributions by others were relatively low.

Repetition ($M_{\text{amount}}=6.89$) occurred 11% of the time. This decision rule consisted of repeating what one did in the previous round⁷ (own lagged amount: $b = 1.00$, Table 3). Residual variance in this rule was low ($\sigma^2 = 0.007$). From the transition probabilities in Table 4, it appears that Repetition was the most unstable decision rule, with no clear pattern for transitioning to one of the other rules.

⁷ Notably, Repetition is higher in the first round of Figure 6, and in this case it means a contribution of 5.

The least frequent decision rule was Nearly-There ($M_{\text{amount}} = 8.23$), occurring 8% of the time. The contribution was quite high on average, with some variation explained mostly by the average co-op contribution in the previous round ($b = 0.185$, Table 3) and very slightly by one's own previous contribution ($b = 0.017$). Residual variance was still rather low ($\sigma^2 = 0.24$). The label was chosen in view of the high probability of an individual switching to Maximum Cooperation in the next round (60% of the time, Table 4).

Figure 6 visualizes the tendency for Maximum Cooperation to increase over time, while Reaction decreases.

Figure 6. Proportion of individuals using each decision rule at each round: First PGG

Level 2: Individual classes. Based on the four decision rules of behavior, the model distinguished among three classes of participants, which we labelled: Committed Cooperators ($M_{\text{amount}}=9.19$, 47% of participants), Responsive Players ($M_{\text{amount}}=8.05$, 36%) and Reactive Players ($M_{\text{amount}}=5.99$; 17%). It will become clear below that we interpret these classes as mainly emerging from group processes: we can rule out that a priori individual differences are involved.

The strongest difference among the three classes are in the probability matrices of transitioning from one to another decision rule ($\chi^2(24) = 184.89, p < 0.001$). There were less strong differences guiding the decision rule at the start of the game ($\chi^2(6) = 13.51, p = 0.04$). The probability matrices for initial decision rules and transition probabilities per individual class are found in Table 5 and the findings of interest will be discussed further.

Throughout the game, Committed Cooperators were much more likely to choose Maximum Cooperation over other decision rules, with a 79% probability. However, in the first round of the game (Table 5), they had a relatively low chance of using it (25%). This suggests that Committed Cooperators did not necessarily start off by contributing the highest amount, rather their cooperation developed over time. Furthermore, once they chose Maximum Cooperation, these players had a 97% chance of continuing with it in the subsequent round.

Responsive Players drew on all decision rules but were most likely to be guided by Maximum Cooperation (49%) and Reaction (27%) during the game. In the first round, they had a 16% and 26% chance of choosing Maximum Cooperation and Reaction respectively (see Table 5). In comparison to Committed Cooperators, Responsive Players had a lower probability of sticking to Maximum Cooperation once they begun to use it (69% compared to 97%).

Finally, Reactive Players were most likely to choose Reaction (66%) and Repetition (21%) throughout the game, and they were the least likely class to select Maximum Cooperation (6%). In addition, they tended to begin the game with the lowest amount of cooperation – with a 63% chance of choosing Reaction⁸ and zero probability of choosing Maximum Cooperation. In the unlikely case that Reactive Players chose Maximum Cooperation in one round, they only had a 6% chance of continuing to use it in the following round.

Level 3: Co-op classes. A total of 86 co-ops formed in the first PGG, across the experimental groups. The model categorized these co-ops into three classes. Strikingly, the three co-op classes strongly overlap with the three individual classes (99.3 -99.6%). This means that the probabilities of the decision rules for cooperative behavior were: 1) consistent among all individuals *within* co-ops and 2) different *between* co-ops. This high correspondence of co-op and individual classes is best explained by the formation of within-co-op social norms, which we will come back to in the discussion.

The three co-op classes were labelled: Committed Co-ops ($M_{\text{amount}}=9.19$), Responsive Co-ops ($M_{\text{amount}}=8.04$) and Reactive Co-ops ($M_{\text{amount}}=6.01$); see Figure 7 for their trajectories of Amounts contributed over time.

⁸ Of course, in the first round, participants are not reacting to anything. However Reaction is labelled as such according to its general pattern.

In a final model, the experimental condition (Categorized versus Non-Categorized) was included as a covariate at the co-op level to determine whether it affected the type of co-op formed in the PGG. However, the overall main effect of condition was only marginally significant ($\chi^2(2) = 4.88, p = 0.09$). For interest, exploration of the paired comparisons suggests that categorization can perhaps, to a small extent, predict the difference between the presence of Committed and Reactive Co-ops between conditions ($\chi^2(1) = 4.22, p = 0.04$). There were more Committed Co-ops in the Categorized condition (55% versus 32%) and more Reactive Co-ops in the Non-Categorized condition (24% versus 10%).

Figure 7. The average amount contributed to the co-op over time: First PGG

Table 5

Transition probabilities for Individual Classes in First PGG

		Starting Decision rule			
Individual Class		Maximum Cooperation	Nearly-There	Repetition	Reaction
Committed		0.26	0.13	0.29	0.32
Responsive		0.16	0.19	0.38	0.26
Reactive		0.00	0.07	0.29	0.64

		Present Decision rule			
Individual Class	Previous Decision rule	Maximum Cooperation	Nearly-There	Repetition	Reaction
Committed	Maximum Cooperation	0.97	0.03	0.00	0.00
	Nearly-There	0.68	0.04	0.25	0.03
	Repetition	0.31	0.21	0.06	0.42
	Reaction	0.21	0.26	0.07	0.46
Responsive	Maximum Cooperation	0.69	0.09	0.00	0.21
	Nearly-There	0.62	0.01	0.21	0.15
	Repetition	0.26	0.19	0.33	0.22
	Reaction	0.29	0.09	0.16	0.46
Reactive	Maximum Cooperation	0.06	0.00	0.00	0.94
	Nearly-There	0.14	0.39	0.18	0.29
	Repetition	0.02	0.14	0.36	0.48
	Reaction	0.09	0.00	0.18	0.73

Cooperation in the Second PGG. The results from the second PGG were very similar to the first. We found the same four decision rules, three individual classes and three co-op classes, as well as the same overlap between individual and co-op classes. To avoid repetition, full results are in Supplementary Information A. To summarize these findings: The same classifications were found in the second PGG, but the overall level of cooperation was higher. Specifically: 1) the mean amounts contributed, predicted by the decision rules, were higher; 2) there was a higher proportion of individuals using Maximum Cooperation in each individual class; 3) more individuals could now be classified as Committed Cooperators and 4) more co-ops could be classified as Committed Co-ops. Therefore, these findings suggest that cooperation is learned and transferred from the first PGG into the second. Cooperative behavior seems to spill over from one stage of the experiment to the next and interestingly, the type of cooperator one is classified as at one time, can change – since there was a higher proportion of Committed Cooperators (13% more) in the second PGG, even though the participants were the same.

Discussion: Cooperative norms develop within groups

In this paper, we aimed to study the emergence of cooperative norms over time, following group formation. Furthermore, we aimed to compare the processes of group formation and cooperation in categorized and non-categorized groups. In the first discussion section, we elaborated on the findings from the more traditional approach to data analysis. In the present section we focus on findings from the dynamic latent class model, with some additional discussion on the experimental method and overall study limitations.

While our first analysis provided a good description about how cooperation generally emerges over time for categorized and non-categorized groups; our second approach, using dynamic latent class models, allowed us to study the emergence of particular classes of individuals and co-ops, and the types of decision rules that they apply. This second method lends itself for modelling inductive processes: we did not explicitly predict or test for particular classes of co-ops or individuals but were able to explore the emergence of these within the context of this game.

We found that co-op members, in a given round, were likely to employ one of four decision rules – Maximum Cooperation, Nearly-There, Repetition and Reaction – which determined the amount contributed to the Public Good. The emergence of some of the decision rules used by participants in this study is in line with previous research. For example, Repetition, in which players simply repeat what they did the previous round, predicted an

average contribution within the range of the 40 – 60% contribution often found in one-shot PGGs (Ledyard, 1995). This decision rule seems to be a “safe” and common strategy and is thus repeated.

In addition, the decision rule of Reaction closely mimics what one finds with conditional cooperation – i.e., one cooperates when the group does and defects when the group does (Axelrod, 1984; Fischbacher, Gächter, & Fehr, 2001). All four decision rules were consistent across both PGGs. The decision rule itself used (a) the particular amount one personally contributed to the PG in the previous round and (b) the average level of cooperation shown by one’s co-op members. The probability of choosing a given decision rule depended on (c) the decision rule one had previously chosen, and (d) the type of individual one could be classified as – Committed Cooperator, Responsive Cooperator or Reactive Player.

These decision rules and the classes of individuals that emerged through interaction in the PGG, help to explain the findings from the first set of analyses – cooperation emerges over time through interaction with others. As an illustration, Committed Cooperators mostly did not start off by hitting the ceiling for cooperation. Their commitment level and high contributions developed over time as they established Committed Co-ops together. These findings indicate that further progress in understanding how to support cooperation can be made by studying the reasons why maximum cooperation emerges, as well as the contexts (i.e., the particular types of groups) in which it flourishes.

One possible key to maximizing cooperation is how a group establishes its shared identity and normative patterns of behavior. We found almost perfect overlap between the individual and co-op classes, meaning that co-ops consisted of people of the same individual class. We interpret this to mean that cooperation depends highly on one’s group and that learning occurs within the group. We believe that we can rule out the alternative explanation for this finding because it is too improbable that across all 86 co-ops, people with the same preferences for cooperation happened to find one another after very limited interaction. Therefore, our finding suggests the formation of group norms, which, in turn, influences the kind of cooperator one ‘becomes’. As additional support for this interpretation, there was also a change in the overall relative frequency of individual classes from the first to the second PGG (although the participants remained the same), meaning that some participants changed the type of person they were classified as. For example, more people were classified as Committed Cooperators in the second PGG. Therefore it would seem that people can learn to become more cooperative when exposed to cooperative groups and also, that cooperative groups emerge in the process of interaction.

This finding is quite different to traditional research findings in the interdependence literature, in which people are usually assumed to have fixed personal preferences for cooperation or selfishness (e.g., Messick & McClintock, 1968; Van Lange, 1999). In this study, we find strong evidence that the type of cooperation that is prevalent in the group as a whole determines the type of cooperator one becomes (see also Peysakhovich & Rand, 2016).

Studying Emergent Social Phenomena

This study shows that individual classes, group norms, and stable co-ops (perhaps with a shared social identification) form in tandem, through interaction. We found that within a short period of interaction, group members aligned their decision making behavior regarding cooperation and, even under the same experimental conditions of the PGG, different types of groups emerged. The key question of this study about the emergence of cooperation could not be answered without our methodological approach: To study the emergent nature of any social behavior (including, but not exclusively, cooperation) it is important to account for complex social interdependencies, beyond dyads. In this study, we used the experimental platform VIAPPL through which we could monitor interaction over time to follow the emergence of cooperation and address issues of causality. While this approach may limit external validity, it has the strong advantage of allowing us to study complex emergent phenomena in a carefully controlled environment.

A potential challenge for research such as this, is the interdependent nature of the data – which needs to be accounted for in the statistical analysis. With multilevel latent class Markov models, we were able to learn from these interdependencies – distilling patterns of behaviors, classes of individuals and classes of co-ops. Without this approach, we would not have seen that individual preferences appear emergent through interaction with the group and are collectively established in a short period of interaction. We imagine many cases in which this type of group analysis could be used to study emergent phenomena and will be useful to those interested in group processes research.

Implications

In this paper, we were able to clearly distinguish three types of cooperators: Committed, Responsive and Reactive. These “cooperators” emerged together in interaction and collectively established social norms regarding decision making on cooperation. Recent research has also uncovered the existence of Consistent Contributors (Weber & Murnighan, 2008) and Resilient Cooperators (Mao, Dworkin, Suri, & Watts, 2017), albeit in lower

numbers than this study, and only making up a minority of their group. Nevertheless, even a single Consistent Contributor can change the social norms of cooperation, leading to higher contributions by group members (Weber & Murnighan, 2008); and a small minority of Resilient Cooperators are able to stabilize unravelling (i.e., prevent progressively earlier defection), thus sustaining high levels of cooperation for longer, at personal cost (Mao et al., 2017).

Similarly, we imagine that Maximum Cooperators, could influence Responsive Players especially, but Reactive Players too. Future research could determine the optimal ratio of these types of cooperators to players who defect regularly, for maximal cooperation to emerge. Perhaps introducing clusters of these cooperators can be effective (see Axelrod, 1984). A challenge here may be that the cooperators in this study emerged together in a short period of interaction but we do not know how, as individuals, they might influence a pre-existing non-cooperative group over time.

Under what conditions do these cooperators emerge? Maximum Cooperators were slightly more common when social categories were salient, suggesting that if social identification is activated early on – rather than later, through induction – more of these cooperator types can emerge.

Further, cooperation-friendly environments (e.g., experiments with a higher marginal per capita return) seem to result in the emergence of Consistent Contributors (Weber & Murnighan, 2008). Likewise, the cooperation-friendly framing of this experiment (as a community game) possibly activated a normative goal frame (Lindenberg, 2015a, 2015b) thus supporting the emergence of many Maximum Cooperators. On the other hand, Reactive Players, or “rational actors”, may emerge in greater numbers than we found when competitiveness is more salient.

Future research could further explore conditions under which different types of cooperators may emerge; what motivates these types of players under what conditions; and how many of them are required to influence others in the group, thus shaping norms of cooperative or uncooperative behavior.

Limitations

According to the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), social identification with a group is often an interplay between deductive and inductive processes. In many natural groups, these processes are quite difficult to completely tease apart. In our study, as with natural groups, it was also difficult to

completely separate these processes in a way that still maintained experimental equivalence between conditions. While our pre-assigned categorized groups were signaled through group homogeneity (visually, through color) and a history of the group was presented to participants (with the story of having arrived from the same country together, an attempt to mimic nationality as a categorical identity), there was no actual history and the groups were minimal and small. Furthermore, categorized individuals could interact with their entire group and choose their own co-ops, which were not always perfectly aligned with their pre-assigned categorical groups.

On the other hand, participants in co-ops in the Non-Categorized condition – co-ops which were indeed small, interactive and heterogeneous – were still faced with the task of choosing their co-ops early on in the game, limiting the organic emergence of these groups. In addition, the other one or two co-ops could be seen on screen by participants during the game. These other groups could have served as comparison outgroups. Therefore, one may argue that non-categorized, inductive groups here function as social categories as soon as participants select their co-ops. Perhaps this could explain why there was not a large difference between conditions in terms of cooperation. However, some differences did still emerge (although often marginally significant). For example, the pattern of decline in cooperation in the first PGG for non-categorized groups, and the fact that more Reactive co-ops were likely to form in the Non-Categorized condition and more Committed Co-ops in the Categorized condition. So, the manipulation appears to have been effective in tapping into different processes. Nevertheless, the small differences between conditions were less impressive than the variability between co-ops within conditions. This variability to us seems more important in understanding cooperation within groups. In other words, any prior categorization effect was overshadowed by the emergent social norms within groups. Therefore, the dynamic process of emergent social norms appears more influential than the static framing of the group, at least in this experiment.

Another potential limitation is that we did not incentivize participants according to the outcome of the experiment. While this is common practice in psychological experiments, it is not the standard economic approach. This may lead to the question whether participants were sufficiently motivated to engage in a meaningful way in the experiment: We believe that indeed they were motivated. Descriptions of the number of messages sent suggest that participants were engaged with one another – allowing for communication over time likely made the relational value of interaction more important than self-interest (i.e., maximizing tokens). Furthermore, not all co-ops reached the highest levels of cooperation therefore, not

incentivizing clearly did not have a uniform (positive) effect on the groups. However, it would be interesting for future research to study how incentives might change the number of Committed Co-ops that form under different goal frames.

From this study, we know that interaction over time is important in the development of cooperative people and groups; however we have not yet examined what it is about the quality of the interaction itself that promotes the emergence of maximally cooperative groups rather than reactive groups. Categorization appears to be only a part of the story in fostering cooperative groups. Our results seem to suggest that people can change and adapt depending on the social context of interaction, and become more cooperative together if they can develop the right learning environment as a group. Some groups, however, are more successful than others at forming cooperative norms.

Conclusion

The results from this study show that collaboration is not a static given, but rather cooperation within groups is emergent over time through social interaction. There are large differences among groups to the extent in which they can achieve maximum cooperation, and while some of this appears to be accounted for by shared category membership, most of it emerges through interaction. In that process of emergence, individual types and co-op types arise in tandem, shaping (and being shaped by) emergent group norms. The emergent properties of the “personality” of the individual cannot be seen independently of the emergent properties of group as a whole (in fact there is almost perfect overlap between the two). At the end of the day, this means that at least some of the static factors discussed at the start of this paper are shaped collectively, through social interactions.

Chapter 3: Social Categories and Interpersonal Ties - Pathways to Cooperation

Abstract

Research in the social identity literature has shown that belonging to a shared social category can increase one's cooperation with members of that category. Our previous research has shown that emergent group norms for cooperative behavior – in terms of which decision rules to use when cooperating in a repeated Public Goods Game – are very important in determining whether high levels of cooperation are reached: both in groups with a prior social category label and in groups without them, cooperation emerges over time through interaction. The present paper is a conceptual replication of our previous study, but uses a stronger manipulation, comparing groups with a primed social category to primed interpersonal ties. Results replicate those found before: 1) high levels of cooperation can emerge in both bottom-up (social categories) and top-down groups (interpersonal ties); 2) group norms for cooperative behavior are created in which individuals align their behavior within their group; and 3) this norm emergence occurs regardless of the social identity pathway primed. Novel findings include that: 4) primed social categories appear to prompt initially higher levels of cooperation, but 5) bottom-up groups reach these same levels over time and finally, 6) in groups in which the average level of cooperation is high, group members are more highly identified at the end of the interaction. Thus, in addition to replicating earlier findings, this study suggests that emergent social identification and cooperation may be mutually reinforcing processes.

In this paper, we look at the emergence of cooperation over time in a Public Goods Game (Olson, 1965) in which participants interact with one another over time in small groups on the experimental platform, VIAPPL (see viappl.org). While we know that ingroup identification plays an important role in the emergence and maintenance of cooperation within groups (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Simpson, 2006), we know less about how social identity emerges, hand in hand with group norms that sustain cooperation among ingroup members. In this study, we compare the emergence of cooperation within social categories as well as in groups emphasizing interpersonal ties, where we expect the processes to be somewhat different in each configuration of the group. Nevertheless, based on past research (see Chapter 2 of this thesis), we expect that the variability of cooperation within conditions will be greater than between conditions: our key prediction is that different types of groups form in the process of interaction with different patterns of cooperation, and that these groups account for cooperation more so than the somewhat static experimental manipulation.

This paper will be structured in the following way: First, we will look at cooperation as a social dilemma and introduce the paradigm that this study will employ (i.e., dynamic Public Goods Games), as well as the factors that affect cooperation (relevant to this study). We will also provide the theoretical framework guiding our experimental cues for social identification by exploring the similarities and differences between conceptualizations of the group as social categories and interpersonal ties. Furthermore, following our prior research, we shall explain that processes of norm formation take place when cooperation emerges in groups over the course of a game. Finally, we will lay out our aim for this study.

Cooperation as a Public Goods Game

Cooperation is fundamental to group life – it runs through all social interactions whether it be in terms of friendships and family relations (imbuing both symbolic and instrumental value); teamwork within organizations; or markets and economic trade on a national level. Understanding the factors that facilitate and maintain cooperation over time is therefore an important research area in many fields, including sociology, behavioral economics and social psychology. One of the ways in which cooperation can and has been studied, is through social dilemma games where there is a personal cost to cooperating – this cost reflects the cost of real life cooperation. Public Goods Games (PGGs) (Olson, 1965) are an example of one such social dilemma game.

A Public Good (PG) is defined as a resource or service which is formed through individual contributions and shared among individuals, regardless of how much they have personally contributed (for example see Samuelson, 1954). Public television and radio; material infrastructure (such as parks, bridges etc.); intellectual property developed in small groups; and collective action are all examples of public goods (Katz et al., 2004; Shankar & Pavitt, 2002). In a Public Goods Game, participants choose how much to invest in the PG. After investments are made, the total sum of the contributions is multiplied by a pre-defined number greater than 1 (usually doubled) and everyone in the game receives an equal share of the profit, regardless of their personal contribution. Therefore, while maximum cooperation is the socially optimal outcome, defection can maximize the instrumental self-interest of the individual (in the short term and as long as others continue to cooperate). In iterative PGG's, participants interact with one another over time, investing in the PG over multiple rounds – this allows one to study the process of the emergence of cooperation. Since there is continued interaction over time, “the shadow of the future” (Fearon, 1998) is in operation – enabling factors such as sanctioning, reciprocity and normative action to come into play –thus often leading to an increase in cooperation, compared to one-shot games (Dal Bó, 2005). In addition to expectations of the future, experiences of the past (i.e., learning) can also occur in iterative games. Indeed, some argue that trust – an important component in facilitating cooperation – is a consequence of the interdependency between “the shadow of the future” (i.e., positive expectations generate trust) and “the shadow of the past” (i.e., past experience mediates trust building indirectly) (for example, see Poppo, Zhou, & Ryu, 2008).

Social Norms in Public Goods Games

The role of social norms in cooperation has long been acknowledged as a pivotal characteristic of the social contexts in which cooperation occurs, both within and between groups. For example, framing a social dilemma in cooperative or competitive terms, thereby pre-constructing norms in social dilemmas, has been shown to affect the level of cooperation (see for example Liberman et al., 2004; Lindenberg, 2015a; Van Lange et al., 2013), as does the payoff structure of the public goods game (PGG) – whereby payment based on the outcome of the experiment appears to provide a competitive frame to the dilemma, thus reducing cooperation (Jordan et al., 2014; Weber, Kopelman, & Messick, 2004).

In addition to social frames, a generic norm of direct and indirect reciprocity may also play a role in fostering cooperation (Molm et al., 2007). The likelihood of reciprocity

occurring increases in groups that are more homogenous; are small enough for detecting and sanctioning defection; and have stable group membership (Diekmann & Lindenberg, 2015). There is some evidence that reciprocity may be an even stronger predictor of cooperation than merely conforming to experimentally manipulated group norms of cooperation or defection (for example see Romano & Balliet, 2017). Further research shows that norms fostered in social environments outside the lab become social heuristics that spillover into novel lab environments (Peysakhovich & Rand, 2016) and since reciprocity is considered to be a generic norm in itself (Gouldner, 1960), perhaps certain norms – such as the norm of reciprocity – are stronger than norms which are experimentally manipulated inside of the lab.

In many experimental studies, the effect of social norms on cooperation has been explored in a somewhat static way (for example, by providing normative or competitive frames to participants). However, we also know that in natural settings, social norms can only emerge over time and come to affect cooperation in a more dynamic way, presumably through social interaction. There has been previous research which suggests that the dynamic emergence of social norms is indeed an important aspect to cooperation. For example, the studies by Peysakhovich and Rand (2016) manipulated social norms of cooperation by exposing participants to externally imposed interaction rules designed to either foster norms of cooperation or defection, during experience in a repeated game (Stage A). They then measured the effect of this manipulated norm through one-shot cooperation games (Stage B). Importantly, the authors found evidence for the spillover of social norms from Stage A to Stage B. An extension of this work would be to look at the emergence of these norms (without direct manipulation) through interaction in small groups. Indeed, in a review of conditional cooperation as a social norm operating within cooperation games, Fehr and Fischbacher (2004) argue that although it is clear that the socio-economic environment shapes the benefits and costs of cooperation (and punishment for non-cooperation), not much is known about the process of norm formation within particular environments, either empirically and theoretically.

In Chapter 2 of this thesis, we found that there appears to be strong social norm formation which occurs within small interactive groups in a dynamic and interactive public goods game (PGG). In the experiment participants could self-form groups before the beginning of the PGG (after being provided with a categorization cue or not), and during multiple rounds of contributing to the Public Good, they were able to communicate with one another and receive full feedback regarding one another's contributions. We found that three

distinct kinds of groups emerged which utilized different sets of decision rules for cooperation. These decision rules affected their level of cooperation. Also, group members strongly conformed within groups. The groups were labelled: Committed Co-ops (i.e., groups that gave maximally over time), Responsive Co-ops (i.e., groups whose decision rules were dependent on group average contributions in the previous round) and Reactive groups (i.e., groups in which individuals responded to low average contributions by giving even less the next round). Importantly, group norm emergence was largely independent of pre-experimentally manipulated social identity cues of social categorization versus non-categorization.

These results showed that cooperation is not a static given (i.e., a deterministic function of categorization), instead it emerges over time through social interaction and, while some groups can reach maximum cooperation better than others, this can only be partially explained by shared category membership. However, this represents a single study of its kind and therefore more research in this area is needed to further understand how emergent norms (rather than manipulated and somewhat “static” norms alone) can have an impact on the level of cooperation that a particular group shows.

In the present study, we aim to extend our previous research to further test the way in which social norms emerge together with the formation of a shared social identity. Indeed, research has shown that the emergence of social identity content (including group norms), often goes hand in hand with the emergence of a shared sense of social identity (as it applies to politicization, see Turner-Zwinkels, van Zomeren, & Postmes, 2015). Therefore, in the present study we aim to conceptually replicate the results of our first study by strengthening the social categorization cue and comparing this ‘social categories’ condition to a condition in which interpersonal ties are primed, rather than not providing any cue to group membership at all (which was the case in the previous Chapter).

In the next section, we discuss the nature of group membership further by comparing social categories to interpersonal networks.

Cooperation in Social Categories

Why do people show normative behaviour? One reason is that when people identify as members of their group, the group goal becomes their personal goal and they are more likely to act in normative ways, signaling that they are prototypical members of their group; and will place the group’s interests above their self-interest (Tajfel et al., 1971; Turner, 1991; Turner

et al., 1987). While simply being a member of a group (or social category) does not necessarily imply that one will have strong psychological connection to the group; social categorization is considered a pre-condition to social identification and is usually associated with strong ingroup cooperation, even in meaningless, experimentally manipulated groups (Tajfel et al., 1971; Turner, 1991). Social identification, therefore, is the degree to which one incorporates the identity of one's group membership into one's personal identity, which comes to influence behavior in particular ways.

Indeed, direct experimental evidence shows that the extent to which one identifies with one's social category increases cooperation within groups in many Public Goods studies (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Simpson, 2006; Wit & Kerr, 2002); this is likely because it maximizes ingroup outcomes and reduces ingroup inequalities (Simpson, 2006) and because it predisposes group members towards expectations of reciprocity (Tanis & Postmes, 2005). Traditionally, this theoretical approach to the impact of social identification on cooperation could imply that social categorization is a somewhat static factor that will normally predict a stable level of cooperation within the category/group. However, there is some initial evidence to suggest that cooperation emerges over time through interaction both in groups that are formed from a social category and those that are not (Chapter 2 of this thesis), although the pathways to cooperation are somewhat different. To explain such emergence, further research should study the additional factors that result in the emergence of cooperation over the course of social interaction – this is one of the goals of the present research.

Differences between Social Categorization and Interpersonal Networks

As we argued above, from existing research we expect cooperation to be high in social categories, through processes of social identification. However, in many respects social categories are very different to other conceptualizations of the group – such as small interactive groups and interpersonal networks. Certain characteristics of social categories (such as social identification, belonging etc.) can develop in small groups and in networks too (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), but this is a very different type of process to that of shared category membership.

According to the traditional social identity perspective, groups are often conceptualized as social categories – broad, abstract groups based on homogenous traits (e.g., gender, nationality, race etc.). Postmes et al. (2005) refer to social identification with these categories

as deductive social identities, which form from the top down, based on shared characteristics. According to self-categorization theory (Turner, 1985, 1991), contexts that make one's categorization as a member of a particular group salient, activate associated norms and expectations that come along with being a member of the group. Category salience, in turn, increases social influence among group members and adherence to shared group norms (Turner, 1991). In sum, social identification through categorization results in individuals acting as members of a group by following relevant group norms and placing group goals ahead of self-interested goals that do not favor the group.

More recently, research has focused on the ways in which some of the properties of social categories (such as social identification, perceived entitativity but also shared norms; Postmes, Spears, et al., 2005) can emerge within small groups and social networks too. The formation of inductive social identities (Interactive Model of Social Identity Formation, Postmes et al., 2005) provides one such route through which some of the properties of social categories come into play in interactive groups. In contrast to deductive social identities, inductive identities form from the bottom up, through interaction and communication amongst group members over time (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005).

Similarly, groups have also been formulated as interpersonal networks (Deaux & Martin, 2003; Easterbrook & Vignoles, 2013), in which members of the network have close, personal bonds with some, but not all, other members and these bonds are created through interaction. Interpersonal networks are usually bounded by the possibilities for face-to-face or other direct means of communication, implying that their size will be smaller than that of social categories. The number of bonds of any one network member will be limited by constraints posed by the possibilities for interaction. For example, Dunbar (2008) mentions 5 network members as typical for 'support cliques' and 15 for 'sympathy groups'.

Despite some obvious differences between social categories and inductive groups or social networks, research has found that being a member of either of these types of groups can lead to similarly high levels of social identification, belongingness, and entitativity (Postmes, Spears, et al., 2005), suggesting that some properties of large and abstract social categories can also emerge in networks. However, the pathways through which these similar properties may emerge, are different. As an illustration: Although categories and networks both imbue individuals with a sense of belonging, the belongingness felt in interpersonal networks is mediated by the quality of the interpersonal bonds, in which the nature of the real social

interaction is crucial; whereas belonging in social categories is mediated by perceived intragroup similarity (Easterbrook & Vignoles, 2013).

Moreover, research has also shown that in groups formed on the basis of interaction and iterative cooperation (i.e., inductive groups), the emergence of a sense of shared identity is mediated by individual distinctiveness and by the perceived value of the personal contributions of self and others, to the group (Jans et al., 2012; Koudenburg et al., 2015; Van Mourik Broekman et al., 2018; Van Mourik Broekman, Koudenburg, Gordijn, Krans, & Postmes, 2019). By contrast, until now the assumption has been that the individual plays no central role in the formation of groups based on category membership. So, while the outcomes between categorical groups and smaller networks (such as social identification, belongingness and cooperation) may be similar, the pathways will likely be different. For example, cooperation may initially be higher in deductive groups compared to inductive groups, but over time, cooperation can also emerge in the latter types of groups.

The Interplay between Social Categorization and Interpersonal Networks

Rather than focus on the differences between categories and networks, one can also focus on the ways in which categories and networks are enmeshed, interact and mutually reinforce each other. Ultimately, in nearly every group, processes that stem from shared social categorization (top-down) co-occur with processes that stem from intra-group communication and interaction in smaller groups (bottom up) (Postmes, Spears, et al., 2005). For one thing, categorization affords opportunities and constraints regarding with whom to link in everyday interaction (Deaux & Martin, 2003). In other words, categories influence which networks we choose to belong to. For example, a common feature of social networks is the presence of homophily – whereby people form networks with similar others (Lazarsfeld & Merton, 1954; McPherson, Smith-Lovin, & Cook, 2001).

As an illustration: in the study of the effect of immigration on friendship formation, homophily is found to be common in school-based friendship networks (i.e., interpersonal networks). Here, the choice of friends (or interaction partners) is often based on ethnicity – which is a shared social category (for example, Smith, Van Tubergen, Maas, & McFarland, 2016). More intricately, whether an immigrant can gain access to a friendship network, can depend on how they *identify* at a categorical level, and not just on the presence of an obvious, externally shared feature such as nationality. For example, native peers of immigrants are more likely to include immigrant friends in their networks if they have a strong host-country,

rather than ethnic, identification (see for example Leszczensky, 2013; Leszczensky, Stark, Flache, & Munniksma, 2016) and further, minority students may reject from their friendship network, fellow minorities who do not show strong minority identification (Boda & Néray, 2015). Studies such as these provide support for the idea that social identification based on social categories can influence the types of smaller interpersonal networks (such as friendship networks) that form.

As we can see from social identification research, social categories and smaller, inductively formed networks have been theoretically distinguished from one another. However, in many respects, they share similarities and are usually enmeshed. While there has been much research showing that social categories facilitate cooperation, and deter defection – through goal salience shifts (from individual to group goals) and normative behavior, for example – not much is known if, or how, these processes may occur in interpersonal tie groups⁹. Therefore, this paper takes a closer look the interplay between social categories and interpersonal ties to better understand how cooperation can emerge and be sustained over time.

The present research

In this paper, we seek to compare the emergence of cooperation in social categories and interpersonal tie groups – by zooming in on their similarities and differences – and thus further understand the interplay of these two group processes on cooperation. We expect to replicate results of our previous research, which showed that strong social norms evolve among individuals both in small groups which are formed from social categories, and groups which are not (Chapter 2 of this thesis). As a conceptual replication, the present study also builds on our previous research in that we manipulate the trajectories to social identity formation by maximizing the differences between the experimental conditions. Our previous study compared a categorization to a non-categorization condition, while in the present study, we compare social categories to interpersonal tie groups (described below) in order to study their effect on cooperation.

⁹ While our research was inspired by the distinction between social categories and interpersonal networks, in this study we refer to these interpersonal networks as “interpersonal tie groups” or “interpersonal ties” to avoid confusion with social network analysis. In our study, ties were not dyadic, nor could we analyze network structure.

Method

Participants and Design

In total, the study consisted of 240 participants who participated in groups of six, resulting in a total of 40 groups (180 female, 56 male, 4 undeclared, $M_{age} = 21.5(3)$). We had two experimental conditions (Interpersonal Ties versus Social Categories) – each replicated 20 times. Participants were incentivized either by course credit or a fixed payment according to the length of the experiment (approx. 1 hour). The study was conducted at the University of Groningen in the Netherlands and was approved by the departmental Ethics Committee.

Procedure

Six participants were invited into the lab at one time. They were seated at computers where they played a Public Goods game using the Virtual Interaction Application (VIAPPL, see viappl.org). Before the start of the game, participants read an instruction manual with the back story to, and instructions of, the game. They were told that they were about to start farming on a virtual island and to do so they would join one of two farming groups (or farming co-operatives). Following the group formation phase, they would begin investing in their co-op over 11 rounds of the game.

After logging on to the game, participants joined the farming co-operative that they were instructed to join (after random assignment by the software application) and engaged in a five-minute chat conversation with their co-op on a pre-assigned topic (see experimental manipulation below). Once the conversation time was up, participants played 8 rounds of the game where, at each round, they could choose to invest in their co-op (0 to 10 tokens). The amounts contributed by each member of the co-op were added together, multiplied by 1.2 and thereafter divided equally among all members of the co-op; regardless of how much they themselves invested. Participants' token balances were updated at the beginning of each new round. This calculation was based on a constant increase of two tokens per round, plus the amount they did not contribute (i.e., their remaining personal token balance) and the amount they received from the co-op profit, which was an equal share. Before each round, participants could briefly message each other for a period of 40 seconds and following each round, participants were shown an image of what everyone else had contributed the previous round. In addition, they could also see the investments of the other co-op in the previous round.

Before the last two rounds of the game, to emphasize the end game, there was a mid-experimental questionnaire to complete. After the last two rounds, a post-experimental questionnaire was administered. Participants left the lab once this final questionnaire was completed.

Experimental Manipulation. Each game was assigned to one of the two experimental conditions which were designed to manipulate the type of social identification processes that we are interested in. For each condition, the description of what a farming co-op is, was different (see Supplementary Information B for more details on the instruction manuals). In the Interpersonal Ties condition (see Figure 8), based on a manipulation of inductive identity used in previous research (Jans et al., 2012; Postmes, Spears, et al., 2005 and Chapter 2 of this thesis), participants were each assigned a unique farm animal representing their type of farm on the island. Participants were either placed on the east or west side of the island and were instructed to join a farming co-operative with all of the members from their side of the island. Therefore, there were two co-ops, each consisted of three members, where every individual was afforded a unique identity (symbolized by their farm animal) as well as a common co-op identity, based on the geography of the island.

To further strengthen this manipulation, the topic of conversation for the first phase of the experiment was:

“As you know, people generally rely on their neighbours and friends for social support. Please discuss in your group: What are the five most important benefits that personal relations would provide to a farmer on a newly discovered island?”

In the Social Categories condition (see Figure 9), participants were either assigned to farm cattle or corn and were instructed to join the co-op with all similar farmers (i.e., join the Cattle or Corn Co-op, depending on their assigned avatar). Therefore their unique identity, relative to the Interpersonal Ties condition, was downplayed and their common co-op category identity made more salient. In contrast to the former condition, the topic of conversation for the Social Categories condition was:

“As you know, farmers generally rely on their farming co-operatives to support agriculture. Please discuss in your group: What are the five most important benefits that farming co-operatives would provide to the members of the co-operative as a whole?”

By referring to the co-op as a whole, the aim was to make the salience of the social category stronger, rather than interpersonal relations (for similar manipulations see for example Haslam, Oakes, Reynolds, & Turner, 1999).

Figure 8. Interpersonal Ties Condition in VIAPPL

Figure 9. Social Categories Condition in VIAPPL

In contrast to Chapter 2 of this thesis, participants in this study were *not allowed to self-form* groups after the experimental manipulation. While in real life, self-selection into groups can be an important aspect to inductive group formation, this is much less common in existing social categories. Although not impossible, it rarely happens that people change race, gender etc. – at least not regularly, compared to the change in interpersonal networks such as work groups and friendship circles. By allowing both conditions to self-select their groups in Chapter 2, the differences between the conditions was not necessarily strong enough to see how the trajectories to cooperation may be different. In this study, we alter the manipulation to see if the difference between categories and interpersonal groups are stronger than the previous Chapter suggested.

Dependent variables

Cooperation/Amount Contributed to the Public Good. Cooperation was operationalized as the amount contributed to the co-op per round. The minimum amount per round was 0 tokens, while the maximum amount was 10, and participants could contribute any number in between and including these values.

Social Psychological Measures. We measured social psychological constructs just before the last two rounds of the game and again post-experimentally. All items were measured on a 7 point Likert scale, unless otherwise specified. We were primarily interested in identification with the co-op (e.g., “During the game, I identified with other members of my co-operative”, adapted from Leach et al., 2008; 6 items; $\alpha=0.87$, GLB = 0.90), perceived entitativity (e.g., “This co-operative acted as a unit”; Brooke, Postmes, Jetten, & Dyson, 2009; 4 items, $\alpha=0.88$, GLB = 0.91) and a sense of belonging with the co-op (e.g., “During the game I felt connected with one or more members in my co-operative”; Van Beest & Williams, 2006; 4 items, $\alpha=0.79$, GLB = 0.83).

Furthermore, we measured the degree to which participants see the goal of contributing to the PG as a group/interdependent goal (e.g., “I see myself and the other members of my co-op as a group with common goals”; 6 items, $\alpha=0.88$, GLB = 0.94) or an individual/independent goal (e.g., “I think each member of my co-op has his or her own interests”; 4 items, $\alpha=0.75$, GLB = 0.77). These questions were adapted from a deductive identity manipulation from Swaab, Postmes and Spears (2008). We also evaluated the perceived closeness to one’s own co-op and to the other co-op through an image selection task (see Schubert & Otten, 2002). These items assessed the perceived overlap between 1) self

and own co-op and 2) self and other co-op (for the images used, see Figure B1 and Figure B2 in Supplementary Information B). The closeness items were significantly and negatively correlated ($r(237) = -0.20$, $p = 0.001$) and were used separately in the analyses. All of the above items were measured before the last two rounds of the game.

Post-experimentally, we measured social identification again (6 items, $\alpha = 0.92$, GLB = 0.94), as well as perceived trust in the co-op (e.g., “I trusted that other members of my co-operative would follow through on what they said in their messages”; 3 items, $\alpha = 0.78$, GLB = 0.79) and satisfaction with the co-op (e.g., “I wanted to exit my co-operative”, reverse scored; 4 items, $\alpha = 0.93$, GLB = 0.93). Finally, through two items, created for the purpose of this study, we also measured the expected reward for contributions (“I believed that people in my co-op would reward me for my contributions”) and the expected punishment for lack of contributions (“I believed that people in my co-op would punish me if I didn’t contribute fairly”).

Hypotheses and Expectations

Below we list our hypotheses (i.e., testable propositions) and expectations (i.e., propositions that depend on particular in-game behaviors that might or might not be displayed).

Expectation 1. We expect there to be higher levels of ingroup identification belongingness, perceived entitativity, perceived trustworthiness and satisfaction in co-ops which show higher levels of cooperation.

Hypothesis 2. We do not expect a significant difference in the strength of ingroup identification between the Social Categories and Interpersonal Ties conditions. This expectation also applies to belongingness, perceived entitativity, perceived trustworthiness and satisfaction with the co-op, expected reward and expected punishment between the conditions. This null statistical hypothesis is based on research which shows that shared identities and solidarity can also arise through interaction without the need of explicit social categories (Jans et al., 2012; Postmes, Spears, et al., 2005, and Chapter 2 of this thesis).

Hypothesis 3. The perceived goal behavior of group members will be more interdependent (group-based) in the Social Categories than the Interpersonal Ties condition. Conversely, the perceived goal behavior of group members will be more independent (individualist) in the Interpersonal Ties condition, in which heterogeneity is more salient, compared to the Social Categories condition.

Hypothesis 4. There will be a greater sense of closeness to one's own co-op in the Interpersonal Ties condition, where personal relations and interpersonal ties are made more salient, compared to the Social Categories condition.

Hypothesis 5. Overall, there will be more cooperation in the Social Categories versus the Interpersonal Ties condition.

Expectation 6. In the Social Categories condition, higher and more stable patterns of cooperation will occur in earlier rounds and decrease slightly over time. However, in the Interpersonal Ties condition, a similar level of cooperation will be reached in later rounds and increase over time. Thus we expect similar levels of cooperation to be met in both conditions toward the end of the interaction. We do not have specific predictions for different end-game effects, as this is a more explorative aspect of the design.

Expectation 7. There will be variability in cooperation norms between groups, even within the same condition. We will be able to classify different “types” of farming co-operatives independently of the experimental condition, based on shared cooperative behavior during the iterative PGG (see Chapter 2 of this thesis).

Analysis Approach and Results

The method and results of the analyses are reported in two sections. First, we present the method and results together for the social psychological measures. Second, we report the method and results for cooperation over time, which includes three subsections: 1) the analysis of the differences between experimental conditions (used descriptively, as not all the assumptions of the multilevel longitudinal model are met); 2) the classification of co-ops according to similar decision rules; and 3) the description of homogeneity of cooperative behavior across all co-ops.

Social Psychological Effects

Method. To test differences in the measured constructs between the Interpersonal Ties and Social Categories conditions and amongst co-ops, a multilevel, multivariate model is applied using `runMlwin` in R (Version 2.36) (Leckie & Charlton, 2013; Rasbash et al., 2009). Our nesting structure is: response (Level 1) nested in participant (Level 2), nested in co-op (Level 3), nested in game (Level 4). The explanatory variables tested are: the experimental

condition (Social Categories vs Interpersonal Ties)¹⁰; the average amount contributed by the co-op in the second half of the game – to allow for possible convergence of behavior –; and the individual's mean deviance from the average co-op contribution. The co-op contributions are split up into two variables, the average for the co-op and the individual deviation, because this yields the distinction between individual-level and co-op-level effects on the dependent variables (cf. Snijders & Bosker, 2012). The dependent variables are the social psychological measures: social identification, belonging, entitativity, trust of co-op, satisfaction with co-op, expected reward and expected punishment. Correlations among constructs can be found in Table B1 in Supplementary Information B.

Results. The intra-class correlations (see Table B3 in Supplementary Information B) show that for all the dependent variables, very little of the unexplained variance lies at the experimental group level (3%, averaged across variables), a fair amount lies at the co-op level (31%), and most resides at the individual level (66%).

Iteratively, we established that, of the models tested, the best fitting model was the model with only the average contributions of the co-op as the explanatory variable, excluding the effect of the experimental condition and individual deviations from the co-op's average contributions (see Table B4 in Supplementary Information B for model comparison). A Chi-Square test was conducted on the deviance statistics for the null model and the final model reported here. The result was significant ($\chi^2(11) = 47.6, p < 0.001$), therefore univariate results are interpreted.

The findings show that there were indeed significant effects of the average contributions from the co-op (in the second half of the experiment) on many of the social psychological variables. In particular, in co-ops with higher levels of cooperation, people shared a greater sense of social identification; entitativity; belonging; satisfaction with, and trust of, the co-op; closeness to their own co-op and the perception that co-op members shared interdependent group goals (see Table 6). These findings are in line with Expectation 1.

The non-significant effect of condition on the social psychological variables support Hypothesis 2, that there should be no differences between conditions on measures of: social identification, belongingness, perceived entitativity, perceived trustworthiness and satisfaction with the co-op, expected reward and expected punishment between the conditions. However, our prediction that there would be a difference between conditions on

¹⁰ For the table of the descriptives per condition, see Table B2 in Supplementary Information B.

the perception of interdependent group goals and independent/individualist goals (Hypothesis 3), was not met. Furthermore, we had predicted that there may be greater perceptions of closeness to one's own co-op when interpersonal ties are made salient (Hypothesis 4), which also was not the case since there was no multivariate effect of condition. Finally, how one feels psychologically about the co-op at the end of the PGG can be explained more by group-level than individual-level variables, since the effect of the individual deviance from the co-op's average contribution is non-significant while the group-level average contribution is significant.

Table 6

Multivariate MLM: Fixed part of the model

	Coef.	Std. Err.	Z-score	P-value	95% Conf. Interval	
Intercept_Social Identification	2.36	0.53	4.46	0.000	1.32	3.39
Intercept_Entitativity	1.55	0.68	2.27	0.023	0.21	2.89
Intercept_Belonging	3.26	0.50	6.52	0.000	2.28	4.24
Intercept_Satisfaction with co-op	3.41	0.62	5.46	0.000	2.19	4.64
Intercept_Trust	2.87	0.66	4.34	0.000	1.58	4.17
Intercept_Interdependent goals	2.65	0.49	5.32	0.000	1.68	3.63
Intercept_Independent goals	5.37	0.53	10.14	0.000	4.33	6.41
Intercept_Closeness to own co-op	2.32	0.63	3.67	0.000	1.08	3.55
Intercept_Closeness to other co-op	2.03	0.59	3.43	0.000	0.87	3.19
Intercept_Expected reward	4.67	0.71	6.56	0.000	3.28	6.07
Intercept_Expected punishment	4.75	0.69	6.91	0.000	3.41	6.10
Level of cooperation_Social Identification	0.32	0.06	5.24	0.000	0.19	0.43
Level of cooperation_Entitativity	0.48	0.08	6.14	0.000	0.32	0.63
Level of cooperation_Belonging	0.26	0.06	4.53	0.000	0.15	0.37
Level of cooperation_Satisfaction with co-op	0.26	0.07	3.68	0.000	0.12	0.40
Level of cooperation_Trust	0.30	0.08	4.00	0.000	0.15	0.45
Level of cooperation_Interdependent goals	0.33	0.06	5.90	0.000	0.22	0.45
Level of cooperation_Independent goals	-0.12	0.06	-1.91	0.056	-0.23	0.00
Level of cooperation_Closeness to own co-op	0.33	0.07	4.56	0.000	0.19	0.47
Level of cooperation_Closeness to other co-op	0.02	0.07	0.27	0.787	-0.11	0.15
Level of cooperation_Expected reward	-0.15	0.08	-1.82	0.069	-0.31	0.01
Level of cooperation_Expected punishment	-0.07	0.08	-0.95	0.342	-0.23	0.08

The Effect of Social Categorization and Interpersonal Ties on Cooperation

In Chapter 2 of this thesis, a similar experiment was analyzed. We found that some co-ops had virtually constant contributions over time, whereas others showed strong fluctuations. Such a data pattern violates the assumption of residual homoscedasticity made in multilevel models (MLM) for longitudinal data, and invalidates the standard errors obtained from such models. The same pattern was found in the data analyzed here. Therefore, here we report the MLM analysis for descriptive purposes without emphasizing the associated *p*-values or model fit. We also conduct a longitudinal latent class analysis that more closely represents the choices made by participants of how much to cooperate on a round-by-round basis. The two different types of models will be presented sequentially.

Method. To test the overall effect of the experimental condition on cooperation over time, we first conducted a longitudinal, polynomial multilevel model (Snijders & Bosker, 2012). Analyses are conducted using the lme4 package (Bates et al., 2015) in the R environment (R Core Team, 2016). Our data structure was: round/time (Level 1), nested in participant (Level 2), in co-op (Level 3), in experimental group (Level 4). Model selection was based on Chi-Square tests of model fit where our final model included a spline function – which allows one to model the change in the direction or speed of growth at specified points (for a treatment of splines, see Snijders & Bosker, 2012).

Results. According to the intra-class correlation, 25% of the unexplained variance lies at the co-op level and 75% at the round level (and none at the experimental group or individual level). Through model testing, we found the best model was a quadratic conditional growth model with a spline¹¹, and random slopes for round in co-op. Table B5 in Supplementary Information B provides more details for model selection.

The selected model included an interaction for the quadratic term for round with condition ($\beta = 0.05$, $SE = 0.026$) as well as the interaction of the spline (node at round 6) and condition ($\beta = -0.15$, $SE = 0.049$). For the full table of results (Table B6), see Supplementary Information B. By plotting the predicted values for cooperation over time for each condition (see Figure 10), we can see that there is higher cooperation in the Social Categories condition compared to the Interpersonal Ties condition, especially in the early stages of interaction. While cooperation slightly decreases toward the end of the game in the Social Categories

¹¹ The spline was such that the function was quadratic for the rounds up to round 6, as well as quadratic for round 6 to 11, but the coefficient for the squared term changes after round 6.

condition, it appears to stabilize for the Interpersonal Ties condition, perhaps suggesting different end-game effects for each condition. The overall results of the analysis are in line with Hypothesis 5 and there is also some support for Expectation 6, although we did not have specific predictions for different end-game effects.

Figure 10. Cooperation over time

Note: This is a plot of the fitted values of the co-ops where each colored line represents one of the 80 co-ops.

Figure 11. Cooperation within co-ops over time

We can see from Figure 11, which plots the random slopes for every co-op in the study, that there was a lot of variability in cooperation among the different co-ops in both conditions: some co-ops show the emergence of cooperation over time, others do not show such emergence and others still, show the extinguishing of early high cooperation. We explore the differences between co-ops in the next two subsections: First, we formally classify co-ops using a latent class model and then we provide descriptive patterns for the homogeneity of behavior within all 80 co-ops over time.

Classifying cooperative behavior, types of individuals and types of co-ops

Method. Analyses for the amount contributed to the public good were conducted using a multilevel latent class Markov model (Vermunt, Tran, & Magidson, 2008) implemented in Latent Gold (Version 5.1) (Vermunt & Magidson, 2016).

Our analysis procedure was the same as in Chapter 2 of this thesis which the reader can refer to, to avoid repetition. In brief: amount contributed (i.e., cooperation) is modelled as a linear regression, with, as predictors, the amount contributed by the individual and the average amount contributed by the co-op, both as recorded in the previous round. These regression models represent the decision rules employed by the individuals to determine the amount of cooperation. Reflecting the multilevel structure, there are latent classes for individuals (Level 2) as well as for co-ops (Level 3). The latent class of the individual determines probabilistically the initial choice of the decision rule and also the possible changes in decision rules from round to round. The individual level classes depend probabilistically on the latent class of the co-op. In this model, one's individual class and the co-op class cannot change from round to round, unlike decision rules which are the dynamic component of the model. The experimental condition is modelled as a covariate at the highest level (co-op level) since it is shared by participants within co-ops.

Results. The final model (see Supplementary Information B for model selection details, Table B7) contained four unique decision rules (Level 1), two individual classes (Level 2) and two co-op classes (Level 3). The individual and co-op classes overlapped almost perfectly (99%).

Level 1: Decision rules for cooperation. The four decision rules were labelled: Maximum Cooperation (the ceiling for cooperation), Nearly-There (very close to Maximum Cooperation both in terms of the level of cooperation and the likelihood of transitioning to Maximum Cooperation), Reaction (rewarding or punishing the co-op) and Defection (failure

to cooperate). These labels were selected to fit the defining characteristics of these decision rules which are reported in more detail below.

Regression results for Amount contributed (i.e. cooperation) were not significant for own lagged amount meaning that one's personal history of cooperation did not play a role in any of the four decision rules ($\chi^2(4) = 0.7$, $p = 0.95$). However, the average lagged amount of the co-op was significant ($\chi^2(4) = 36.8$, $p < 0.001$), indicating that the decision rules depended on the average amount contributed in the previous round by all co-op members. The regression results for each decision rule are presented in Table 7 and discussed further below.

Furthermore, the decision rules were significantly different from one another from the very first round of the experiment, predicting different levels of cooperation from the outset of the interaction ($\chi^2(3) = 9.8$, $p < 0.05$). Additionally, the four decision rules were significantly different in terms of their transition probabilities (i.e., a participant's likelihood of switching decision rules in the following round, given their decision rule in the current round) ($\chi^2(12) = 942.7$, $p < 0.001$). Descriptions of the transition probability results follow below (see Table 8).

Table 7.

Four Decision rules: Description and Regression Results

	Maximum Cooperation	Nearly- There	Reaction	Defection
Overall relative frequency	60%	6%	24%	9%
Mean Amount	10	8	7	2
Intercept	10.000	9.000	4.347	1.551
Time Dummy ¹	0.000	-4.000	1.204	1.095
Lagged amount (own)	0.000	0.000	-0.023	-0.033
Lagged amount (co-op)	0.000	0.000	0.326	-0.004
Residual variance	0.001	0.011	1.969	1.404

Note: Except for the first two rows, the numbers in the table are regression coefficients

Table 8.

Transition Probabilities of the Decision rules

Decision rule

Previous Decision rule	Decision rule			
	Maximum Cooperation	Nearly-There	Reaction	Defection
Maximum Cooperation	0.83	0.04	0.09	0.05
Nearly-There	0.42	0.17	0.36	0.05
Reaction	0.38	0.08	0.47	0.07
Defection	0.23	0.02	0.41	0.34

Maximum Cooperation was the most prevalent decision rule, occurring 60% of the time. Guided by this decision rule, an individual would contribute the maximum number of tokens to the co-op ($M_{\text{amount}} = 10$). There was an 83% chance that this decision rule would remain stable in the following round, meaning that an individual would not be very likely to choose another decision rule. There was hardly any residual variance ($\sigma^2 = 0.001$) due to the ceiling effect and high conformity on the amount to contribute when using this decision rule.

The second most common decision rule, Reaction ($M_{\text{amount}} = 7$), guided participants' actions 24% of the time. Under this decision rule, the amount contributed was partly predicted by the average amount one's co-op had contributed in the previous round ($b=0.33$). Although not a part of the regression model, there was a 43% chance that one would be guided by Reaction if, in the preceding round, the average amount contributed by the other co-op members was between 0-7.6 tokens. In contrast, there was only a 4% chance that one would be guided by Reaction if the co-op contributed the maximum amount of 10 in the previous round. Furthermore, the transition probabilities suggest that one had a 47% likelihood of continuing to use this decision rule in the following rounds but there was also a 38% chance of switching to Maximum Cooperation.

Taken together, these results for Reaction (both model predictions and the descriptive for this rule) suggest that one is reactive especially to low contributions from one's co-op, such that one will respond negatively to the co-op for low average contributions but also, that one is likely to react positively to higher contributions by the co-op and therefore can switch to Maximum Cooperation in response to the co-op. In support of this interpretation, the posterior probabilities further show that there is a 90% chance of Maximum Cooperation for

those individuals whose co-ops gave an average of 10 in the previous round. This decision rule had the highest residual variance ($\sigma^2 = 1.969$), meaning that the amount that one contributed while being guided by this decision rule was highly variable.

Defection ($M_{\text{amount}} = 2$), in which one failed to cooperate with the co-op, occurred with only a 9% probability. This decision rule did not at all use the amount contributed by the co-op in the previous round ($b = 0.000$). In addition, Defection was a rather unstable decision rule: While there was a 33% probability that Defection would continue to be used in the following round, there was a 41% chance that a person would switch to Reaction (where participants respond usually to low amounts contributed by the co-op) and a 23% chance a person would use Maximum Cooperation. The fact that about a quarter of the time Defection transitions into Maximum Cooperation suggests that Defection can be somewhat rectified through interaction. The residual variance was relatively high for Defection ($\sigma^2 = 1.414$)

Finally, the least occurring decision rule was Nearly-There ($M_{\text{amount}} = 8$) which guided behavior 6% of the time. Unlike Reaction, Nearly-There did not at all use the lagged amount of the co-op ($b = 0.00$). Also in comparison to Reaction, this decision rule was more unstable. One had a higher probability of transitioning into Maximum Cooperation (41%) in the next round or switching to Reaction (36%), rather than continuing to be guided by Nearly-There (17%). Residual variance was low ($\sigma^2 = 0.011$) compared to some of the other decision rules, meaning it predicted a relatively small margin of cooperation (i.e. amount contributed to the public good).

As one can see from Figure 12 the strategy of Maximum Cooperation increases over time while Reaction somewhat decreases. While Defection is reduced at the mid-game, it increases in the last round, indicating some end-game effects. Figure 13 shows that the decision rule Maximum Cooperation, predicts a stable amount of 10 per round while after the first few rounds, Nearly-There predicts a stable amount, as does Defection. However, Reaction predicts an amount that is more prone to fluctuation over rounds, which makes theoretical sense since this decision rule is based on a response (positive or negative) to the average amount given by the co-op in the previous round.

Figure 12. Proportion of individuals using each decision rule per round

Figure 13. Mean amount predicted by each decision rule per round

Level 2: Individual classes. The model classified two individual level classes: Responsive Players which consisted of 55% of participants ($M_{\text{Amount}}=8$) and Committed Cooperators who made up the remaining 45% ($M_{\text{Amount}}=9$). The two individual classes differed significantly from one another in terms of which decision rule they were likely to use in the beginning of the interaction ($\chi^2(6) = 32.7, p < 0.001$); as well as in their probability of transitioning into one of the other three decision rules, given their current decision rule ($\chi^2(12) = 162.3, p < 0.01$). For the full transition probabilities see Table 9.

Table 9.

Transition probabilities for Individual Classes

		Starting Decision rule			
		Maximum Cooperation	Nearly-There	Reaction	Defection
Committed		0.50	0.14	0.31	0.05
Responsive		0.09	0.23	0.31	0.37

Individual Class	Previous State	Present Decision rule			
		Maximum Cooperation	Nearly There	Reaction	Defection
Committed	Maximum Cooperation	0.92	0.01	0.03	0.04
	Nearly-There	0.56	0.13	0.21	0.11
	Reaction	0.55	0.14	0.31	0.00
	Defection	0.65	0.09	0.13	0.13
Responsive	Maximum Cooperation	0.66	0.08	0.18	0.07
	Nearly-There	0.36	0.18	0.43	0.03
	Reaction	0.34	0.07	0.51	0.08
	Defection	0.13	0.00	0.48	0.39

Throughout the public goods game (PGG), Committed Cooperators had an 83% probability of selecting Maximum Cooperation as their decision rule and only a 9% chance of choosing Reaction (with a 4% chance each of choosing Defection and Nearly-There). At the start of the PGG (round 1), half of all Committed Cooperators selected Maximum Cooperation, while only 5% began with Defection. In addition, a Committed Cooperator who was guided by Maximum Cooperation in the previous round, had a 92% chance of remaining with this pattern of behavior in the following round.

Overall, Responsive Players had a 42% probability of utilizing Maximum Cooperation; a 35% chance of Reaction and 14% chance of Defection. They were only guided by Nearly-There 9% of the time. In contrast to Committed Cooperators, at the start of the PGG, Responsive Players only had a 9% chance of selecting Maximum Cooperation. Instead, they more likely begun with Defection (37% of the time). In terms of transitioning in and out of decision rules: Responsive Players had a comparatively lower probability of sticking with Maximum Cooperation if they selected it in the previous round (66%), while they had an 18% chance of transitioning from Maximum Cooperation to Reaction.

Notably, with regards to the probability of transitioning *out* of Defection, a Committed Cooperator was 52% *more likely* to switch to Maximum Cooperation from Defection, compared to a Responsive Player.

Level 3: Co-op classes. The model classified two co-op classes and they overlap almost perfectly (99%) with the individual level classes (i.e., Committed Co-ops consisted mostly of Committed Cooperators and Responsive Co-ops mostly of Responsive Players). The difference between the two co-op classes was indeed significant ($\chi^2(1) = 16.7, p < 0.001$).

Responsive Co-ops made up 55% of the co-ops ($M_{\text{amount}}=7.55$) while Committed Co-ops ($M_{\text{amount}}=9.27$) made up the remaining 45%. Given the strong overlap between individual and co-op classes, behavior was consistent within co-ops and different between co-ops. This finding suggests that individuals quickly learn norms of cooperation over time and their behavior becomes aligned with that of their group. A similar result for group norm formation was found in Chapter 2 of this thesis.

The experimental condition (Interpersonal Ties versus Social Categories) was a marginally significant predictor of the co-op classes ($\chi^2(1) = 3.7, p = 0.05$). The Interpersonal Ties condition was made up of 33% Committed Co-ops and 67% Responsive Co-ops; while the Social Categories condition consisted of 56% Committed Co-ops and 44% Responsive Co-ops. Therefore, there were more Committed Co-ops in the Social Categories condition where broad social categories, rather than interpersonal ties, were made salient.

Figure 14. Mean amount contributed to the co-op over time

Figure 14 shows that cooperation improves over time for both classes of co-ops. While Committed Co-ops overall start with higher levels, Responsive Co-ops increase their cooperation over time.

These findings are in line with Expectation 7, as we find different co-ops forming with their own norms for cooperation and furthermore, these types of groups are meaningfully different even for the same experimental condition.

Individual class covariates. We also included the social psychological measures as inactive covariates in the model, which simply shows how these covariates relate to the classes. They are “inactive” as no estimation and no statistical tests are performed (Vermunt & Magidson, 2016). This step allows us to determine whether the type of player one was classified as may have an influence on social psychological states. The patterns reported here are descriptive since we were not testing whether any of these has a significant effect on cooperation or the type of individual classified.

Table 10 reports the full pattern of results but overall, we see that Committed Cooperators score above average on entitativity, belongingness, social identification, trust and satisfaction with the co-op, perception of interdependent goals and closeness to own co-op. Responsive players, on the other hand, tend to score average or below average on these measures. Moreover, Committed Cooperators also score above average on closeness to the

other co-op, below average on expected reward, and average on expected punishment from their co-op for their actions. Taken together, these results suggest that Committed Cooperators are high identifiers.

Table 10

Breakdown of the probabilities for each social psychological correlate by Individual Class

	Level on Scale	Responsive Players	Committed Cooperators
Entitativity	High	44%	56%
	Mean (5.7)	69%	31%
	Low	80%	20%
Belongingness	High	41%	59%
	Mean (5.5)	63%	37%
	Low	62%	38%
Social Identification	High	43%	57%
	Mean (5.1)	60%	40%
	Low	67%	33%
Trust	High	44%	56%
	Mean (5.5)	70%	30%
	Low	61%	39%
Satisfaction with co-op	High	48%	52%
	Mean (5.7)	63%	37%
	Low	72%	28%
Interdependent goals	High	32%	68%
	Mean (5.5)	57%	43%
	Low	67%	33%
Independent goals	High	58%	42%
	Mean (4.4)	61%	39%
	Low	51%	49%
Closeness to own co-op	High	44%	56%
	Mean (5.1)	64%	36%
	Low	65%	35%
Closeness to other co-op	High	44%	56%
	Mean (2.1)	57%	43%
	Low	60%	40%
Expected Reward	High	61%	39%
	Mean (3.4)	52%	48%
	Low	34%	66%
Expected Punishment	High	57%	43%
	Mean (4.1)	50%	50%
	Low	51%	49%

Note: Rows sum to 100%. Each cell percentage indicates the probability that the given type of player would score in a certain range on the given measure. To simplify the presentation of the results we collapsed the probability above and below the mean of the given measure (which is recorded in brackets).

Descriptive Emergence of Cooperative Norms

The latent class analysis provides strong evidence that co-op members come to align their behavior over the course of interaction and social norms regarding which decision rules to use arise within co-ops. How do these behavioral norms emerge in co-ops over time? There are various ways of describing the developments over time and one is simply to look at the emergence of behavioral consistency (e.g., co-ops whose members display the same behavior from round to round). For example, low variance in cooperative behavior may be an indication of behavioral norms and agreement; and these patterns of agreement over time can help us to understand if, and when, the emergence of cooperation occurs and for which co-ops. The following section provides us with a description of these patterns for all co-ops in the present study.

Figure 15 visualizes the co-ops when individual members contributed the exact same amount to the Public Good in a particular round (i.e., there was no variance in a co-op's contributions in that round). The white spaces indicate that there was no such alignment, while the color code shows the exact amount that was converged on. As we can see from the figure, the exact convergence mostly happened at maximum cooperation, while there are a very few occasions where some co-ops managed to align on something other than 10.

Furthermore, only 5% of co-ops gave the exact same amount consecutively from the first round through to the last round of the public goods game (PGG). On the other hand, 15% of co-ops contributed the same amount in the first two rounds. Additionally, 48% of co-ops managed to align their behavior in two consecutive rounds from round 4 onwards (i.e., from rounds 4-5, 5-6 etc.), while only an average of 19% of co-ops did this in consecutive rounds from 1 - 3. Since cooperation within co-ops in the present study is very high overall, this descriptive evidence provides additional support for our argument that cooperation, and agreement on the amount to contribute within the group, emerges over time rather than being present from the beginning. Additionally, there is also evidence that cooperation can break down in some groups over time (see the bottom rows in Figure 15), which provides us with some case studies in which cooperation is not always stable. These case studies suggest that cooperation needs to be actively maintained.

Additional descriptive analysis showed that in 72% of the rounds, contributions of all participants within a co-op differed by not more than 2 tokens. Therefore, in Figure 16 we visualize, for each co-op in every round, the alignment (or not) of their cooperative behavior within two tokens of the group mean, color-coded by the mean amount that the group

converged on. The figure shows that even when behavioral alignment is considered less strictly (i.e., not the exact same amount, but within two tokens of one another), then most alignment still occurs at the higher end of what one could maximally contribute. Overall, co-ops are less likely to align their behavior in early rounds. However, later they can reach high levels of cooperation. Furthermore, there are some cases where alignment rarely occurs while in contrast, in some co-ops alignment can occur right from the beginning of interaction. Both figures also show a few instances of end-game effects whereby in the last round of interaction (note, participants knew it would be the final round), alignment of cooperative action broke down. These end-game effects were also suggested by the multilevel regression but, by and large, cooperation was more sustainable than not.

In sum: the pattern of these descriptive findings show that emergence of cooperation within groups over time is an important element in the PGG experiment and that a more stable pattern of behavior is maximum cooperation.

Figure 15. Heatmap of cooperative emergence (or not) per co-op:
Null variance

Figure 16. Null Variance Heatmap of cooperative emergence (or not)
per co-op: Variance of 2 tokens

Discussion

In this paper, we aimed to study the role that social categories and interpersonal ties play in the emergence of cooperation over time. We provided participants with experimental cues (Social Categories versus Interpersonal Ties) which we expected would lead to different trajectories of cooperation. As a follow-up to previous research in Chapter 2 of this thesis, we wanted to zoom in on the emergence of social norms guiding cooperation levels within both kinds of groups (Social Categories and Interpersonal Ties), as cooperation emerges over time through social interaction. We expected these emergent norms to be stronger in determining the development of cooperation than the differences that could be accounted for by the experimental condition. Our main findings from this study will be discussed as follows: 1) group norms develop in early rounds of interaction whereby individuals align their decision-making rules for cooperation; and the effect of these norms are stronger than the primed social identity pathway; 2) overall, cooperation emerges over time and while social categories may prompt initially higher levels of cooperation, bottom-up groups can reach the same high levels of cooperation; 3) group members are more highly identified in groups where cooperation is higher and 4) following 2 and 3, social identification and cooperation may be mutually reinforcing processes.

The Emergence of Committed and Responsive Co-ops

In this study, as in our previous research (Chapter 2) we found evidence suggesting that strong norm formation in cooperative decision making took place across conditions and was in fact stronger than the effect of the experimental manipulation. First, we find strong support for this claim from the 99% overlap between the two individual and two co-op classes given by the dynamic latent class model: Committed Co-ops consisted almost entirely of Committed Cooperators and Responsive Co-ops, of Responsive Players. Cooperative behavior was completely consistent within co-ops and different between the two types of co-ops. Since individuals were randomly allocated to conditions, we can confidently rule out that the consistency in cooperative decision rules between the individual and their group is due to their personality which determines their individual behavior: it must be that the emergent properties of the group (which of course may be influenced by players' *initial* personal preferences) comes to completely dominate the personal preferences of players later in the game. We also find additional support for our claim of norm emergence in our descriptive analysis where we found that many co-ops aligned their cooperative behavior around the

maximum amount they could contribute to the Public Good, and much of this alignment occurred in the first few rounds of play.

Also replicating the findings from our previous study, Committed Cooperators had a much higher chance of being guided by Maximum Cooperation as the decision rule in the first round of interaction, compared to Responsive Players. Given that there is a very strong overlap between individual and co-op classes, this finding suggests that if enough group members start off the interaction by placing trust in their group through contributing the maximum amount, this sets a basis for the emergence of cooperative group norms. This appears to be the general pattern, although the descriptive analysis given by Figure 10 suggests that this is not always the case, as there are a few case studies where cooperation started off reasonably well but deteriorated over time.

In further support of Chapter 2, members of Committed Co-ops are more likely to stick to Maximum Cooperation once they begin using it to guide their decisions during the public goods game (PGG), while Responsive Co-ops have a greater chance of changing their pattern of behavior, evidently as they react to member contributions over time. Committed Co-ops also appear to be more resilient to defection in that they have a far greater chance, compared to Responsive Co-ops in which group members defect, of switching to more cooperative behavior in the next round. Perhaps the few instances of defection by Committed Co-ops serve to sanction (or at least show social disapproval for) non-cooperative behavior; but the willingness to switch back to Maximum Cooperation in the following round also signals to fellow group members that they are willing to restore cooperation – this resembles the tit-for-tat strategy in which one's cooperation is conditional on the cooperation of others (Axelrod, 1984; Axelrod & Hamilton, 1981). In addition, even though Responsive Co-ops are more likely to start off with defection, they too can reach high levels of cooperation, which suggests that cooperation emerges over time through interaction and can emerge even when interaction starts off with a level of uncertainty.

The finding that about a quarter of the time someone who uses defection as a decision rule will transition into using Maximum Cooperation, which is arguably quite a drastic flip in behavior, suggests that failure to cooperate can be rectified through interaction. Although we still find very mild end-game effects where defection increases slightly, the proportion of people choosing Maximum Cooperation remained much higher than the proportion who chose defection at the end of the game. That Maximum Cooperation remains high right to the

end, suggests that there is a more general trend for stable cooperation to emerge in one of two forms: Committed Co-ops and Responsive Co-ops.

If the evolution of committed groups in interaction is crucial to developing optimal levels of cooperation, it is also important to try understand what it is about the social situation and the people involved, that can lead to committed cooperators and groups forming. Committed Cooperators in the present study showed greater solidarity with their groups compared to Responsive Players. This result is perhaps not surprising since they were nested within co-ops which showed similarly high levels of cooperation as themselves. However, since we could not measure these social psychological variables beforehand (when co-ops did not yet exist), we are unable to draw any firm causal lines. It could be that high levels of cooperation fostered a sense of solidarity; or that those who have a greater tendency to feel solidarity with groups to which they belong, will naturally cooperate more. However, since Committed Cooperators together created Committed Co-ops through interaction, it might at least suggest a causal pathway whereby cooperation actually results in higher solidarity rather than the reverse.

Furthermore, slightly more Committed Co-ops formed when broad social categories, rather than interpersonal ties, were made salient – this mild effect was also found in our previous study. Given that social categorization seems to help initiate the formation of cooperative groups somewhat more than inductive group formation, it may be that social identity can kick-start the emergence of cooperative norms.

Social Categories versus Interpersonal Ties

This study also supports the results of the previous Chapter by providing further evidence for the fact that when social categories are made salient, group members appear to have a basis to cooperate (i.e., possibly through shared social groups and group heterogeneity), and cooperate at higher levels from the beginning of social interaction. In other words, at the start of the collaboration there appears to be greater trust and expected reciprocity (see Tanis & Postmes, 2005) which results in higher levels of cooperation among those who have a pre-defined social category, compared to those who have been primed with the importance of interpersonal relationships. This can be seen from the different starting points for cooperation between conditions in Figure 10 of the results. Although cooperation in this study tended to slightly decline toward the very end of the interaction for categorized individuals, cooperation still remained well above starting levels. The results also show that when interpersonal ties are

made salient, cooperation is established later on in interaction, compared to social categories, but strengthens over time, in line with our expectations.

In terms of the particular patterns of cooperation over time, while our previous research suggested that categorized individuals show less of a tendency to decrease their level of cooperation over time (compared to non-categorized individuals); categorized individuals in the present study did show a slight decrease in cooperation (compared to when interpersonal ties were made salient) at the end-game. Here it seems that interpersonal ties, above broad social categories, that may act as a buffer against cooperative decline. This finding appears to be somewhat consistent with findings from Van Mourik Broekman et al., (2018) who compared groups that were formed through interactive cooperation (similar to our interpersonal ties condition) with groups formed through uniform cooperation (similar to our social category condition) and control groups with no interaction. The groups that were formed interactively showed greater commitment during a follow-up task (suggested by sustained activity levels during a physical exercise) compared to both uniform and control groups, which showed declining levels of activity.

We had expected that social categories and interpersonal ties would achieve similar levels of social identification, in accordance with the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005). We find some support for this expectation due to the null effect of condition on any of the social psychological variables measured. However, the results of the analysis of the social psychological measures did show that the average contribution of one's co-op, in the second half of the game, had a noticeable impact on one's psychological feeling about the group, regardless of the experimental condition. In particular, participants who were members of co-ops that contributed a higher mean amount to the public good showed, at the end of the experiment, higher levels of social identification, entitativity, belonging, satisfaction with and trust of their co-op, greater closeness to their co-op as well as shared the perception that their co-op acted based on interdependent group goals. Furthermore, one's individual deviation from the group's average level of cooperation did not influence one's feeling about the group, suggesting that one's identification with, and perception of, the group was entirely dependent on what happened at the group level, rather than one's individual decisions within the group.

Although the effect of the experimental condition could, to some extent, explain the pattern of cooperation over time, there was also large variability among co-ops, regardless of condition. Furthermore, the impact of a particular co-op's cooperation level on one's

psychological state also appeared to be more important than the just the effect of the experimental manipulation. Therefore, while the pathway to group formation may result in a slightly different overall trajectory for cooperation, it is what happens within the groups themselves, above the static experimental condition, that ultimately leads to some groups showing stronger emergence of cooperation compared to others.

Conclusion

In this study, we show that cooperation is an emergent process that unfolds over time through interaction and that this emergence occurs both in social categories and interpersonal ties (which represent two social identity pathways). Both pathways to social identification with one's group can result in high levels of cooperation, albeit through different routes: For example, social categories appear to start off with higher levels of cooperation but interpersonal tie groups can reach the same (high) level of cooperation over time. Furthermore, social norms for appropriate behavior (i.e., which decision rules to use and when) arise through interaction, resulting in different types of groups (in this study, named the Committed and Responsive Co-ops). Finally, beyond our previous research, we show that high identifiers most commonly belong to groups in which cooperation is highest and moreover, there are slightly more high identifiers in the social categories condition (in the sense that there are more Committed Co-ops in this condition). Taken together, this suggests that social identification and cooperation arise in tandem and are likely mutually reinforcing but also that a social category is not necessary for this to happen. The key findings in this paper replicate what we found in our previous study but also add to it. By changing the experimental manipulation in order to compare a richer social categories condition to an interpersonal ties condition (rather than a non-categorization condition), we can conclude that dynamic and emergent group norms are much stronger at predicting cooperation than static factors, such as common category membership or individual preferences.

Chapter 4: When Social Categories and Interpersonal Ties Fail to Produce Cooperation

Abstract

Past research has shown that both social categorization and interpersonal ties foster cooperation in small groups interacting in a Public Goods Dilemma. In these studies, groups come to align their behavior through normative patterns of cooperative decision-making and different kinds of groups emerge – all with fairly high levels of cooperation. In this paper, we attempted to replicate this effect with some changes. Unexpectedly, we see that neither primed social identification pathway (through social categorization or interpersonal ties) guarantees the emergence of cooperation. Instead, we find only partial replication: one out of three types of groups align their decision-making behavior and reach fair levels of cooperation. The other two types of groups, containing even a few Defectors, are much less stable – cooperation starts low and devolves over rounds of interaction, without strong normative patterns emerging. Nevertheless, some cooperative individuals still exist in these groups, despite it being against their narrow self-interest. While dynamic within-group factors appear foremost in the emergence and maintenance of cooperation; given that this study was conducted in a different societal context –macro-level factors may kick start, or indeed hamper, the emergence of cooperative group norms.

In previous research using Public Goods Games, we have shown that stable systems of cooperation emerge whereby members of a group come to align their decision rules for cooperation and become homogenous in their overall cooperation levels (see Chapter 2 and 3 of this thesis). Three different kinds of groups, with their own normative patterns, tended to emerge: Committed Co-ops (groups which hit the ceiling for cooperation and are the most stable); Responsive Co-ops (groups in which cooperation remains high but people base their decisions primarily on what their group has done in the previous interaction, thus increasing or decreasing their contributions based on the group) and Reactive Co-ops (groups in which people react to low contributions by giving even less in the following interaction). We believe that within-group social interaction is crucial for the emergence of these cooperative norms.

However, in our previous research, overall cooperation started rather high and tended to increase in most groups. In the current study one key aim was to increase the variance in the initial levels of cooperation to study whether cooperation could still reach the same high levels found in prior studies. Indeed, our changes to the experiment led individuals to make much lower initial contributions, as we had desired. However, as we will show, we only saw the emergence of moderate levels of cooperation in one of three types of groups. In the others, we witnessed a breakdown of cooperation and the formation of less stable groups.

The introduction of this paper will be structured as follows: First, we broadly introduce our research in reference to our prior studies, discuss the change in experimental setting, and introduce the experimental paradigm (a dynamic Public Goods Game). Next, we discuss particular macro-level and group-level factors that may influence cooperation – the literature included in these sections helps provide structure to the unexpected findings of the present study.

The aim of this paper, and the broader program of research which it is a part of, is to study the emergence (or in this case, the breakdown) of cooperation in small, interactive groups. We compare two experimental conditions designed to reflect two potential foundations for the emergence of cooperation: Social Categorization and Interpersonal Ties. Participants interacted with one another over time, playing a Public Goods Game (PGG) with communication, through the computer-mediated interaction platform, VIAPPL (the Virtual Interaction Application, see viappl.org). As mentioned above, this study saw a greater breakdown of cooperation than in previous Chapters. Therefore, we discuss possible reasons for this lack of cooperation and argue that more research should be conducted into how

macro-level factors may interact with group-level factors to affect cooperation in different contexts, especially in non-WEIRD societies (Henrich, Heine, & Norenzayan, 2010).

Cooperation as a Social Dilemma

Social dilemmas are regularly used to study the emergence and maintenance of cooperation. In experimental paradigms such as Public Goods Games (PGG), participants are given the choice to cooperate with others, or defect. While the socially optimal outcome is for all players to cooperate and subsequently share in the material benefits generated from the act of cooperation, the temptation for free-riding still exists (Olson, 1965; Samuelson, 1954). Due to the nature of public goods – they are equally accessible and equally divisible – an individual may get away with not contributing to the existence of the public good (PG) while still having equal access to it. On the other hand, for the PG to exist a certain number of people need to cooperate and contribute to its' existence, or it fails to exist for everyone.

Cooperation may be risky for an individual when there is no guarantee that everyone else will cooperate. In fact, in many social dilemma situations it was traditionally considered rational for players to defect out of self-interest, rather than cooperate (Edwards, 1962). Despite this, cooperation levels are usually well above what is predicted by the rational choice model for cooperation in social dilemmas (Axelrod & Hamilton, 1981; Barrera, 2014; Ledyard, 1995) and these levels of cooperation also differ among societies (Henrich & Boyd, 2005). For example, cooperation is usually higher in collectivist cultures which value collective-interest over self-interest (e.g., C. C. Chen & Chen, 1998). However, in some cases (as we shall see in the present study) we find that cooperation starts low and declines over time. In this paper, we discuss what possible factors, beyond a traditional rational choice explanation, could potentially contribute to these low levels of cooperation – we begin by considering factors at the societal level given the change in setting from the Netherlands to South Africa.

Macro-level influences on Cooperation

While previous studies that found high levels of cooperation (see Chapter 2 and 3) were conducted in the Netherlands, we extended the setting of the present experiment to South Africa. As such, we begin by discussing macro-level factors found to influence cooperation, before looking at group-level factors that may explain lower levels of cooperation found in this paper.

Goal Perception and Cooperation. While self-interest may be a predominant barrier to cooperation in individualistic societies, this may not be an adequate explanation for the same problem in collectivistic societies, since individuals within the latter are usually motivated by collective-interest. Indeed, certain societies appear to be more cooperative and trusting than others (Henrich et al., 2001; Jordan, Peysakhovich, & Rand, 2014). There are possible influences at the societal level that may affect cooperation levels in social dilemmas. First, societies may have particular norms for cooperative behavior. Indeed, even the setting of an experiment can greatly influence whether cooperation emerges or not. Therefore, we start by looking at goal framing theory (Lindenberg, Fetchenhauer, Flache, & Buunk, 2006) in order to explain influences on behavior that are external to group interaction itself. Next and relatedly, we discuss cultural patterns, the role of societal institutions and the role of trust and punishment in different societies.

Group interaction takes place in particular environmental contexts which may activate self-interest or collective-interest to varying degrees and further, normative patterns usually differ at a societal level as well as at a local level. The fact that context is important has been illustrated, for example, through research which has manipulated the framing of a social dilemma (to appear more cooperative or competitive) in order to study its effect on cooperation (see for example Liberman, Samuels, & Ross, 2004; Van Lange, Joireman, Parks, & Van Dijk, 2013). As a more concrete illustration, research has shown that a normative goal-frame can be activated through presenting a public goods game as a “Community Game”, resulting in higher levels of cooperation; while presenting the same game as a “Wall Street Game”, one can activate a gains goal-frame which increases competition and defection (Liberman et al., 2004; Lindenberg, 2015).

Besides activating cooperation or defection by experimentally manipulating goal-frames through the description of an experiment, whether or not an individual’s material outcome is dependent on the public goods game (PGG), or not, can also have an influence. In other words, paying participants based on their ‘performance’ in the PGG can increase defection as explicit monetary incentives may overshadow their intrinsic motivation to cooperate and increase the likelihood of expected utility decision making, or making the “rational choice” (Jordan et al., 2014; Weber et al., 2004). Seeing social relations and group interaction as a kind of marketplace exchange would have a very different effect on one’s behavior, in comparison to seeing group interaction as having symbolic benefits that are not directly related to explicit monetary reward – and these perceptions of group relations may

differ across societies and cultures. It is also quite probable that normative and goals frames may be more or less prominent depending on, for example, whether a society is more or less collectivist or individualist in nature. Therefore, culture at a societal level may generate expectations around how to behave under particular circumstances, and these expectations may spill over into interpersonal interaction.

Culture and Cooperation. Cultural values, which differ both within and between countries, appear to play some role in whether or not cooperation emerges. Traditionally, cultural research has focused on the distinction between individualist and collectivist societies (Hofstede, 1980). The starker the contrast between two countries on the individualist-collectivist (I-C) dimensions, the greater the difference in cooperation; such that collectivist societies cooperate more while individualist societies engage more in competition and free-riding in social dilemmas (e.g., Cox, Lobel, & Mcleod, 1991; Parks & Vu, 1994). However, one could also argue that individuals in societies focused on building and maintaining strong *family ties* (i.e., collectivist cultures) lack norms of cooperation with strangers. It has been suggested, for example, that collectivistic people will respond negatively to punishment for not cooperating with strangers because cooperating with strangers is not culturally normative (see Balliet & Van Lange, 2013).

Although culture itself is not necessarily seen as static and there are likely to be cultural shifts over time, within the context of a single experiment one's cultural preference is usually treated as fixed: collectivists may be more cooperative, while individualists are more likely to show narrow self-interest. Therefore, how cultural preferences interact with emergent group processes is an important extension of cultural studies on cooperation.

Furthermore, the individualism-collectivism dichotomy may be too simplistic. And indeed, this distinction has now been extended – it is further qualified by preferred power differentials: vertical and horizontal. Cultural patterns can thus be divided into four types: horizontal collectivism (H-C), vertical collectivism (V-C), horizontal individualism (H-I) and vertical individualism (V-I) (Singelis, Triandis, Bhawuk, & Gelfand, 1995; Sivadas, Bruvold, & Nelson, 2008). Drawing these further distinctions between I-C also helps to explain the presence of different within-country cultural values, especially in diverse societies such as South Africa.

While both collectivistic patterns see the self-concept as being interdependent with group identity, the primary difference between the sub-types is that H-C individuals prefer equal relationships, while V-Cs' accept and expect status differences. On the other hand, both

individualistic patterns are defined by an autonomous self-concept but, while H-Is' see all individuals as equal, V-Is' expect inequality and support competition¹² (see Probst, Carnevale, & Triandis, 1999).

Probst et al. (1999) directly tested the effect of these four cultural patterns on cooperation in a social dilemma. They found that the most noticeable difference existed between vertical individualists and vertical collectivists such that the former were more likely to defect while the latter would cooperate, in a single-player prisoner's dilemma. Furthermore, in attitudinal measures, V-Is' reported goal was to maximize individual interests and V-Cs' goal, to maximize group interests. However, this study did not allow interaction among participants, therefore we do not know how strong the effect of cultural patterns on cooperation is in interactional settings.

From the I-C social dilemma literature, it appears that the traditional rational choice model (i.e., a person will likely defect as it is in one's self interest, especially in one-shot interactions) might work, at least in part, to predict behavior for pro-selves in cultures where individualism is higher but may not provide a good explanation for the behavior of those with collectivist values. Chen & Chen (1998) argue that the mechanisms that have been seen to increase cooperation – such as: superordinate goals, group identity, trust, accountability, communication and reward structure – may operate differently in collectivist and individualist societies. For example, these authors propose that when considering cooperation in newly formed groups, a new group identity that enhances personal identities may increase cooperation in individualist cultures; while a new group identity that complements existing group identities will increase cooperation in collectivist societies.

Societal institutions and Cooperation. While cultural differences may explain between-society differences in cooperation, the quality of societal institutions may also play a role. While experiences of trustworthy institutions (such as government structures) may

¹² These four cultural patterns have some association with social value orientation (SVO, Messick & McClintock, 1968), which is a person's' fairly stable preference for cooperation or defection. SVO and the four cultural patterns seem to share some of the same variance, and the cultural patterns, rather than SVO may predict cooperation better (e.g., Probst et al., 1999). These patterns also correspond with Fiske's social relations model (e.g., Rai & Fiske, 2011) which defines four preferences for how societies distribute resources. The overlap has been suggested by Probst et al., (1999) whereby both collectivisms encompass communal sharing (i.e., resources shared on needs basis), while H-C also includes equality matching (i.e., equal distribution) and V-C includes authority ranking (i.e., higher status results in more resources). While both individualisms include market pricing (i.e., merit-based sharing), H-I includes equality matching and V-I, authority ranking.

increase generalized trust in society, distrust may arise when institutions are seen as exploitative and corrupt¹³.

Indeed, while norms of direct and indirect reciprocity appear to be fairly universal (Diekmann & Lindenberg, 2015; Gouldner, 1960; Jordan et al., 2014), the quality of the societal institutions can vary drastically among different societies. In some environments it may be safe to trust strangers, reciprocate and cooperate with them; however in others it may be safer to assume non-cooperation and thus defect oneself (Jordan et al., 2014).

There is evidence to show that cooperation learned in one context – for example, through experience with, or perceptions of, societal institutions – can spill-over into other contexts, such as experimental lab settings (e.g., Peysakhovich & Rand, 2016) or small group settings. Taking this spill-over effect into account, the quality of societal institutions is important in fostering sustainable cooperation at all levels. ‘Quality’ may not be straightforward though: the quality of institutions is not only determined by what is enshrined in the constitution of a particular country (i.e., how democratic the institutions are), but also the extent to which constitutional guidelines are enforced and coordination between oversight authorities can occur (for example, see Pillay, 2004).

In South Africa for example, corruption in public institutions is prolific despite having an impressive democratic constitution with many oversight authorities (Pillay, 2004). High profile corruption has been exposed in the previous administration (for example, Public Protector South Africa, 2014), having also existed historically in the oppressive apartheid government (for example, see Hyslop, 2005). Long-term exposure to unfair and untrustworthy institutions could trickle down into smaller scale interactions among members of the general public, whereby is safer to try to maximize one’s own self-interest rather than trust a possibly untrustworthy collective to which one has no close, direct ties. This may be exacerbated if one’s society is more collectivist in nature and cooperating with close family members and friends, rather than strangers, is the norm.

While macro-level societal factors such as normative frames, cultural values, societal institutions and trust, all play a role in the emergence of cooperation within smaller groups, we also need to consider the dynamic interpersonal factors which relate to how new groups are formed. As an illustration, factors seen to enhance cooperation in one culture may not

¹³ Since measures of trust are usually correlated with national wealth, wealth inequality and market competitiveness, one possible explanation for low generalized trust at the societal level is also the economic development of a country (Balliet & Van Lange, 2013).

work identically in another culture (C. C. Chen & Chen, 1998). In particular, with regards to social identity, identities that enhance individuality may help cooperation in individualist settings while identities that support existing close-knit identities in collectivist cultures, may increase cooperation in those settings. We discuss the effect of social identity on cooperation in the following section, as this will also provide the groundwork for the experimental manipulations that we use in the present study (also see Chapter 2 of this thesis).

Group level influences: Social Identity Pathways to Cooperation

One factor that can increase cooperation and ameliorate defection is group membership. For example, ingroup favouritism has shown to reliably result in within-group cooperation across different experimental paradigms (for a review see Balliet, Wu, & De Dreu, 2014) and ingroup cooperation is seen as accounting for most real-world cooperation (e.g., Parks, Joireman, & Van Lange, 2013). It has been proposed that social identification with one's group is one possible driving force behind cooperation within groups, also during Public Goods Games (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Turner, 1991; Wit & Kerr, 2002). Therefore, while there are apparent societal level factors influencing cooperation in smaller groups, there are also important group level factors which become salient during group interaction.

The role of social identification on ingroup cooperation has predominantly been studied from a categorization perspective, in which broad social categories – based on similarities among group members – are in the foreground of one's social identity and the presence of an outgroup is salient (Postmes, Spears, et al., 2005; Tajfel et al., 1971; Turner, 1985). However, a more dynamic view of social identification are so-called inductive identities: these form from the bottom-up through interaction and are based on one's personal value to the group (i.e., intragroup differences which are complementary and contribute to the success of the group). The existence of dynamically formed social identities has been suggested by the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005) as well as a network approach to social identity in which direct interpersonal ties between group members are seen as primary to the group's existence and identity (for example, see Deaux & Martin, 2003; Easterbrook & Vignoles, 2015; Leszczensky, 2013). For shared identities to be induced, the salience of an outgroup is not necessary. While it has been proposed that both processes of identity formation (bottom-up and top-down) can result in equally high levels of social identification and belongingness, the

pathways to these outcomes may be different (e.g., Easterbrook & Vignoles, 2013; Koudenburg et al., 2015).

In previous research, we have directly compared the levels of cooperation over time between experimentally manipulated social categories and inductive-type groups (Chapter 2 and 3 of this thesis). Overall, cooperation is slightly higher when social categories are made salient (in both Chapter 2 and 3), however, inductive-type groups (for example, where interpersonal ties are made more salient, Chapter 3) can result in more sustained cooperation over time, even when the end-game is made explicit. Therefore, from previous research, it appears that both types of social groupings can enhance cooperation, albeit possibly through different trajectories. In sum, group membership and social identification may increase cooperation under many circumstances and especially so when a normative goal frame is activated (Lindenberg, 2015b). However, there may be other factors which could overshadow any positive effect of social identification and normative goal framing on cooperation. These factors may include: a competing gains norm that is activated by explicit monetary incentives, spill-over from societal institutions, and differing cultural values – even within the same country.

Aim of the research

Given the high levels of cooperation and similar findings in Chapter 2 and 3 of this thesis, we aimed to extend the study of Chapter 3 in particular, by: (1) sampling in a different social context, (2) changing the payoff structure such that people are paid based on the outcome of the public goods game (PGG), and (3) by increasing the group size. We hoped these changes in setting and design would give more variance in the initial contributions in the PGG, rather than having people hit the ceiling for cooperation early on in interaction. We expected that cooperation would still emerge, although the trajectory would be somewhat different from the previous studies. Given the change in the societal context, we also wanted to see whether one's within-country cultural values made any difference to the experience of the group, or to overall cooperation levels.

The fact that there were three main changes between Chapter 3 and the present study complicates drawing direct comparisons. Taking this into consideration, the present research can only directly answer questions relating to the difference in cooperation between the experimental conditions (i.e., the two social identification pathways: Social Categories versus

Interpersonal Ties) and whether one's cultural values have any effect on one's experience of, or behavior in, the PGG.

Method

Participants and design

Student volunteers (N= 300, 167 males, 130 females, 3 undeclared, $M_{age} = 21.7 (7.7)$) from the University of KwaZulu-Natal, South Africa, participated the PGG experiment in groups of ten. Participants were incentivized according to a payment scale¹⁴ based on how many tokens they ended up with at the end of the experiment (an average of 30 ZAR). 30 experiments were conducted in total, with 15 replications in each of the two conditions (Interpersonal Ties versus Social Categories condition). Ethical clearance was granted by the Humanities & Social Sciences Research Ethics Committee, UKZN.

Procedure

Groups of ten participants were invited to participate in an experiment at one time. After signing informed consent sheets, participants were given a few minutes to read an instruction manual (see Supplementary Information C) with the explanation and instructions for the game.

Thereafter the experimenter guided participants through a brief practice round where they would learn how to use the software platform on which the experiment was run – the Virtual Interaction Application (VIAPPL, see viappl.org). Following this, participants answered a pre-experimental questionnaire. After the first questionnaire, the game began.

In the first stage, participants would enter the game arena – which appeared onscreen as an island– and each participant would be able to see the avatars (icons) which represented the type of farm each individual was assigned to in the game. These avatars were randomly assigned to the participant by the VIAPPL software when participants logged onto the game. Instructions appeared onscreen that informed participants which ‘farming co-operative’ – or group – they would join, according to the experimental condition. There were five participants in each co-op.

Following co-op formation, there was a five-minute period in which participants were asked to discuss, via instant messaging, the topic provided to them (described below).

¹⁴ Participants were aware of the payment scale prior to the PGG.

Directly after the conversation was finished, participants began investing in their co-op according to the rules of a Public Goods Game (PGG). For 11 rounds, participants could choose to invest 0 - 10 tokens per round. The total amount invested in the co-op was summed, multiplied by 1.2 and divided equally among all co-op members, regardless of how much they had personally invested. At the end of each round, the participants' token balance was updated by the following rules: 2 additional tokens per round + the amount participants retained from the previous round (i.e., what they had not invested) + their share of the co-op profit.

Before each round of investment in the Public Good (PG), participants had 40 seconds to message one other regarding any topic; and following each round, a visual summary image was shown to participants – providing feedback regarding everyone else's contributions. After the ninth round, a 'mid-experimental' questionnaire was given, before the final two rounds of play. This questionnaire was used to get a sense of the feelings towards the co-op before the PG end-game – as having the end of interaction in sight has been demonstrated to result in increasing in defection (Ledyard, 1995). After the final two rounds of the game – which were emphasized via a brief message informing participants that the game would soon end – participants were presented with a post-experimental questionnaire.

After completion of the final questionnaire, participants were paid according to the number of tokens they had accumulated by the end of the experiment and they could leave the lab.

As with our previous study, in Chapter 3 of this thesis, we had two experimental conditions – the Interpersonal Ties and Social Categories condition. In the Interpersonal Ties condition participants were randomly assigned to one side of the game island (east or west). They each had one of ten unique animals that they would 'farm' in the game, therefore their individuality was emphasized (see Figure 17). By contrast, in the Social Categories condition, participants were assigned to either be cattle or corn farmers, highlighting group homogeneity (see Figure 18).

To further manipulate the differences that we were interested in studying, participants in each condition had a different topic of conversation that they would engage in with their co-op members prior to the start of the PG game. The topic in the Interpersonal Ties condition was:

“As you probably know, people generally rely on their neighbours and friends for social support. Please discuss in your group: What are the five most important benefits that personal relations would provide to a farmer on a newly discovered island?”

While the topic in the Social Categories condition was:

“As you probably know, farmers generally rely on their farming co-operatives to support agriculture. Please discuss in your group: What are the five most important benefits that farming co-operatives would provide to the members of the co-operative as a whole?”

In the Interpersonal Ties condition, farmers on the east side of the island were instructed to join one co-op together, while those on the west joined another. In the Social Categories condition, all the cattle farmers would form one co-op while all the corn farmers would form the other. For both conditions, participants were not given a choice as to which co-op to join in order to strengthen the manipulation.

The procedure for the present experiment was nearly identical to Chapter 3 of this thesis. Differences were that: participants interacted in groups of 10 instead of 6; the context of the study differed (South Africa versus the Netherlands) and the instruction manual made more salient an example of how an individual could earn more if they defected while their co-op still contributed highly – we did this to try to increase the variance, especially in starting levels of cooperation, as participants in the previous studies seemed to ‘max out’ quite quickly. Finally, participants were paid according to the number of tokens they ended up with at the end of the game, whereas for the studies of Chapter 2 and 3, participants were paid according to course credits or a standard amount of money, independent of their number of tokens.

Dependent variables

Cooperation/Amount contributed to the Public Good. Cooperation was operationalized by the amount contributed to the co-op at every round (an integer from 0 – 10).

Social Psychological Measures. All questionnaire items were measured on a 7-point Likert scale, from “strongly disagree” (1) to “strongly agree” (7), unless otherwise specified. The pre-experimental questionnaire consisted of 14 items which measured vertical and horizontal collectivism and individualism (Sivadas et al., 2008). Although all four of these constructs were found to have rather low reliability (H-C: e.g. “I feel good when I cooperate with others”; $\alpha=0.54$, Greatest Lower Bound (GLB) = 0.63; V-C: e.g. “I would sacrifice an activity that I enjoy very much if my family did not approve of it”; $\alpha=0.46$, GLB = 0.52; H-I:

e.g. “I enjoy being unique and different from others in many ways”; $\alpha=0.54$, GLB = 0.57; V-I: e.g. “I enjoy working in situations involving competition with others”; $\alpha=0.60$, GLB = 0.60); this could be due in part to the relatively small number of items for each construct (3-4 items). Briggs and Cheeks (1986) suggest looking at the mean inter-item correlations instead of alpha and to retain those items that have a correlation of between 0.2 and 0.4. Doing this indicated that 1 item from H-C and 2 items from V-C should be dropped for the analysis.

Figure 17. Arena in the Interpersonal Ties Condition

Figure 18. Arena in the Social Categories Condition

The mid-experimental questionnaire¹⁵ which participants completed before the last two rounds of the game measure: perceived entitativity ($\alpha=0.76$, GLB = 0.77); social identification ($\alpha=0.81$, GLB = 0.87); belonging ($\alpha=0.81$, GLB = 0.85); perception of group interdependence/common group goals ($\alpha=0.82$, GLB = 0.89); perception of independent/individualist goals ($\alpha=0.81$, GLB = 0.85). Closeness to own co-op and the other co-op were evaluated through an image selection task based on single item measures (Schubert & Otten, 2002, Chapter 3 of this thesis).

Finally, the post-experimental questionnaire measured social identification with one's own co-op, through a single-item measure (as validated by Postmes, Haslam, & Jans, 2012). In addition, trust ($\alpha=0.78$, GLB = 0.78, one item dropped) and satisfaction ($\alpha=0.80$, GLB = 0.81) with the co-op were also measured (see Chapter 3 for item details); as well as perceived competition between co-ops – through a single item (“There was no competition between the co-ops”, reversed scored) and bias against the other co-op (e.g., “My co-op was better than the other”, 3 items, $\alpha=0.76$, GLB = 0.76, one item dropped). The last two questions were developed for the purpose of this experiment.

Hypotheses and Expectations¹⁶

Hypothesis 1. We do not expect a difference between the Social Categories and Interpersonal Ties condition on the measure of social identification (i.e., statistical null hypothesis). We also do not expect differences in belongingness, perceived entitativity, perceived trustworthiness and satisfaction with the co-op between the conditions, according to the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005).

Hypothesis 2. The perceived goals of group members will be more interdependent (group-based) in the Social Categories than the Interpersonal Ties condition. Conversely, the perceived goals of group members will be more independent (individualist) in the Interpersonal Ties condition, in which heterogeneity is more salient, compared to the Social Categories condition.

¹⁵ The same items were used in the previous study (see Chapter 2 and 3 of this thesis for examples and references).

¹⁶ As not all of our hypotheses were strictly testable propositions, we label them as expectations that we had for the data prior to conducting the experiment.

Hypothesis 3. There will be greater perceived intergroup competition and ingroup bias in the Social Categories compared to the Interpersonal Ties condition, as the saliency of an outgroup for social categories tends to be associated with bias against the outgroup.

Hypothesis 4. There will be slightly higher levels of cooperation in the Social Categories compared to the Interpersonal Ties condition.

Expectation 5. In the Social Categories condition there will be higher and more stable patterns of cooperation in early rounds of the PGG and this will decrease slightly over time. On the other hand, in the Interpersonal Ties condition, similarly high levels of cooperation will be reached in later rounds and increase, rather than decrease, over time.

Expectation 6. We measured four dimensions of culture in this study and we expect that different cultural dimensions may relate to the level of cooperation one shows. Specifically, vertical individualism (which values individual status) will foster the greatest defection while horizontal collectivism (which emphasizes interdependence and sociability) will foster the greatest cooperation.

Expectation 7. We expect different classes of co-operatives will form fairly independently of the experimental condition (Social Categories and Interpersonal Ties), where classes of co-ops are characterized by their norms of behavior.

Analytic approach and Results

Social Psychological Effects

In order to test differences in the mid and post experimentally measured constructs between the Interpersonal Ties and Social Categories conditions, we employ a multilevel, multivariate model in runMLwin in R (Version 2.36) (Leckie & Charlton, 2013; Rasbash et al., 2009). Response (Level 1) is nested in participant (Level 2), nested in co-op (Level 3), nested in experimental group (Level 4). Due to the many dependent variables (DV's) in the questionnaire (see, dependent measures above), we decided to collapse the ones that were highly correlated to simplify the analysis. Correlations (see Table C1 in Supplementary Information C) suggested that social identification, entitativity, belongingness, satisfaction with one's own co-op and closeness to one's own co-op could make up one variable, which we will call 'solidarity'¹⁷. The perception of group members having interdependent goals was also highly correlated with the variables in this list, however, since we had a specific

¹⁷ In previous research, solidarity has comprised of social identification, entitativity and belongingness (see for example, Koudenburg, Postmes, Gordijn & van Mourik Broekman, 2015).

hypothesis (Hypothesis 2) about this measure we kept it separate. In addition to solidarity, the other DV's were: independent/individualist goals, interdependent/group goals, trust, closeness to the other co-op, ingroup bias and perceived competition. Table C2 in Supplementary Information C gives the descriptives for each social psychological measure by experimental condition.

The independent variables (IV's) tested were: the experimental condition; the average amount given by the co-op in the second half of the PGG – giving enough time for norms to be established –, and the individual's deviance from that amount. Lastly, since the cultural variables (V-C, V-I, H-C, H-I) were measured pre-experimentally, they were included as IV's which could influence the perceptions about the group, additional to interaction in the game – although we had no strong prior expectations.

Results. Through model comparison (see Table C3 in Supplementary Information C), the best fitting model included the following DV's: average contribution of the co-op ("Mean co-op"); Horizontal Collectivism (H-C) and Horizontal Individualism (H-I). The experimental condition was not significant (which provides support for Hypothesis 1 but does not support Hypothesis 2 or 3). Individual deviance from the average co-op contribution was also not significant and therefore not included in the model – nor was Vertical Collectivism (V-C) or Vertical Individualism (V-I)¹⁸.

The intra-class correlations are fully reported in Table C4 in Supplementary Information C. The proportion of variance at the game level was very low (near 0 for all DV's) and at the co-op level, it was highest for solidarity (41%) and lowest for perceived competition between co-ops (3%).

The effect of co-op contribution (Mean Co-op). The average amount one's co-op contributed in the second half of the PGG had positive significant effects on one's sense of solidarity, trust, perception of interdependent goals and ingroup bias (see Table 11); while it had significant negative effects on the perception of independent goals and perceived competition between co-ops. There was no effect for closeness to the other co-op. The overall pattern of results suggest that the more ones' co-op contributed to the Public Good: 1) the more one felt connected to the co-op, 2) the less one perceived the co-op members to have independent/individualistic goals and 3) the more ingroup bias one experienced.

¹⁸ We checked whether results differed substantively from a model with all the variables included and they did not. Therefore, we confirmed the best fitting model.

Horizontal Collectivism. An individuals' measure of H-C had a significant positive effect on solidarity and the perception of interdependent goals, such that the higher one scored on H-C, the more solidarity one felt towards one's co-op and the more one perceived that the goals of their co-op members were interdependent (i.e., for the collective). H-C had no notable effect on trust, independent goals, closeness to the other co-op or perceived competition between co-ops.

Horizontal Individualism. H-I had a significant positive effect on the perception of independent goals as well as significant negative effects (albeit, much weaker) on closeness to the other co-op and perceived competition between co-ops. The more individualistic one was, the more one saw one's co-op members' goals as being independent (i.e., self-interested). The absence of the solidarity effect for H-I suggests that collectivists are more likely to feel solidarity with their group compared to individualists, even in interactive settings.

The Effect of Social Categories and Interpersonal Ties on Cooperative Behavior

Descriptives. While the overall level of cooperation was high in the previous two studies (Chapter 2 and 3), cooperation was much lower in the present study regardless of the experimental condition (Social Categories: $\text{Mean}_{\text{Cooperation}} = 2.79(3.3)$, Interpersonal Ties: $\text{Mean}_{\text{Cooperation}} = 2.43(2.6)$). In addition, in contrast to the previous two studies of this thesis, the proportion of variance explained by the co-op level (with the experimental condition included) was much lower (8%) than at the game level (32%).

Method. To test the overall effect of condition (Social Categories versus Interpersonal Ties, coded 0 and 1 respectively) on cooperation over time, a multilevel linear regression model was applied using the lme4 package (Bates et al., 2015) in the R environment (R Core Team, 2016). Round/time (Level 1) was nested in individuals (Level 2), nested in co-ops (Level 3), in experimental group (Level 4). A simple linear growth model was fitted. Random slopes for round were included at both the individual and co-op level. Model selection was based on model fit (see results for details). As with our previous studies in Chapter 2 and 3, the multilevel growth model provides an overarching view of the data and should be considered descriptive because the data violates the assumptions of the model (i.e., homoscedasticity). Therefore, we also model the data using a dynamic latent class model (below) for a more process-oriented view regarding the decision rules that guide participant cooperation or defection over time.

Table 11

Multilevel Multivariate Model for social psychological variables: Fixed Part

	Coef.	S.E	Z	P	95% CI			Coef.	S.E	Z	P	95% CI	
Intercept (Solidarity)	2.18	0.67	3.27	0.001	0.88	3.48	Intercept (Closeness to other co-op)	2.62	0.96	2.73	0.006	0.74	4.49
Mean co-op (Solidarity)	0.26	0.06	4.46	0.000	0.15	0.37	Mean co-op (Closeness to other co-op)	0.06	0.05	1.09	0.277	-0.05	0.16
HC (Solidarity)	0.33	0.08	3.93	0.000	0.16	0.49	HC (Closeness to other co-op)	0.24	0.12	1.96	0.050	0.00	0.48
HI (Solidarity)	-0.13	0.08	-1.63	0.103	-0.28	0.03	HI (Closeness to other co-op)	-0.25	0.12	-2.16	0.031	-0.48	-0.02
Intercept (Trust)	3.44	1.02	3.37	0.001	1.44	5.45	Intercept (Ingroup bias)	2.58	0.95	2.70	0.007	0.71	4.44
Mean co-op (Trust)	0.23	0.07	3.39	0.001	0.09	0.36	Mean co-op (Ingroup bias)	0.20	0.06	3.36	0.001	0.08	0.32
HC (Trust)	0.13	0.13	0.96	0.335	-0.13	0.38	HC (Ingroup bias)	0.16	0.12	1.31	0.190	-0.08	0.39
HI (Trust)	-0.02	0.12	-0.19	0.848	-0.26	0.22	HI (Ingroup bias)	0.08	0.12	0.72	0.473	-0.14	0.31
Intercept (Interdependent goals)	2.74	0.67	4.09	0.000	1.43	4.05	Intercept (Perceived Competition)	4.60	1.02	4.50	0.000	2.59	6.61
Mean co-op (Interdependent goals)	0.25	0.05	4.89	0.000	0.15	0.34	Mean co-op (Perceived Competition)	-0.14	0.06	-2.25	0.024	-0.27	-0.02
HC (Interdependent goals)	0.20	0.09	2.40	0.017	0.04	0.37	HC (Perceived Competition)	0.27	0.13	2.05	0.040	0.01	0.53
HI (Interdependent goals)	-0.13	0.08	-1.61	0.106	-0.29	0.03	HI (Perceived Competition)	-0.27	0.12	-2.17	0.030	-0.51	-0.03
Intercept (Independent goals)	4.36	0.63	6.90	0.000	3.12	5.59							
Mean co-op (Independent goals)	-0.19	0.04	-4.31	0.000	-0.28	-0.10							
HC (Independent goals)	-0.08	0.08	-1.03	0.303	-0.24	0.08							
HI (Independent goals)	0.32	0.08	4.20	0.000	0.17	0.47							

Results. The intra-class correlations from the null model show that 32% of the unexplained variance lies at the game level; 8% at the co-op level; 12% at the individual level and 48% at the round level. The conditional growth model with random slopes provided the best fit to the data and is reported here¹⁹. For model comparisons see Table C5 in Supplementary Information C.

There was a negative effect of round on cooperation ($\beta = -0.12$, $SE = 0.02$); as well as a negative interaction between round and condition ($\beta = -0.06$, $SE = 0.03$). Overall, cooperation decreased over time in both conditions and furthermore, cooperation broke down more rapidly in the Interpersonal Ties condition compared to the Social Categories condition, as visualized in Figure 19. Given the results of our previous research (see Chapter 2 and 3), we were not expecting such low levels of cooperation at the start of the game (although we had hoped to lower it somewhat), nor did we expect a drastic decline over time.

Nevertheless, our findings partially support Hypothesis 4 – there was indeed higher cooperation in the Social Categories condition. Furthermore, following Expectation 5, the predicted decrease in cooperation in the Social Categories condition was supported (but not the predicted initial level of stability), while the expectation that cooperation would increase for the Interpersonal Ties condition found no support in this analysis. Figure 20 shows the variation between co-ops in each condition, and the general pattern of increasing defection seems strong, with only a few co-ops (for example in the Social Categories condition) showing slightly higher and more stable levels of cooperation.

Using the above presented model as a base model, we could test whether cultural values (H-C, V-C, H-I or V-I) had any additional explanatory value on cooperation over time and we also tested whether it had an effect on the first round of interaction. Neither model showed any effect for any of the cultural factors. For the sake of space, we just report the model for initial contributions, because in this model culture would be less likely contaminated by group processes²⁰ (see Table 12 below). Since cultural values had no effect on actual behavior, Expectation 6 is not supported.

¹⁹ Random slopes are modelled at the co-op level and not the game level, despite most of the intercept variance lying at the game level. This is supported by model fitting: (BIC (reported model) = 14527.7, BIC (random slopes for game) = 14556.3). Looking at the raw data, there appears to be only one game where the co-ops acted similarly, therefore we expect the variance at the game level is high due to this one game.

²⁰ Note: we also tested whether the cultural variables, aggregated by co-op, had an effect on cooperation and they did not.

Figure 19. Average cooperation over time

Figure 20. Co-op cooperation over time

Table 12

The effect of cultural values on cooperation

	Amount
Condition: Interpersonal Ties	-4.59 (7.25)
V-I	-0.12 (0.68)
V-C	-0.24 (0.59)
H-I	0.23 (0.97)
H-C	1.26 (1.03)
Constant	23.87** (10.07)

Note: *** $p < .01$; ** $p < .05$; * $p < .1$

Classifying cooperative behavior, types of individuals, and types of co-ops

Method. In order to take into account the dynamic nature of an individual's decisions regarding how much to cooperate with the co-op on a round-by-round basis, as well as to classify, based on similar characteristics, the co-ops that formed, we applied a multilevel latent class Markov model using Latent Gold (Version 5.1) (Vermunt & Magidson, 2016). The same analytic method and model building procedure for the latent class model was followed from our previous studies (Chapter 2 and 3 of this thesis). The details have already been explained in previous chapters so will not be repeated here.

In summary, this model allowed us to classify an individual's decision rule which informs one's level of cooperation or defection in a particular round (i.e., how much one contributed to the Public Good). Decision rules are dynamic, which means that they can change from round to round, where changes are modelled based on one's decision rule in the previous round; as well as the type of individual one is classified as at the higher level of the model. The model therefore also classifies the types of individuals and the types of co-ops that form, according to similar shared properties. The individual and co-op classes are stable (unlike the decision rules) and do not change from round to round. The main benefit of using this type of analysis is that while the multilevel growth model provides a descriptive view of the data, the latent class model used here provides a more nuanced view of the round-by-

round behavior, which fits the data better and overcomes the violation of the assumption of homoscedasticity which is required for the multilevel growth model.

Results. The estimated model specified 5 decision rules, 3 individual classes and 3 co-op classes. For the details of model selection, the reader is directed Table C6, and a subsequent description, in Supplementary Information C.

Level 1: Decision rules for cooperation. We labelled the five decision rules as: Maximum Cooperation, Marginal Cooperation, Ambivalent Defection, Near-Defection and Complete Defection, due to their features discussed below. The regression results for the decision rules can be found in Table 13, with their overall relative frequency and the mean amount contributed to the Public Good (PG), with which they are associated. The history of the game had a significant effect on which decision rule would be chosen: both for own lagged amount ($\chi^2(5) = 28.13, p < 0.01$) and the mean lagged amount for the co-op ($\chi^2(3) = 41.42, p < 0.01$). Further, the decision rules at the beginning of the experiment differed significantly from one another ($\chi^2(4) = 73.64, p < 0.01$), predicting different levels of cooperation from round one. In addition, the transition probability matrices of the five decision rules were significantly different ($\chi^2(20) = 218.78, p < 0.001$). Descriptions of these transition results are elaborated on below and found in Table 14.

Table 13

Five Decision rules: Description and Regression Results

	Maximum Cooperation	Marginal Cooperation	Ambivalent Defection	Near - Defection	Complete Defection
Overall relative frequency	0.07	0.29	0.14	0.21	0.29
Mean Amount	10	4.6	2.09	1	0
Intercept	10	3.440	2	1	0
Time Dummy ¹	0	-0.761	1	0	0
Lagged amount (own)	0	0.149	0	0	0
Lagged amount (co- op)	0	0.268	0	0	0
Residual variance	0.008	3.019	0.004	0.003	0.002

Table 14

Transition Probabilities of the Decision rules

		Present Decision rule				
Previous decision rule		Maximum Cooperation	Marginal Cooperation	Ambivalent Defection	Near-Defection	Complete Defection
	Maximum Cooperation	0.66	0.21	0.03	0.03	0.08
	Marginal Cooperation	0.05	0.49	0.15	0.15	0.16
	Ambivalent Defection	0.01	0.33	0.24	0.26	0.16
	Near-Defection	0.01	0.15	0.19	0.41	0.25
	Complete Defection	0.02	0.11	0.08	0.16	0.63

The two most common decision rules guiding the level of cooperation were: Complete Defection and Marginal Cooperation – both with a 29% probability occurring throughout the game.

The amount contributed when guided by Complete Defection ($M_{\text{amount}} = 0$) could not be predicted by the history of the previous round – neither by one's own lagged amount ($b = 0$) nor by the lagged amount of the co-op ($b = 0$). From the transition probabilities in Table 14, if one chose Complete Defection in one round, there was a 63% chance that it would remain the decision rule in the next round; while there was only a 11% chance that one would subsequently be guided by Marginal Cooperation. By comparing the transition probabilities of all 5 decision rules, Complete Defection was one of the most stable decision rules, with only Maximum Cooperation being 3% more stable (see Table 14). Complete Defection had almost no residual variance ($\sigma^2 = 0.002$), which makes sense given that it embodied the floor effect for cooperation.

Marginal Cooperation ($M_{\text{amount}} = 4.6$), as prevalent as Complete Defection, was the decision rule associated with the second highest contribution level. Both own lagged amount ($b = 0.149$) and the lagged amount of the co-op ($b = 0.268$) had a significant effect on the amount contributed to the PG. This indicates that if one contributed a high amount in the previous round and one's co-op contributed even higher, then one was likely to presently draw on Marginal Cooperation as their decision rule. Although not part of the regression results or transition probabilities, examination of the posterior probabilities provides further support for this interpretation: If, in the previous round, one had contributed in the higher

range (6 - 10 tokens), or median range (around 3 - 5 tokens) then one was likely to use Marginal Cooperation in the following round with a 48% and 37% probability, respectively. In addition, one was also likely to choose this decision rule if one's co-op contributed a higher amount in the previous round. For example, if the co-op contributed an average of 3 – 5 tokens then there was a 42% chance selecting Marginal Cooperation in the following round, and a 39% chance if the co-op gave around 5 -10 tokens.

After selecting Marginal Cooperation, there was a 49% chance of remaining with this decision rule and only 5% chance of transitioning to Maximum Cooperation (see Table 14). In addition, there was about an equal chance (~15%) of transitioning into the remaining three decision rules. The residual variance for this rule was very high ($\sigma^2 = 3.019$).

The decision rule to contribute the maximum amount (10 tokens), labelled Maximum Cooperation, occurred only 7% of the time. The amount contributed when using this decision rule could not be predicted by one's own lagged amount nor by the lagged amount of the co-op ($b = 0$ for both). If in the previous round, an individual used the Maximum Cooperation decision rule, they had a 66% of doing the same in the following round, and a 21% chance of transitioning into Marginal Cooperation. There was a much lower chance of someone switching from Maximum Cooperation to the three lowest contributing decision rules: Complete Defection (8%); Near-Defection (3%) and Ambivalent Defection (3%). It therefore appears that Maximum Cooperation was a fairly resilient decision rule; especially considering that there was a high incidence of Complete Defection in the game. Since Maximum Cooperation was the ceiling effect for cooperation, the residual variance was almost nil ($\sigma^2 = 0.008$).

Finally, the remaining two decision rules are quite similar to one another. Neither could be predicted by one's own contribution in the previous round, nor by the contribution of the co-op ($b = 0$ for both decision rules and both predictors). Near-Defection ($M_{\text{amount}} = 1$) occurred 21% of the time and Ambivalent Defection ($M_{\text{amount}} = 2.09$), 14%. Both decision rules were close to Complete Defection in terms of their mean amounts and both had almost no residual variance ($\sigma^2 = 0.004$ and $\sigma^2 = 0.003$ for Ambivalent Defection and Near-Defection respectively). However, comparison of the transition probabilities (Table 14) indicates that individuals choosing Near-Defection in one round, compared to those selecting Ambivalent Defection, had a 9% greater chance of transitioning to Complete Defection in the following round. Furthermore, people who selected Ambivalent Defection showed an 18% greater chance of transitioning into Marginal Cooperation, compared to those who selected

Near-Defection. Finally, if one chose Ambivalent Defection, rather than Near-Defection, one was slightly more likely (9%) to transition into Marginal Cooperation than to stay stable (i.e., to remain with Ambivalent Defection). These findings suggest that there was a greater likelihood for people selecting Ambivalent Defection to become more cooperative in later rounds of the game (thus the label), while people selecting Near-Defection were a lot more likely to defect completely and not remain as open to future cooperation.

Figure 21. Decision Rules over time

As Figure 21 shows, overall, Marginal Cooperation decreases over time while Complete Defection increases. In sharp contrast to Chapters 2 and 3, Maximum Cooperation is least likely to occur and does not increase over time.

Level 2: Individual classes. There were three classes into which individuals were classified. Two of them were quite similar in overall relative frequency: Marginal Cooperators (45% of individuals, $M_{\text{amount}} = 3.14$) and Defectors (43%, $M_{\text{amount}} = 1.09$). The highest contributors, Resilient Cooperators ($M_{\text{amount}} = 5.60$), made up the remaining 12%. These classes differed from one other, both in terms of the decision rule that they primarily selected at the beginning of the game ($\chi^2(8) = 32.02, p < 0.001$) and in terms of their transition probability matrices (i.e., the chance of transitioning from one to each of the other decision rules; $\chi^2(40) = 437.98, p < 0.01$, see Table 15).

Table 15

Transition probabilities for Individual Classes

		Starting Decision rule					
		Individual Class	Maximum Cooperation	Marginal Cooperation	Ambivalent Defection	Near-Defection	Complete Defection
		Resilient	0.14	0.56	0.05	0.19	0.05
		Marginal	0.09	0.56	0.21	0.09	0.05
		Defectors	0.00	0.42	0.09	0.23	0.25
		Present Decision rule					
Individual Class	Previous Decision rule	Maximum Cooperation	Marginal Cooperation	Ambivalent Defection	Near-Defection	Complete Defection	
Resilient	Maximum Cooperation	0.85	0.15	0.01	0.00	0.00	
	Marginal Cooperation	0.33	0.52	0.11	0.00	0.03	
	Ambivalent Defection	0.12	0.00	0.48	0.40	0.00	
	Near-Defection	0.01	0.00	0.09	0.89	0.00	
	Complete Defection	0.31	0.39	0.00	0.00	0.29	
Marginal	Maximum Cooperation	0.30	0.36	0.08	0.11	0.15	
	Marginal Cooperation	0.03	0.49	0.18	0.16	0.14	
	Ambivalent Defection	0.00	0.45	0.25	0.22	0.08	
	Near-Defection	0.02	0.33	0.29	0.28	0.08	
	Complete Defection	0.10	0.38	0.19	0.13	0.19	
Defectors	Maximum Cooperation	0.00	0.00	0.00	0.00	0.99	
	Marginal Cooperation	0.02	0.45	0.10	0.16	0.28	
	Ambivalent Defection	0.01	0.11	0.13	0.34	0.41	
	Near-Defection	0.00	0.05	0.13	0.35	0.47	
	Complete Defection	0.00	0.05	0.05	0.16	0.73	

Overall, Marginal Cooperators used the Marginal Cooperation decision rule 45% of the time, more so than Defectors (14%) and Resilient Cooperators (22%). Furthermore, 21% of the time they drew on Ambivalent Defection – which we know from the transition probabilities of the decision rules, was likely to increase the chances of future cooperation. At the beginning of the interaction (round one), 56% of Marginal Cooperators chose Marginal Cooperation and only 8%, Maximum Cooperation. In addition, Marginal Cooperators who selected Complete Defection in one round, although they had an 18% chance of remaining with it, had a 38% chance of switching to Marginal Cooperation.

Defectors chose Complete Defection 55% of the time and chose Maximum Cooperation less than 1% of the time. In the first round of the game, Defectors had a 42% probability of being guided by Marginal Cooperation and a 25% chance of Complete Defection; suggesting that defection, rather than cooperation, increased over time. Strikingly, there was a zero probability that Defectors would begin with Maximum Cooperation. Defectors using Complete Defection in one round of the PGG, had a 73% probability of sticking with Complete Defection in the following round. Finally, none of the Defectors who chose Maximum Cooperation would continue to cooperate the following round, instead they had a 99% chance of switching to Complete Defection.

Resilient Cooperators, the smallest class of individuals, mostly employed the decision rules of both Maximum Cooperation (41% of the time) and Marginal Cooperation (22%), and only selected Complete Defection 2% of the time. 14% of Resilient Cooperators begun by choosing Maximum Cooperation and 56%, Marginal Cooperation – fairly similar to Marginal Cooperators. Therefore, Marginal and Resilient Cooperators begun similarly but came to differ in their cooperation strategies throughout the course of interaction. Resilient Cooperators who used Complete Defection in one round, only had a 29% chance of continuing to do so and were actually 10% more likely to select Marginal Cooperation in the subsequent round. When Resilient Cooperators used Maximum Cooperation in the previous round, they had an 85% probability of sticking with it, a 15% chance of subsequently selecting Marginal Cooperation, and zero probability of turning to Complete Defection.

Level 3: Co-op classes. Finally, at the highest level, three classes of co-ops were estimated. The Breakdown Co-op ($M_{\text{amount}} = 1.93$) was the most common type of co-op to form (64%), followed by the Struggling Co-op (30%, $M_{\text{amount}} = 3.35$) and lastly, the Resilient Co-op (6%, $M_{\text{amount}} = 5.56$). The three co-op classes which formed differed in terms of the classes of individuals present ($\chi^2(4) = 21.61, p < 0.01$).

In previous studies, in Chapter 2 and 3 of this thesis, we found near perfect overlap between all individual and all co-op classes (in the 99% range) which we interpreted to indicate norm formation within co-ops. However, here we do not find such a strong pattern of norm formation in the present study. The Breakdown Co-op, showed the lowest degree of norm formation consisting of 66% of Defectors, 30% of Marginal Cooperators and only 4% of Resilient Cooperators. The Struggling Co-op was mostly made up of Marginal Cooperators (85%) but also had Resilient Cooperators (11%) and a few Defectors (3%). Finally, the Resilient Co-op shows the strongest norm formation with 99% of people being Resilient Cooperators. This pattern suggests that when there are even a few Defectors in the group, people seem to find it harder to align their behavior as they are reacting to this defection. Without Defectors, and when cooperation is fairly high, norm emergence occurs more easily.

At the co-op level, we tested whether the experimental condition (Interpersonal Ties versus Social Categories) had a significant effect on the type of co-op that formed. As with previous studies in Chapter 2 and 3, we only found a marginal effect for the experimental condition predicting the class of co-op ($\chi^2(2) = 4.75, p < 0.09$). Closer inspection revealed a further, albeit marginal difference as to whether the Breakdown or Resilient Co-op would form ($\chi^2(1) = 3.33, p = 0.06$), but no effect for the Struggling Co-op. This is not a strong result by any means but it does suggest that in the Social Categories condition 74% of co-ops were Breakdown Co-ops; 16% Struggling and 10% Resilient. In the Interpersonal Ties condition, 56% were Breakdown Co-ops and 44% Struggling. Interestingly, no Resilient Co-op's seemed to form in the Interpersonal Ties condition where interpersonal ties rather than social categories were made salient.

From Figure 22 we can see that both the Breakdown and Struggling Co-ops show low levels of contributions over time and this decreases from the first rounds. The Resilient Co-op shows an initial increase in cooperation (having started similarly to the Struggling Co-op) and this levels off and stays around the midpoint of what is possible to contribute. The three co-op classes which formed (largely independently of the experimental condition) provides some support for Expectation 7, although the norm formation, in two of the three co-ops, was not as strong as we may have expected given our previous research (Chapter 2 and 3).

Figure 22. Co-op class contributions over time

Individual level covariates. Our latent class model included social psychological measures as inactive covariates – meaning that they do not change the regression coefficients of the model but can be used to further describe the different individual classes (Vermunt & Magidson, 2016). The full results are reported descriptively in Table 16 below.

The general pattern indicates that Resilient Cooperators experience above average solidarity, Defectors experience below average solidarity and Marginal Cooperators experience average levels of solidarity. The exact same pattern exists for experiences of trust and a similar pattern is present for the perception of interdependent goals (although here, Marginal Cooperators score slightly more above average). Other notable patterns include that: Resilient Cooperators score below average on perceptions of independent goals, while Defectors score above average and Marginal Cooperators score average. Resilient Cooperators are also more biased against the other co-op (in the sense that they felt their co-op was better) but also experience above average levels of closeness to the other co-op. Since Resilient Cooperators also perceived lower than average competition between co-ops, this sense of closeness to the other co-op indeed seems plausible, assuming ingroup favouritism and outgroup derogation are not mutually exclusive. Finally, Defectors perceive above average competition between the co-ops.

Table 16

Breakdown of probabilities for social psychological correlates by individual class

	Level on Scale	Marginal Cooperators	Defectors	Resilient Cooperators
Solidarity	High	43%	37%	20%
	Mean (3.8)	52%	43%	5%
	Low	44%	50%	6%
Trust	High	40%	38%	22%
	Mean (4.5)	55%	39%	6%
	Low	46%	51%	3%
Interdependent goals	High	48%	34%	18%
	Mean (3.6)	45%	45%	5%
	Low	42%	53%	11%
Independent goals	High	41%	52%	7%
	Mean (5.4)	47%	45%	8%
	Low	47%	36%	17%
Bias against the other co-op	High	43%	38%	19%
	Mean (4.4)	45%	49%	6%
	Low	45%	48%	7%
Perceived competition between co-ops	High	37%	53%	10%
	Mean (4.17)	59%	32%	9%
	Low	48%	37%	15%
Closeness to other co-op	High	45%	39%	16%
	Mean (2.6)	46%	47%	7%
	Low	44%	46%	10%

Note: Rows sum to 100%. Each cell percentage indicates the probability that the given type of player would score in a certain range on the given measure. To simplify the presentation of the results we collapsed the probability above and below the mean of the given measure (which is recorded in brackets). The low percentages in the column for Resilient Cooperators reflect their low numbers in the data.

Discussion

In this Chapter, we aimed to extend our previous work from Chapter 2 and 3 of this thesis. We studied cooperation with the same Public Goods paradigm, but in the South African context and with the addition of monetary incentives. Our aim stated at the beginning of this paper – to lower initial cooperation levels and increase the variance in cooperation – proved effective, perhaps too much so. Nevertheless, we replicated the previously found strong norm emergence, in one of the three types of groups.

Overall Levels of Cooperation

Overall, cooperation was low and declined over time in both conditions. This result contrasts with our previous studies in Chapter 2 and 3. First, it is possible that while the experimental manipulation and condition enhanced the normative goal, incentivizing participants by their end token balance made the goal of obtaining higher gains more salient, thus defection was more prevalent (e.g., Lindenberg, 2015b).

Second, the societal context may account for differences among cooperation across the three studies. However, we should note that one's cultural values (both vertical and horizontal collectivism and individualism) had no effect on actual cooperation in this study, although H-C and H-I had some effect on the perceptions of the group and one's feelings toward the group. This suggests that between-person differences in cultural values cannot explain the low levels of cooperation, and that perhaps cooperation is more strongly an emergent property of group interaction.

A third possible explanation for the low levels of cooperation could be a lack of trust at a societal level: Research suggests that if societal institutions, like government structures, are not trusted – arguably the case in South Africa – this may spillover into lab behavior in social dilemmas (Jordan et al., 2014; Peysakhovich & Rand, 2016). Relatedly, the present study was conducted in the wake of the Fees Must Fall protest movement in South African universities (2015-2016); where student activists were protesting ever-increasing university fees, as well as arguing for the decolonization of education. In the aftermath of such a movement, mistrust in the university as an institution could also have been a factor that perhaps explains a different relationship between participants and the university institution (as represented by the experimenter), compared to their European counterparts in Chapters 2 and 3.

However, we unfortunately did not measure participants' trust in societal institutions pre-experimentally (nor cultural values in Chapters 2 and 3) and therefore, we cannot determine a possible macro-level societal explanation for the prevalence of defection in these data.

Pattern of Cooperation in the Social Categories and Interpersonal Ties Groups

From previous research (Chapter 2 and 3) we expected that overall, cooperation would be higher in the Social Categories condition, as social categories appear to be effective in creating contexts for cooperation to flourish. Literature in the field of intergroup relations and

social identification support such a supposition (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Turner, 1991; Wit & Kerr, 2002). This expectation was only partially confirmed: While cooperation was very low in general and decreased over time in both conditions, it was still slightly higher overall, and broke down slower, in the Social Categories compared to the Interpersonal Ties condition. This may suggest that even if defection is rife in a particular environment, social categorization may still have a beneficial effect – even though it cannot, at least by itself, prevent the downward spiral of cooperation when other forces are at play.

If one considers the overall pattern of cooperation given by the first analysis, one might believe that people “bottom out” in the same way as they “maxed out” in Chapters 2 and 3. However – through the analytic methods employed here – we see that one type of stable group aligns their decision rules regarding cooperation, while the other two groups show a lot of variation (i.e., they do not all bottom out), and lack the same norm emergence (even a norm of complete defection).

Strategies for Cooperation and Defection

We found that essentially three distinct types of decision rules emerged²¹: Maximum Cooperation (amount contributed: 10), Defection (0, 1, or 2) and something in between – which is guided by the past contributions of self and co-op members. Compared to our previous two studies in Chapter 2 and 3, Maximum Cooperation rarely occurred.

Furthermore, each type of individual (Resilient Cooperator, Marginal Cooperator and Defector) employed a different set, and proportion of, the decision rules to guide their cooperation in the PGG and these different types of individuals were associated with different social psychological measures. Resilient Cooperators, for example, were more likely to experience higher than average levels of solidarity and trust.

Different proportions of these individual types were found at the co-op level such that we could classify three co-op classes in the present study: The Breakdown, Struggling and Resilient Co-op. In our previous research, we have shown how cooperation develops over time and group norms for cooperation are established such that behavior is consistent within a type of co-op and different among types of co-ops (see Chapter 2 and 3). For Resilient co-ops

²¹ The model classified 5 types of decision rules, but for the sake of discussion we collapse some of the similar ones.

in this study, this general finding was replicated as there was 99% overlap between the individual and co-op class such that Resilient Co-ops were made up almost entirely of Resilient Cooperators. There was not this same strong norm formation in the Struggling Co-op (consisting of 85% Marginal Cooperators, 11% Resilient Cooperators, 3% Defectors) and less so in the Breakdown Co-op (66% Defectors, 30% Marginal Cooperators, 4% of Resilient Cooperators). Therefore, it appears that cooperative actions (such as contributing highly or maximally to the PG) create an environment conducive to the convergence on a common pattern of behavior among all group members; while uncooperative environments – where there are even a few Defectors – result in a misalignment of behavior because people have different decision rules regarding what to do. For example, some individuals try to increase cooperation and show goodwill by cooperating no matter what, others indicate their own self-interest – or lack of trust – by defecting, and others still react to that defection (i.e., play tit for tat; Axelrod, 1984). Cooperation is hard to build and maintain in environments such as these.

While stable groups emerged in both previous studies as well as in one of the groups in the present study, there was a lot of variation in behavior within the other two types of groups – groups which showed a breakdown in cooperation over time. What is hopeful about these uncooperative groups though, is that despite the presence of defectors and despite cooperation going down over time, Resilient and Marginal Cooperators continued to cooperate at least to some extent, perhaps even preventing the complete breakdown of cooperation (see Figure 22). Clusters of these more cooperative types of individuals (also tit-for-tat cooperators; Axelrod, 1984), through their persistent interaction with one another, could change uncooperative norms, thus preventing cooperative decline (also see Mao et al., 2017; Weber & Murnighan, 2008).

Social Psychological Correlates of Cooperation and Defection

As we had expected, there were no differences between the Social Categories and Interpersonal Ties conditions on measures of solidarity and related social psychological constructs. We had expected this based on previous research (Chapter 2 and 3 of this thesis) and the theoretical argument laid out by the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005). However, apart from experimental condition, we did find that the more one's co-op members cooperated, the greater one experienced solidarity to the group, but also bias against the other group (in the sense that participants felt their co-op was better, and should have received an additional

bonus). Therefore, interaction within the group rather than the a priori social category has the greatest impact on one's perception of group relations, and these perceptions are important because they would likely motivate future interaction in the form of cooperation or defection.

The role of cultural preferences

Over and above the co-ops' average cooperation levels, one's cultural values also affected the level of 'groupiness' one perceived. For example, higher horizontal collectivism was associated with greater solidarity (even more than the co-ops' contributions), as well as the perception of interdependent goals within the co-op. On the other hand, horizontal individualists were more likely to perceive that their co-ops' goals were independent (also more than the co-ops' contributions). So, while cultural values did not appear to affect one's behavior, in terms of contributions in the first round or indeed in later rounds, they did still influence the perceptions of one's co-op and the goals of its' members.

Limitations and Future Directions

In Chapter 2 and 3 of this thesis, we found very high levels of cooperation compared to the present study. Because several changes were made to the experimental design between Chapter 3 and the present research, we cannot draw any definitive conclusions as to why, compared to the previous studies, the overall level of cooperation was lower and declined over time. In our view, there could be two plausible explanations: 1) differences in the societal context could have resulted in defection being more prevalent than cooperation, and 2) a gains goal frame – activated by tokens having an instrumental, rather than purely symbolic value – outweighed a normative goal frame – activated by the framing of the experiment. Future research could explicitly tease apart these possible explanations by running identical studies in these two different societies. These studies could manipulate the social identification pathway and compare an instrumental to symbolic outcome condition; also including societal level pre-measures (culture, trust etc.).

Conclusion

Cooperation can emerge in groups where normative patterns for decision making are established that result in high levels of rather stable cooperation, as evidenced by one type of co-op in this study, and in line with the previous Chapters. However, even under similar circumstances, unstable groups also arise which cannot align their decision rules of

cooperation and cooperation further devolves in these groups over time. Nevertheless, these uncooperative groups still contain cooperating individuals – and perhaps in greater numbers, these individuals could potentially change the group norm and allow for the emergence of future cooperation. Finally, while dynamic factors within the group are evidently important for the emergence and maintenance of cooperation, it is perhaps ‘static’, macro-level factors – such as the goal frame, culture or societal context – that can kick start, or indeed hamper, the emergence of cooperative group norms.

Chapter 5: The Role of Communication in Fostering Cooperative Norms

Abstract

Past research has shown that communication in social dilemmas is associated with better cooperative outcomes. However, not much is known about the content of the communication which arises naturally within groups and that facilitates or hinders the emergence of cooperation. In this Chapter, we study the content of the messages sent by participants during the Public Goods Games presented in Chapter 3 and 4. Using a mixed-methods approach, we find that messages coordinating cooperative action appear to facilitate cooperation, especially when it is used in combination with attempts to promote group solidarity. Agreement and interpersonal bonding can also be valuable in creating a cooperative environment. Further, sanctioning did not appear to be effective in building good, cooperative relationships, in fact it was harmful. Taken together, group-based communication, when it has a certain prosocial quality and is aimed at the level of “us”, aids in the creation of prosocial norms for cooperation and thus may allow groups to develop shared understandings, mutual expectations and emergent social identities.

In Chapters 2 through 4 of this thesis we studied the emergence of cooperative behavior over time in three large dynamic Public Goods Games, conducted in the Netherlands and in South Africa. As noted in these chapters, participants could communicate with one another in between contribution rounds of the game, after they had received full feedback regarding the amount that their co-op members had just contributed. We found a rather large coherence within co-ops with respect to the cooperative behavior of their members. In other words, members of the same co-op aligned their decision rules on how much to contribute to the Public Good, and this was especially true of all co-ops in Chapter 2 and 3, and for one co-op in Chapter 4. In the present Chapter we explore the content of those messages in order to see whether there are any patterns in communication which help to distinguish cooperative from non-cooperative co-ops.

Overall, the ability to communicate has been shown to increase cooperation in social dilemmas (Balliet, 2010; X. Chen & Komorita, 1994; Dawes et al., 1977; Ledyard, 1995). It is hypothesized that communication can facilitate cooperation through: 1) enhancing the understanding of the PG situation; 2) providing a means of coordinating action; 3) leading to the creation of cooperative social norms; 4) allowing strategic agreements to be formed; 5) enhancing trust in others; and 6) establishing a social identity (N. L. Kerr & Kaufman-Gilliland, 1994; Shankar & Pavitt, 2002). By providing the means to communicate, people have an opportunity to facilitate cooperation, potentially through one, or many, of the proposed mechanisms, thus leading to cooperative outcomes. However, the simple ability to communicate may not be enough: *what* is communicated is important. The focus of this Chapter is to explore the role of communication in the formation of cooperative versus non-cooperative group norms.

Developing shared expectations

One potential explanation is that communication allows pledges to occur and there is indeed evidence that a pledge with a certain degree of bindingness – in other words, having to follow through on what you have pledged – can increase cooperation (for example, X. Chen & Komorita, 1994). Pledging may be important as it provides information about the intended contributions of others; while commitments limit the degree of false information or strategically misleading pledges that may occur. In addition, the effect of pledging enhances cooperation more if the pledge is group-based rather than an individual pledge (X. Chen, 1996). In the former case, commitments are less changeable because there is a greater sense of

social pressure, and a fear of violating group norms. Indeed, of all the potential explanations for how communication facilitates cooperation, Bicchieri and Lev-On (2007) argue that it seems most plausible, given current experimental evidence, that the likely pathways are through developing mutual expectations for future behavior – often done through pledging and keeping commitments– and by enhancing the salience of pro-social norms.

Social identification

Group-based pledging also creates a condition in which there is greater interdependence and a sense of common fate among group members – which are also important aspects of social identification (Turner, 1991). Indeed, some scholars suggest that the emergence of social identity, through social categorization for example, may result in higher cooperation levels (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Simpson, 2006; Wit & Kerr, 2002). A study by Chen (1996), found partial support for the idea that group identity, arising through communication, plays some role in the emergence of cooperation. While group identity and mean contribution levels were found to be higher in a group-based, compared to an individual-based pledge condition, higher group identity in itself did not lead to higher contributions. So, while social identity through communication may play a role, it appears that it interacts with other factors – such as perceived criticality, that is, the view that one’s individual contributions will make a difference to the shared outcome in terms of the public goods payout – in order for it to have an effect on cooperation. Furthermore, Shankar and Pavitt (2002) argue that norms for cooperative behavior – established through communication – may play a stronger role than social identity in enhancing cooperation. Undoubtedly, however, social norms and social identities are closely related as norms exist with reference to a particular set of social relations, therefore both would be important.

Establishing norms

Communication in itself, can help to establish a normative environment in which cooperation can emerge (Bicchieri & Lev-On, 2007). Indeed, in the previous Chapters of this thesis, we have also seen this to be the case: Specific types of co-ops emerge through interaction and group members within the co-op share the same norms regarding which decision rules to use. In turn, this influences the trajectory of their groups’ cooperation or lack thereof. Furthermore, these types of co-ops form in both social identity pathways – deductive

and inductive groups. What is less clear, both from our own research in this thesis as well from arguments by scholars such as Shankar and Pavitt (2002), is *how* these different norms may arise through communication. Clues to the different pathways to cooperative norms may be found by examining the content of the messages sent during interaction. As far as we are aware, however, there has not been very much exploration of message content in prior social dilemma research.

Computer-mediated communication

Literature examining the idea that communication can increase cooperation has also been concerned with the question of which medium is suitable for the maintenance of successful social relations. The early predominant assumption was that computer-mediated communication would be relatively impersonal (for discussions see Hiltz & Turoff, 1978; Kiesler, Siegel, & McGuire, 1984; Short, Williams, & Christie, 1976), while face-to-face communication was shown to be effective at increasing cooperation (for example see, Dawes et al., 1977). Accordingly, some more recent research has shown that face-to-face interaction may be somewhat more effective in facilitating cooperation (Bicchieri & Lev-On, 2007; Frohlich & Oppenheimer, 1998). At the same time, there is a rich program of research which shows that these social effects depend on the social context of the collaboration (e.g., whether a shared identity exists from the outset of the interaction or not) and that within online collaborations there is a strong tendency for social norms and shared identity to develop hand in hand, over time (for example, Postmes, Spears, & Lea, 1998, 1999, 2000; Postmes, Spears, Lee, & Novak, 2005).

Sanctioning and social disapproval

Finally, communication provides the means through which one can sanction others for non-cooperative behavior. Social order, created through the establishment and maintenance of social norms supporting cooperation, may require norm enforcement by means of sanctioning and punishment. Punishment lessens the appeal of free-riding due to the potential cost associated with being ‘caught’. A meta-analysis on the effect of punishment on cooperation shows that overall, punishment has a medium sized, positive effect on cooperation (Balliet, Mulder, & Van Lange, 2011). Furthermore, punishment is even more effective when it is costly to the punisher; when it is decentralized; and when interaction occurs over time (Balliet et al., 2011).

However, there is much debate in the literature about the exact definition of sanctioning and punishment (e.g., Guala, 2012). For example, from a game-theoretic perspective, endogenous punishment is usually operationalized as the direct fining of a non-cooperative individual by another individual who, serving the role as punisher, also pays a price to sanction. In the real world, punishment can include a wide range of strategies such as ridicule, gossip, verbal confrontation and social ostracism – strategies which are not directly linked to an explicit or immediate financial cost for either the punisher or punished.

In our research, we did not allow participants to punish one another instrumentally, thus we define sanctioning here as the expression of social disapproval for non-cooperation. Indeed, communicated social disapproval can be seen as a form of symbolic punishment which might not be very costly to the punisher – although, of course there may be psychological costs or even social costs to doing the sanctioning, especially if it is viewed by others as illegitimate. Nevertheless, the costs to punish or express social disapproval are not formalized in the games of this thesis.

How people respond to sanctioning, including the verbal expression of disapproval, will likely depend on how they interpret the sanction in the first place. From a sociological perspective, sanctioning can either have a positive or negative relational signal attached to it (Wittek, 2003). Sanctioning, when it expresses a positive relational signal, will cue to the receiver of the sanction, the giver's openness to repairing the relationship so that this may remain or become mutually rewarding in the future. On the other hand, sanctioning which expresses a negative relational signal will likely escalate the sanctioning-retaliation cycle because the cue to maintain a solidarity relationship is lost. Therefore, the way in which the giver communicates one's social disapproval for non-cooperative behavior *and* how the receiver interprets this message would likely affect the effectiveness of the sanction.

Aim

In this Chapter we explore, with a mixed methods approach, how different forms of communication over time are related to the emergence of cooperative norms. While this Chapter is exploratory and partly qualitative in nature, from the literature reviewed above some general ideas can be evaluated about how communication may facilitate cooperative norms. First, communication which enhances a shared social identification with the group may facilitate a sense of common fate, and willingness to place collective-interest over narrow self-interest, thus leading to higher levels of cooperation. Second, developing mutual

expectations and coordinating action, perhaps through individual pledging, may increase cooperation. Finally, if sanctioning occurs and is interpreted as having a positive relational signal, it could be effective for increasing cooperation. On the other hand, if sanctioning is associated with a negative relational signal it might not be effective and might even result in further defection.

Method

Data

Participants could send messages to one another between the active rounds of the game (i.e., between contributions to the PG). Before each communication round, participants received full feedback onscreen regarding everyone's contributions to the PG. Then, before the next contribution round, participants could send messages to one another for a brief period – 40 seconds per communication round. Messages were very short with a character limit of 100 but there was no limit on the number of messages that they could send within the communication period. Needless to say, across 3 studies of 780 participants, there were many messages – a total of 15,774 across all three studies. Our data analysis plan was as follows: First, conduct a qualitative study on a few explorative case studies and then use these insights to generalize beyond the case studies via: 1) graphical representations of the relationship between messages and cooperation; and 2) formal statistical analyses to test the relationship between cause and effect.

Coding procedure

A random sample of 100 messages were taken from the first study (Chapter 2) of this thesis. From this, an initial coding scheme was worked out and tested on random samples from Chapter 3 and 4 of this thesis. This iterative process led to a coding scheme with 16 codes (see Table 17 below). Coding of all three studies was conducted by two independent raters, one of whom is the author of this thesis. Coding was performed using *CodeThing* (see <http://codething.net>), an online software designed for the bulk coding of content. The coders independently coded 15,774 messages across all three studies. Many of the messages were double coded. For example, a message might be interpreted as both awareness of the outgroup and promoting group solidarity if it mentions the other co-op while stating the virtues of one's own co-op. The interrater reliability between the two coders for single-coded messages was substantial ($\kappa = 0.621$, $p < 0.001$) and for double-coded items, moderate ($\kappa = 0.405$, $p < 0.001$) (Landis & Koch, 1977).

Selection of case studies

The studies in Chapter 3 and 4 were most similar in experimental design, so in this Chapter we zoom in on specific co-ops in these two studies and leave out the co-ops from Chapter 2. First, we used the heatmap from Chapter 3 (see Figure 23) and created the same for the PGG co-ops of Chapter 4 (see Figure 24). From these figures, we selected co-ops of particular interest in order to examine the types of messages that they sent throughout their interactions. We use qualitative and descriptive (count) techniques to explore the content of the messages sent during the PGGs.

Results

Case Studies

The results are divided into subsections, based on similar patterns of group cooperation. First, we look at co-ops in both Chapters – Study 2 and Study 3 of Chapter 3 and 4, respectively – which converged on Maximum Cooperation from the beginning. At the other extreme, we take a closer look at those co-ops which converged on Defection or failed to reach consensus on the amount to contribute. And finally, we sample some co-ops in the middle of these extremes, which began aligned in their behavior but then stopped, or followed the reverse pattern.

Maximum Cooperation. First, we look at Study 2 in Chapter 3 and selected three co-ops, called A, B, and C, that aligned their behavior within two tokens of one another on high levels of cooperation (see the top, red rows of Figure 23). The coded messages and the total number of them sent in a round are visualized in Figure 25, which shows for each code of interest, the frequency of messages sent per round by the co-op, coloured according to the range of the amount contributed to the PG. The colours indicate the range of the contributions, where the darker colours show higher convergence and the lighter colours, lower convergence.

Table 17
Coding Scheme

Code Name	Code description	Study 2 <i>Overall Frequency from 3857 messages</i>	Study 3 <i>Overall Frequency from 3741 messages</i>
Interpersonal bonding*	Expression and effort to build or maintain a relationship with group members. Especially comments indicating caring for an individual player. Trying to find out who everyone is in the game, sharing personal information etc.	287	305
Sanctioning *	Complaining about unexpected and undesired behaviour of other group members/ some sort of verbal punishment.	194	816
Uncertainty	Expressing a feeling of being confused or having a lack of insight into the game and what the group should or will do.	187	129
Agreement *	Confirmation or support of someone's action/comment.	447	57
Disagreement	Expressing dissatisfaction with someone's action/comment. Offering alternatives.	35	22
Awareness of outgroup	Expressing knowledge about the existence of another group within the game. Making comparisons to the other co-op.	149	58
Promotion of group solidarity*	Any expression of appreciation directed towards the group (co-op) as a unit; motivating comments etc. In addition, mere identification and unity; "Team", "Comrades".	261	303
Impeding group solidarity	Any expression/action working against promoting group solidarity.	37	87
Facilitating understanding of the game	Any communication aiding members understanding of actions necessary for the Public Goods game. This applies to the rules of the PGG as well as understanding what happened/is happening in the specific game (i.e., commentary in the game). Included in this is mentioning the number of points people have, talking about what strategies might work or not. In general: making meaning of the game.	516	215

Table 17 Continued

Leadership statements*	Statements resembling instructions to follow an action proposed by the member. Fairly directive. Use of exclamation points etc.	240	437
Follower statements	Statements that clearly outsource leadership to another member of the co-op. Asking what one “must” do. Comments indicating a willingness to follow what others say.	78	61
Coordination of cooperative action *	Any communication that serves as basis for action. In other words, discussing how to act (i.e. how many tokens to give) in the coming rounds. Trying to get players points to balance out etc.	1202	1034
Relationship repair*	Phrases or statements that reflect the attempt to apologize/reestablish a relationship that has been harmed or interrupted in some way (i.e. deviating from the amount of promised tokens). Providing explanations for why someone did something.	44	17
Individual hardship	When individuals complain about some aspect of the game and how it affects them. For example, complaining about personal, low token balance.	44	112
Individual pledge	When individuals pledge an amount that they will contribute in the next round (included here is mention of what they gave the previous round).	127	49
Miscellaneous	Phrases that are nonsensical or cannot be coded without understanding the context of the whole conversation.	9	39

Note: The asterisk indicates the codes we chose to discuss in this Chapter as the other codes were not numerous enough and no interesting patterns were discovered. The exception is relationship repair, in that although it was not numerous, it's absence is noticeable particularly when sanctioning is high.

Figure 23. Co-ops in Chapter 3: Convergence on mean amounts

Figure 24. Co-ops in Chapter 4: Convergence on mean amounts

Note: The coloured blocks indicate when co-ops aligned behavior within 2 tokens of one another, coloured according to the mean amount that they converged on. The white blocks show when the difference was 3 or more tokens.

We selected the most highly cooperative groups that emerged early on. While Co-op B shown in Figure 25, sends many messages related to the coordination of cooperative action (e.g., “we didn’t all do 10, you guys want to this time?”, “I think we can all keep doing 10”), it is not a prominent pattern in the other two co-ops presented here (Co-op A and C). Rather, Co-op A spends more time promoting group solidarity (e.g., “Haha we are a really nice group”, “Good group <3”(heart sign)) while Co-op C uses interpersonal bonding (e.g. “Fun fact: did you know that a koala sleeps approx. 22 hours a day?” and the whole conversation weaved in that particular game is a humorous discussion about koala’s)²².

Next, we compare these patterns of communication to three co-ops converging on high contributions in Study 3, where such co-ops were rare because many non-cooperative co-ops formed. We can see from the messages across rounds, that all three co-ops in Figure 26 sent many messages coordinating cooperative action (e.g., “donate 10 please”, “keep 10’s popping”) and co-op members seemed to do this quite directly, often with a leadership quality (e.g. “Green²³ needs to invest 10 again”). For two of the three groups, the promotion of group solidarity is rather high (through the use of messages such as: “Good job members”, “we’re doing good). For Co-op E, however, promoting solidarity seems to be replaced somewhat with the apparently effective use of sanctioning (e.g. “Whoever sent 2, don’t be selfish”, “weak people in this group”).

Generally speaking, across both studies it seems like attempts to coordinate cooperative action, along with interpersonal bonding and the promotion of group solidarity, are associated with high levels of cooperation.

Defection or the lack of convergence. Now we turn our attention the non-cooperative co-ops from Chapter 3 and 4. None of the co-ops of Study 2 in Chapter 3 converged on complete defection. Therefore, we selected three co-ops that failed to converge most of the time and when they did, converged on low levels of cooperation. One of the groups in Study 2 (Co-op I, Figure 27), which failed to create a norm of cooperation, used sanctioning (e.g., “who was the cattle that did not send any?”), which became quite aggressive (e.g., “hope you have bad dreams tonight”, “F*#! you”, “damn traitor”).

²² Note: Most of the agreement in this game turned out to be about koala’s

²³ Green here refers to an individual player onscreen.

Figure 25. Study 2 Convergent groups: Maximum Cooperation

Figure 26. Study 3 Convergent Groups: Maximum Cooperation

By contrast, Co-op G in Figure 27, attempted to coordinate their actions but through all contributing different and low amounts – it seemed to be their strategy to try balance out their tokens rather than all contributing equally every round. There seemed to be no ill will in their messages (e.g., “who invests what?”, “what shall we do?”, “I think 2 if you did 5 last round” etc.). Perhaps this could have arisen from confusion about how to maximize profits – although there was no indication of that in their messages – or simply a failure to successfully coordinate. Finally, Co-op H sent relatively few messages and were unable to coordinate, eventually giving up (e.g., Coordination of cooperative action: e.g., “let’s make a profit”, “all 5”, Impeding group solidarity: “yeah, we suck as a co-op”, Sanctioning: “the mistrust rises as the amount of tokens decrease”).

We compare the non-cooperative co-ops of Study 2 to three that aligned their behavior on defection in Study 3, Chapter 4 (the bottom, yellow rows of Figure 24). In both Co-op J and K in Figure 28 we notice that, overall, there seem to be fewer messages sent and sanctioning is more prominent compared to the highly cooperative groups in Study 2 and 3. Sanctioning is used very early on in interaction which suggests that from the outset, people were not contributing highly and as a result others sent messages to sanction this non-cooperative behaviour. Examples of sanctioning include: “You are not investing and we see you”, “Come on guys, why are you not investing now”; and in some cases, it becomes quite aggressive: “Haaaa You guys are a#@holes” and “F*#! you guys, why am I the only one investing here”²⁴. Furthermore, attempts to promote cooperative action (e.g., “PLEASE”; “Guys let’s donate to the co-op now”) seems to fall on deaf ears as there is no indication of sanctioning being followed by relationship repair and the behavioral pattern indicates that cooperation does not actually improve. Fewer attempts are made to promote group solidarity and coordinate cooperative action. Notably, these two codes were present in the highly cooperative groups.

²⁴ In all studies, participants were told that their messages were being recorded for analysis but I naively did not think to explicitly tell them not to be rude, unkind or swear at one another. I can only hope that no one was seriously affected by the nature of some of the messages. No ethical complaints were made that I am aware of.

Figure 27. Study 2: Co-ops that failed to converge (overall low amounts contributed)

Figure 28. Study 3 Convergent Groups: Defection

Above, we examined more closely those co-ops that were at the extreme end of Study 2 and 3. In other words, we examined those co-ops that converged on high levels of cooperation and those that either failed to converge or converged on defection. We found these co-ops in vastly different proportions in either study. However, we are also interested in those co-ops from either study that fell somewhere between the two extremes presented above. Therefore, next we present co-ops that appeared in either Study 2 or Study 3, but not in both.

First, from Study 2 in Chapter 3, we look at co-ops that: 1) started off well and then stopped converging; and 2) those that built up to convergence on maximum cooperation over time.

Study 2: Maximum cooperation to no convergence. One striking pattern is that for both co-ops in Figure 29, convergence stops after round 7. This lack of behavioural convergence is mirrored by the sudden stop of messages which serve to promote group solidarity, despite their earlier prevalence (e.g., “We corns are sticking together well”, “I think our strategy is awesome”, “Great”, “nice”). In Co-op L, the momentum is lost when one person starts defecting and sanctioning follows (e.g., “Dirty play by one of us”, “Why weren’t (sic) one investing?”). As with the groups that converged on defection or failed to converge completely, in both Study 2 and Study 3, sanctioning here was apparently ineffective. For Co-op M, a similar pattern emerges except that instead of outright defecting, one player tries to coordinate cooperative action in another manner by suggesting that they each rotate defection to try maximize individual profits (e.g., “invest less and then change your investments seeing the others, that’s what I did” and another player responds “Should we do the 10, 10, 1 thing?”).

Study 2: No convergence to maximum cooperation. In the opposite pattern to the one described above, there were also co-ops that reached convergence on maximum cooperation after a few rounds. Co-op N in Figure 30 reached convergence on maximum cooperation after four rounds of play while Co-op O did the same after two rounds. Both co-ops spent a fair amount of messages coordinating cooperative action in the beginning stages (e.g., “Next time 10? We have to pull on the same string”, “okay, it’s a really fast game, let’s do 10?”, “should we invest the maximum?”, “max for all?”) and showed agreement at various stages (e.g., “yeah 10”, “sure”, “yes”). While Co-op N spent some time promoting group solidarity (e.g., “ONE TEAM HAHAAHA”, “keep it up”, “Go team Cattle”), Co-op O

appeared to spend that time on interpersonal bonding, which may have similar effect (e.g., “everyone is very enthusiastic”, “:D”, “Do you do this for SONA²⁵?”).

Next, in Study 3 there are some examples of co-ops that never converged and those which started off fairly well but then stopped aligning their behavior successfully.

Figure 29. Study 2 Maximum Cooperation to defection

Figure 30. Study 2 No convergence then Maximum Cooperation

Study 3: Co-ops which never converged. Both co-ops in Figure 31 show some attempt to coordinate cooperative action (e.g., “invest all tokens brothers”, “How many?”), phrased in a rather directive way in some cases (e.g., “GUYS LETS INVEST THE SAME

²⁵ Reference to course credit (i.e., asking about their motivation for participating in the study).

NUMBER”, “LETS INVEST MORE AGAIN”). However, there is also a lot of sanctioning (e.g., “heey (sic) you guys, why you invest less?...you fool...you stupid”, “pig²⁶ please come on what is wrong with you”, “ay chicken lickin you are robbing”, “DUCK INVEST 10 AND STOP ROBBING US”), which resembles the sanctioning found in co-ops that converged on defection. The fact that sanctioning is not regularly followed by relationship repair is perhaps a reason that cooperation never emerges. Furthermore, in comparison to more successful groups, there is less interpersonal bonding and promotion of group solidarity.

Study 3: Co-ops that started off well and then stopped converging. In all the example co-ops in Figure 32 there are many messages with the apparent intention of coordinating cooperative action (e.g., “let’s do 8”, “let’s all invest 10 guys, no cheating please”) and more so, with a directive or leadership quality (e.g., “WE SHOULD ALL INVEST GUYS”, “8 NOW GUYS”). Similar to other dysfunctional co-ops though, there is also a lot of sanctioning (e.g., “be loyal guys”, Duck farmer, stop being unfair”, “GOAT AND PIG ARE PLAYING US THEY (sic) INVESTING LITTLE MONEY”). This pattern of message content is very similar to co-ops that align on defection or never manage to reach agreement on cooperative action. Notably, for Co-op R in Figure 32 there is some promotion of group solidarity (e.g., “maize people, we on it for real”, “shine maize farmers for life”). However, closer inspection of the message exchange indicate that there is one person – out of five – who appear to use the promotion of group solidarity to cover up for their defection. While everyone else is trying to sanction this person for not contributing, the defector seems to ignore these messages and just pretend to be a good team member by saying things that are in ‘team spirit’.

²⁶ References to animals are pointing to the “type” of farmer they were (i.e., their avatars).

Figure 31. Study 3: Co-ops that never converged

Figure 32. Study 3 Co-ops that got off to a reasonable start

Overall impressions from the case studies

In order to generalize beyond these case studies it is useful to first discern the general patterns observed. First, in co-ops that move towards maximum cooperation there are more messages that promote group solidarity and there is less sanctioning. This pattern is particularly visible if you compare Figure 25 and Figure 26 on one hand, to Figure 27 and Figure 28 on the other hand. Of course sanctioning is not necessary in highly cooperative groups where everyone is already contributing. But sanctioning appears to have been rare also at the start of collaborations, when cooperation was not so high yet. Only in a few cases, there was any sanctioning in cooperative groups that appears to have been effective (e.g., Co-ops C and E). By contrast, in co-ops that could not converge on high contributions or that converged on defection, there are many more instances of sanctioning. Examples of this can be found in

Co-op's I, J, K, P, Q, R, S and T. Notably, this sanctioning is sometimes harsh and not followed by relationship repair. Overall, we can see that there is much more sanctioning in groups that are struggling to cooperate, also early on in interaction. Here, sanctioning is apparently unable to stop the decline in cooperation, or it may even have promoted decline. Thus, the sanctioning used by participants in these studies appears to be poor at promoting cooperation.

Overall, most co-ops (both cooperative and non-cooperative) sent messages attempting to coordinate cooperative action. However, only in cooperative groups in which coordination appeared in conjunction with the promotion of group solidarity, does said coordination appear to be effective. Additionally, it seems that interpersonal bonding may also work to help boost cooperation levels in a similar fashion to the promotion of group solidarity. For instance, there are a few highly cooperative groups which do not send messages promoting group solidarity but do have high levels of interpersonal bonding – one exemplary of this is Co-op C, but also see Co-op O. Finally, one could also expect that there would be more agreement in cooperative compared to non-cooperative groups and indeed, we see evidence of high agreement in cooperative co-ops – Co-ops B, C, N and O – but not in uncooperative co-ops such as Co-ops P, Q, J and K. In sum, coordinating cooperative action in conjunction with messages promoting group solidarity, interpersonal bonding and agreement may facilitate the emergence of cooperative norms.

Generalizing beyond the case studies

We also attempted to quantify some of the above impressions, by running additional analyses. In order to test whether the frequency of different types of messages influence the mean amount given by the co-op in the subsequent round, we conducted a simple logistic regression²⁷. The dependent variable is a binary variable that indicates whether the average amount contributed to the co-op increases from the previous round. The independent variables tested are the actions in the previous round: 1) the average amount given by the co-op, 2) the square roots of the number of messages in different coding categories (i.e., coordinating cooperative action, interpersonal bonding, agreement, promoting group solidarity, leadership statements and sanctioning) and 3) the interaction between these.

²⁷ Given that much of this analysis was exploratory, we chose not to present complex multilevel analyses. We did attempt a few models that did not converge. The multilevel models that did converge gave very similar results to those presented here.

Separate logistic regressions were conducted for Studies 2 and 3. A backward selection procedure was used to select the final models. In this model, interactions were tested and eliminated when they explained insufficient variance. Model comparison tables can be found in Supplementary Information D (see Table D1 and Table D2). Note that code frequencies were not highly inter-correlated– the highest was $r = 0.35$ and $r = 0.54$ in Study 2 and 3 respectively²⁸.

Study 2. The mean amount contributed by co-ops in these data is 8.2 tokens – indicating overall high levels of cooperation. The final model is presented in Table 18 where the interaction effects in the final model remained significant after backward selection. The results show one main effect: The more messages coded as Coordination of cooperative action that were sent in the previous round, the more likely that the co-op would increase contributions in the current round. The remaining main effects can be interpreted in light of their interactions. There were four two-way interaction effects, visualized in Figure 33.

The patterns of the interactions for the amount given in the previous round by: agreement, interpersonal bonding and promoting group solidarity, are quite similar. These patterns show that an increase in contributions due to the number of messages sent is lower for larger previous amounts. In other words, sending more messages that express agreement, interpersonal bonding or promote group solidarity, will be effective in increasing cooperation when it is rather low. Noticeably, the interaction between amount given in the previous round and the number of Sanctioning messages is opposite: The probability of increasing contributions due to number of sanctioning messages sent is higher for larger previous amounts, although still not very high. In other words, sending more sanctioning messages when the previous contributions are low, does not seem to increase contributions. In fact, sanctioning messages may even lessen the likelihood of contributions increasing in the next round.

²⁸ The highest correlation for Study 3 was coordinating cooperative action with leadership statements. Since this correlation was not very strong and also not present in Study 2, we did not combine these codes in the analysis.

Table 18

Study 2 Logistic regression: Effect of the frequency of messages of a given kind on the increase in the amount given the following round.

<i>Dependent variable:</i>	
	Up
Amount given in the previous round	-0.459 (0.065)***
Coordination of cooperative action	0.736 (0.163)***
Promoting group solidarity	2.430 (1.273)*
Agreement	1.791 (0.773)**
Interpersonal bonding	2.262 (1.021)**
Sanctioning	-2.137 (0.725)***
Amount*Promoting group solidarity	-0.323 (0.144)**
Amount*Agreement	-0.219 (0.091)**
Amount*Interpersonal bonding	-0.322 (0.120)***
Amount*Sanctioning	0.266 (0.091)***
Constant	2.468 (0.540)***
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

Table 19

Study 3 Logistic regression: Effect of the frequency of messages of a given kind on the increase in the amount given the following round.

<i>Dependent variable:</i>	
	Up
Amount given in the previous round	-0.479 (0.112)***
Frequency Coordination of cooperative action	-0.081(0.200)
Amount*Coordination of cooperative action	0.155 (0.069)**
Constant	0.266 (0.274)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

Figure 33. Study 2 Interaction Effects

Note: To create this plot, the frequencies were squared to transform back to the original data. The y-axis represents the probability from 0 – 1, transformed from the log odds of the logistic regression model. 0 number of messages sent, provides the baseline of the effect.

Study 3. In contrast to Study 2, the mean amount contributed by co-ops in these data is 1.5 tokens – indicating overall very low levels of cooperation. The same process for model selection, described above, was followed for Study 3. The results of the final model can be found in Table 19. The main effects can be interpreted in light of the interaction between them. Figure 34 shows the interaction between the amount given in the previous round by the number of messages coded as Coordination of cooperative action, sent in the previous round. The interaction shows there is a higher probability of contributions increasing depending on the number of messages sent, for any number of tokens given in the previous round, besides 0. In other words, the more messages sent coordinating cooperative action, the better.

Figure 34. Study 3 Interaction Effect

Note: To create this plot, the frequencies were squared to transform back to the original data. The y-axis represents the probability from 0 – 1, transformed from the log odds of the logistic regression model. 0 number of messages sent, provides the baseline of the effect.

Discussion

Previous scholars have argued that for cooperation to emerge, communication among individuals is important. Indeed, communication has been found to increase cooperation in social dilemmas (Balliet, 2010). However, less is known about how communication facilitates the emergence of particular types of cooperative group norms. In this Chapter, we provide qualitative and quantitative evidence which suggest that groups that successfully align their behavior on high levels of cooperation tend to exhibit particular communication patterns.

Coordinating cooperative action

Qualitative results as well as quantitative results show that one form of communication that appears to enhance cooperation are attempts to coordinate cooperative action. Co-op members do this by making active suggestions to each other about how the group should behave, often by suggesting to each other how many tokens should be contributed to the Public Good in the next round of play. This finding is consistent with prior research: Communication can be used to coordinate action, negotiate strategic agreements, establish mutual expectations for future behavior and facilitate the emergence of cooperative social norms (e.g., Kerr & Kaufman-gilliland, 1994; Shankar & Pavitt, 2002).

Relatedly, research has suggested that communication can coordinate cooperation through *individual* pledging: exclamations such as "I will give 10 to the co-op!" might help establishing norms for cooperation – especially if it is binding to some extent (for example, X. Chen & Komorita, 1994). However, in our studies, we did not see many instances of individual pledging in either studies (the reader is referred to the total frequency of pledging in Table 17). Rather, group members focused on the *collective* amounts to contribute (i.e., they were busy coordinating at the level of "us") which suggests that there was greater focus on generating shared expectations as a group, in a collaborative manner. This finding implies that during the public goods game, communication was used as a means for establishing collective intentions, rather than reciprocal expectations among individuals – this is quite consistent with ideas about collective intentions being shaped at the level of “us” rather than at the level of “me and you” (e.g., Searle, 2002). Conversely, it may be inconsistent with the idea that coordination happens at the dyadic, interpersonal level of the “I will do x and you will do y” type. Indeed, Dawes, Van der Kragt and Orbell (1990) argued that discussion in social dilemmas makes the collective, rather than the individual, central; and that this

phenomenon in turn supports the idea that communication can help cooperation through the emergence of social identification (but see Bicchieri & Lev-On, 2007).

Promoting group solidarity

Although the coordination of cooperation appears to be necessary, it does not appear to be sufficient. The data show that there were many messages coded as coordination of cooperative action in groups that were not successful in creating cooperative norms (see Co-ops G, H, I, J and K). Therefore, we would argue that coordinating communications should be paired with messages that promote a sense of “we-ness” and solidarity. Indeed, we found that the promotion of group solidarity appears to be associated with developing cooperative norms, supported both by the qualitative analysis and the logistic regression results for Study 2 in which cooperation was much higher and increased over time, in contrast to Study 3. This finding is in line with existing literature which suggests that communication can lead cooperation through social identification (X. Chen, 1996; Shankar & Pavitt, 2002), also in computer-mediated contexts (Postmes, Spears, & Lea, 1998, 1999, 2000). It also dovetails with evidence that having a high social identification with the group can increase cooperation (Brewer & Kramer, 1986; De Cremer et al., 2008; De Cremer & Van Vugt, 1999; Simpson, 2006; Wit & Kerr, 2002). But crucially, it shows that such solidarity should not be conceived of as given but that it is actively construed and maintained through communication (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005).

The regression results for Study 2 indicate that other strategies also serve a similar role as promoting group solidarity in order to make coordination more effective. These are interpersonal bonding and agreement. Qualitatively, interpersonal bonding – not the promotion of group solidarity – was found in high levels in at least two highly cooperative co-ops (e.g., Co-op C; Co-op O). In addition, in Study 2, interpersonal bonding increased cooperation in the next round when the average level of cooperation was low in the previous round.

Literature suggests that in some groups interpersonal bonding could be a way of forming a social identity with the group through bottom-up processes (Postmes, Spears, Lee, & Novak, 2005). However, this pattern was not replicated in Study 3 – probably due to lack of cooperation in general (i.e., there was not enough data of people cooperating, thus there was no opportunity for the effect of interpersonal bonding to emerge). Furthermore, some existing data suggests that interpersonal bonding may *not be as effective* as promoting groups

solidarity. Interpersonal bonding messages were also scattered throughout the communication of some of the non-cooperative co-ops in Study 2 (see qualitative analysis, Co-op I) and Study 3 (Co-op P, R, S and T).

So, while interpersonal bonding may increase cooperation, possibly through bottom-up social identity formation and the development of a sense of common fate, this is not always the case. In fact, there is research to suggest that social approval can exist in non-cooperative groups where interpersonal relations become more important than the cooperation levels at a group level (Flache, 1996; Flache & Macy, 1996). These studies show that bilateral cooperation is learned quicker than complex, multilateral cooperation. The authors theorize that because of this, the desire to obtain social approval from interpersonal relations may result in individuals not being able to sanction others to enforce cooperation at a group level. Having said that, in our data sanctioning was very prevalent in Study 3 where cooperation was low, even in cases where there was some interpersonal bonding.

Sanctioning

According to the game-theory literature, punishment can be an effective strategy in the establishment of cooperative norms (Balliet et al., 2011; Horne, 2001; Voss, 2001). Therefore, one may reason that sanctioning should reduce defection and increase cooperation. However, the evidence provided here shows that there may be a downside to sanctioning under some circumstances. First, from the qualitative analysis of Studies 2 and 3 we see that sanctioning was not followed by messages of relationship repair and further, sanctioning did not seem to have any behavioral effects (except in one or two instances for highly cooperative groups where defection and sanctioning was very uncommon). Second, the quantitative analysis provided additional support to the assertion that sanctioning does not always work to increase cooperation: There was no effect of sanctioning in Study 3, while it had a *negative effect* on cooperation in Study 2.

One may argue that sanctioning failed to create or enforce cooperative norms because it is ‘cheap talk’ (Farrell, 1987) – meaning that it was non-binding and costless to the person who is doing the sanctioning. From our analysis, however, it appears that other types of talk do indeed matter and can positively influence cooperation. We see this for the coordination of cooperative action, interpersonal bonding, promoting group solidarity and agreement. As such, there is no reason to suspect that verbal sanctions could not also be influential. The present findings may then be better explained by relational signaling theory:

Sanctioning in groups that have not had the chance to develop solidarity ties could be perceived as expressing a negative relational signal (Witteck, 2003). Indeed, from the qualitative analysis we see that sanctioning was often harsh and did not leave much room for relationship building (e.g., “F*#! you guys, why am I the only one investing here”). In turn, sanctioning messages such as these can actually escalate the sanctioning-defection cycle rather than enhancing the saliency of the solidarity relationship. On the other hand, positive relational signaling may also help to explain why, in some already cooperative groups, the few instances of sanctioning appear to be effective, presumably because solidarity ties already exist and the sanctioning is not so harsh.

Conclusion

Previous research has shown that communication in social dilemmas is associated with better cooperative outcomes. Simply allowing communication to occur naturally, however, is not enough. The content of the communication is important. The results of this Chapter suggest that the coordination of cooperative action appears to be effective, when it is used in combination with attempts to promote group solidarity – for example, through the use of encouragement and team spirit. Agreement and interpersonal bonding are also valuable in creating a cooperative environment. These ways of communicating within groups appear to work in combination to create prosocial norms for cooperation and develop a shared understanding and mutual expectations for how group members will act. Finally, sanctioning is clearly not always a straightforward way to build good, cooperative relationships – especially when it is not tactful and does not signal the desire for establishing mutually beneficial relationships.

Chapter 6: General Discussion

Emergence is when “the high-level phenomenon arises from the low-level domain, but truths concerning that phenomenon are unexpected given the principles governing the low-level domain.”

David Chalmers (2006, pp. 244)

The overall aim of this dissertation was to study the emergence of cooperative norms over time in small, interactive groups. Applying the above quote to the social world: Emergence is when the group phenomenon arises from the individual domain, but truths concerning that phenomenon are unexpected given the (perceived) principles governing the individual domain. We applied a dynamic perspective to social dilemma games in order to understand how cooperation emerges in small groups that interact, communicate, and thus may form bonds over time.

What guides an individual’s decision to cooperate or not? In traditional economic approaches, individuals were thought to make a very “rational” calculation (whether through conscious or unconscious processes): Weigh the costs and benefits of cooperating, then act (for discussion on rationality in economics, see Simon, 1986). Many early theories from an economic perspective have assumed and argued that humans are essentially “homo-economicus” – that is, individuals are primarily concerned with their own self-interest in terms of maximizing their own profit (e.g., Edwards, 1962; Hardin, 1968). Under this assumption, it is rational not to cooperate because it is possible to gain more if one does not share resources – especially in once-off interaction, or when longer-term interaction is about to end. However, a key problem with such assumptions is that there is abundant evidence of “irrationally” high levels of cooperation in social dilemma games (and in society at large) (for example, see Ledyard, 1995).

Accordingly, in line with perspectives such as interdependence theory (Kelley et al., 2003; Kelley & Thibaut, 1978; Rusbult & Van Lange, 2008; Thibaut & Kelley, 1959) and goal-framing theory (Lindenberg, 2015b, 2015a), the rational calculations of individuals seeking to maximize their rewards are not independent: they take interdependence with others into account and thus moment-to-moment decisions to cooperate are made against the background of longer-term relational considerations. In other words, one’s goal may not be to gain resources here and now, but to establish and maintain relationships – which in the long run should ultimately be beneficial for instrumental reasons too. Therefore, the definition of

rationality in the context of human relations has slowly changed from a logical, mathematical definition assuming atomized individuals to an integration of rationality plus sociality – social rationality (for example, see Diekmann & Lindenberg, 2015).

Whilst the consideration of an individual's decision to cooperate as being *in relation to others* has moved cooperation research forward, limitations remain that cannot be addressed until we consider more closely how individual level interactions with others results in emergent group processes. For example, in modern interdependence theory, the extent to which one values relations over self-interested, instrumental outcomes, is still seen as a more or less fixed preference (e.g., Kelley et al., 2003; Messick & McClintock, 1968). In other words, whether one is “prosocial” or “proself” (i.e., one's social value orientation or SVO) will largely predict to which extent one will cooperate and under a variety of conditions. “Proself” people will likely act in accordance with traditional economic understandings of human behavior and may defect rather than cooperate in an attempt to accrue more resources; while “prosocial” people will value establishing and good relationships and thus will cooperate as a way of signalling the willingness to sustain a mutually beneficial relationship.

While there has been additional research into how one's SVO may interact with the context (for a review of some moderators see Balliet et al., 2009), a more complex understanding about how these personal response styles play out in dynamic settings, where individuals interact for a prolonged period of time, has not yet been explored in detail. Similarly, while goal-framing theory provides an explanation for how the social context may influence, and perhaps change, an individual's goals in a given situation (e.g., by situationally making different norms for behavior salient, see also Turner, 1991), it does not detail when or how the *active co-creation* of these norms with others might play out in interaction²⁹. As such, both theories could be interpreted as somewhat deterministic: pre-existing characteristics of individuals determine how they cooperate in groups; the social norms bound up with the situation cues an individual's behavior; or the social environment (e.g., groups, organizations, society or even culture) exerts a major influence in shaping the actions of individuals.

²⁹ Note that goal-framing theory does argue that people can self-regulate to change their sensitivity to environmental cues; and avoid, or seek out, certain cues (see for example, Lindenberg & Steg, 2014). Nevertheless, while this elaboration suggests some agency in individual cognition, it does not address the role of interacting individuals on emergent processes and norms.

In sum: While the contribution of ‘socially rational’ theories to the understanding of human cooperation has indeed been fruitful, nevertheless most of this research has been focused on individual preferences that exert a constant influence on the extent to which someone will choose to cooperate under a wide variety of circumstances, or on how the environment may change one’s individual goal or activate particular social norms. In this thesis, we were principally interested in extending this to the *dynamic* factors that occur in small, interactive groups which cause some groups to cooperate and flourish and others not to. How do people create social norms of cooperation with their groups, in real time; and how is group behavior an emergent property of interacting members?

The Methodology and its Innovations

Studying emergent group phenomena is a complex undertaking—after all these are inherently unpredictable, and emergence is fundamentally antagonistic to strict experimental control. So to understand how cooperation emerges through interaction within a group over time, we adapted two existing methodologies (in data collection and in data analysis) and applied them in a novel way.

Dynamic Public Goods Games in VIAPPL. In terms of *data collection*, we ran three studies in order to address the emergence of cooperation over time using a dynamic Public Goods Game (PGG), set up in the computer-mediated experimental platform, the Virtual Interaction Application (VIAPPL; see viappl.org; and as used in a simple exchange game, see Durrheim, Quayle, Tredoux, Titlestad, & Tooke, 2016). VIAPPL allowed us to simulate societies in which people could exchange goods over multiple rounds of a social dilemma game – that is, a game where there is an inherent tension between individual and collective interest (Olson, 1965) . In such cases, the socially optimal outcome is universal cooperation, whereas the best individual outcome is defection while all others continue to cooperate. Our methodology allowed participants to interact, communicate and receive feedback regarding one another’s behavior between rounds of contributing to the public good. Thus, they did not just exchange goods but, as in the real-world, they could interact with each other about anything they liked, albeit via text-based chat only. Moreover we developed a context within which the formation of groups would meaningfully relate to the social exchange in the game: we designed stimuli to create the world of ‘farming co-operatives on a deserted island’ and tried to ensure that within this context, participants’ interactions served a purpose in the formation of their co-operatives.

Stimulus material in the PGG and reasons for changing it across experiments.

Because we were inherently interested in social interaction and the emergence of cooperation, we used the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005) as a framework that informed our thoughts about the factors that might promote and encourage the emergence of cooperation, as well as the processes that might account for this cooperation such as social identification formation. Accordingly, our studies did not just allow for interaction but we also developed experimental manipulations that we thought might influence emergence.

In the first study (Chapter 2), we compared a Categorized condition to a Non-Categorized condition, assuming that social categories would enhance cooperation overall but that interactive, non-categorized groups could reach similar levels of cooperation over time. We found partial support for this hypothesis but the effects of the manipulation were not strong and we did not find the predicted time pattern. Since the differences between the experimental conditions were not as robust as they could have been (i.e., because participants in the categorized condition could self-form groups, interact and communicate, these groups may have been more similar to inductive groups than we had hoped), in Chapter 3 we strengthened the experimental manipulation. Specifically, we prevented individuals in the categorized condition from self-forming groups and, as a result, had to limit interaction for the inductive, Interpersonal Ties groups, and instead made their inductive nature salient by emphasizing their members' heterogeneity and highlighting the importance of interpersonal relations rather than social categories. This time, we found that the pattern of cooperation over time was more consistent with our expectations: inductive groups began with slightly lower levels of cooperation and, over time, reached similarly high levels as social categories; while social categories still showed slightly higher levels of cooperation overall. It should be noted, however, that the differences between the experimental conditions were not huge.

Our feeling was that the first two studies were consistent with one another but because the overall levels of cooperation were very high, possible ceiling effects could limit a full understanding of how deductive and inductive group processes influence cooperation. Thus, in Chapter 4, we again changed the design somewhat. More in line with economic traditions of experimental design, we paid participants according to their end of game outcome, which is not often done in psychological studies. This change was made to lower the initial values of cooperation and see how cooperation would emerge when it began a bit lower. Indeed, the starting levels were lower but perhaps too much so and cooperation largely failed to emerge. In sum, all three studies allowed for social interaction but we also manipulated the degree of

categorization in different ways. As we discuss further in the summary of the findings, the manipulations mostly had the predicted effect but these effects were weak and as research progressed, we concluded they are not the most interesting feature of the findings. Nevertheless, these ideas guided our design of the experiment arena in VIAPPL and appear to have provided the backdrop to allow for emergent group processes.

Data analysis to study emergent processes. Our second methodological contribution was in the area of *data analysis*. As mentioned, emergence is an inherently unpredictable process and is therefore fundamentally antagonistic to attempts of strict control, and/or predefining pathways along which it might proceed (if it occurs at all). We applied a multilevel latent class Markov model (Van de Pol & Langeheine, 1990; Vermunt et al., 2008) which is inherently suitable for studying inductive, dynamic processes because it does not rely on the identification of predefined patterns of behavior or structure. Rather, it allows for the distinction and classification of whatever characteristic patterns of behavior may emerge over the course of interaction. This model not only accounted for the interdependencies inherent in the experimental set-up; it allowed us to learn from these interdependencies.

Without this approach to the analysis, we would not have found the finding we are most excited by: Particular types of decision rules, used to determine how much to cooperate in any given moment, are an emergent property of the group. In other words, over a short period of interaction, individuals align their decision making behavior within their group. Thus the “type” of person one is in an interactive group situation, depends on the nature of *interaction within the group* and is not purely a fixed and stable preference. This particular finding would not have been possible by using traditional types of analysis. While our traditional analysis, by a linear multilevel model, did indicate (through the random slopes at the group level) that there was great variation among groups even in the same experimental condition; the latent class analysis provided a process-oriented way of quantifying and describing these patterns and could show that people may develop similar behavioral tendencies through interaction over a short period of time.

Summary of key findings across Chapters

Two of our PGG studies were conducted in the Netherlands (see Chapter 2 and Chapter 3) where we incentivized participants with course credit or a standard amount, in the case of the few paid participants, with compensation independent of their behavior in the experiment. The final study was conducted in South Africa (see Chapter 4), where we

incentivized participants with a payment according to their end token balance. Based on the Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), all three studies were designed in order to examine the trajectories of cooperation through: a) deductive processes (the Categorization/Social Categories condition in Chapter 2 through 4) and b) inductive processes (namely, the Non-Categorization condition in Chapter 2 and Interpersonal Ties in Chapters 3 and 4).

The groups formed in the experiments were called co-ops, reflecting that cooperation was the decisive feature of the behavior of the group members. First, and following from the multilevel latent class Markov analysis, in all three studies we discovered the formation of “co-op types” which overlapped nearly 100% with “individual types”, strongly suggesting the emergence of unique cooperative norms within groups, in a short period of interaction (to our best knowledge, within the first 4 rounds). In Committed Co-ops (Chapter 2, 3) and Resilient Co-ops (Chapter 4), the norm was to contribute very highly, even maximally, to the public good in almost every round. In Responsive Co-ops (Chapter 2, 3), while also sometimes contributing maximally, the norm was to also base cooperation on what the rest of the co-op members did in the previous round – essentially rewarding cooperative action by the group (by personally giving more the next round), and indirectly sanctioning uncooperative action (by giving less). Finally, in Reactive Co-ops (Chapter 2) the norm was to give less than Committed and Responsive Co-ops and especially react negatively to low contributions from the co-op, by contributing even less themselves the next round. Note that in Chapter 4, we also found two other “co-op types” (the Struggling and Breakdown Co-ops) which did not form similarly strong normative patterns, discussed in further detail later.

Second, within-group convergence on high, even maximum, levels of cooperation was found to be associated with particular kinds of social interaction. For example, taken from the content analysis of the messages sent between rounds (Chapter 5), we found that coordination of cooperative action at the level of “us”, not at the level of “you and me”, increased the likelihood of the emergence of cooperation within a group, especially when used in conjunction with communication that enhanced the promotion of group solidarity, interpersonal bonding on non-task related subjects, and agreement. Furthermore, in these studies sanctioning was not an effective tool in ensuring the emergence of cooperation – in fact, in many groups it appeared detrimental. Sanctioning’s negative effect was possibly due to the harshness of the messages sent which, in absence of a pre-established relationship, failed to signal the importance of the group relationship continuing on good terms (e.g., Wittek, 2003). Taken together, for cooperation to flourish within groups of three or more

members, there should be an active shaping of social norms for cooperation through communicating in a way which enhances the relationship with the collective and ensures its sustainability.

Finally, in Chapters 2 and 3, we found that for *both social identification pathways* there were high levels of cooperation overall. However, by changing the experimental context in Chapter 4, as well as employing a different incentive scheme by using material rather than symbolic rewards, we found that cooperation was rare and defection (rather than maximum cooperation) was commonplace. Although there were a few cooperative groups in the form of Resilient Co-op's in Chapter 4, the vast majority of the co-ops in the last study were classified as the Struggling or Breakdown type which did not show the same strong norm emergence: they consisted of individuals of different "types" using different patterns of decision rules. What is notable here though, is that despite these co-ops consisting of many defectors, and despite cooperation going down over time, there were still some Resilient and Marginal Cooperators in these types of co-ops who kept trying to build a relationship with the group at the expense of their short-sighted self-interest. Axelrod (1984) discussed the possibility that clusters of particular types of cooperators (specifically, tit-for-tat cooperators) can enter into a situation permeated with defection and could, through their interaction with one another, change the norm to increase overall cooperation. This idea as well as the findings of Chapter 4 provide hope to situations where cooperation feels unattainable: if more Resilient or Marginal Cooperators enter the scene, could the social norm of these failing co-ops change?

Practical Implications

From the research presented in this thesis, we can see that there are a few factors that appear conducive to facilitating the emergence of cooperative groups. In cooperative groups, group members align their decision rules and behavior, creating strong cooperative norms.

First, pre-existing (and somewhat static) environmental factors may act as a starting point determining, at least in part, how cooperation unfolds through interaction over time. For example, cooperative groups are more likely to emerge in environments that facilitate normative goal frames rather than competitive goal frames. Although not directly tested experimentally, we see that in Chapters 2 and 3, in which there were no monetary incentives tied to the outcome of the game and thus rewards were symbolic, high levels of cooperation flourished. However, in Chapter 4, where there was a monetary incentive, cooperation was much less likely to emerge. Indeed, in this last study, it seems that the framing of the

experiment (as a “Community/Farm” game) was possibly overshadowed by a competitive goal frame (Lindenberg, 2015a).

Further, pre-existing cultural values may also play some role in initiating cooperation. However, we did not explicitly test the role of between-country cultural values on cooperation, therefore we do not know the exact role that culture plays in the differences in cooperation levels in Chapter 2, 3 in comparison to Chapter 4. While there has already been previous research to suggest that differences between cultures are meaningful in determining cooperation levels in social dilemmas (see for example, Joseph Henrich et al., 2001), we found little evidence for the role of *within-country* culture on cooperative behavior in Chapter 4³⁰. Nevertheless, it is quite possible that somewhat static environmental cues (such as the experimental framing or societal context) activate high levels of cooperation in the first round of play. We see that cooperation starts much higher in Chapters 2 and 3, compared to Chapter 4. Early defection appears hard to ameliorate, especially with the very high degree of harsh sanctioning evident in the PGG of Chapter 4 (see the content analysis of messages in Chapter 5). Considering the atmosphere for interaction is apparently set right from the beginning, it appears that interventions that would facilitate cooperation, such as highlighting similarity and providing a normative goal frame, should be introduced as soon as possible.

Second, while the beginning of group interaction appears to play a role – perhaps influenced by an external static factor – importantly, the studies in this thesis show us that the *emergence of cooperation over time* is crucial. As an illustration of this, in Chapters 2 and 3 we see that not all members of Committed Co-ops start by cooperating maximally from the first interaction, but this maximum level of cooperation develops as time goes on. Additionally, in the Committed, Responsive (Chapter 2, 3), and Resilient Co-ops (Chapter 4), there was almost complete overlap in the group members’ decision-making behavior regarding how much to contribute to the public good, meaning that these social norms must develop through interaction over time.

The formation of cooperative norms may require communication to aid in the alignment of decision-making and cooperative behavior. In Chapter 5 we see that there are different communication strategies which seem to benefit the emergence of cooperation. Notably, groups that show greater convergence on high levels of cooperation, send many more messages coordinating cooperative action at the level of “us”. Results show that this effect is

³⁰ Although horizontal collectivism had some positive effect on social identification, measured at the end of the interaction period.

causal, in the sense that the lower the average cooperation level is in the previous round *and* the more coordination of cooperative action messages sent directly afterwards, the probability of cooperation increasing in the next round is higher. Another communicative feature of cooperative groups appears to be messages that encourage bonding – namely, promoting group solidarity as well as interpersonal bonding on non-task related subject, although to a lesser extent. Taken together, group interventions based on facilitating particular communicative patterns, such as the ones described in this thesis, may encourage the emergence of cooperation.

While the emergence of cooperative group norms through endogenous processes are far more important than the social identity pathway that was primed by the experimental condition, we do still see that slightly more Committed Co-ops (in Chapter 2 and 3) and more Resilient Co-ops (in Chapter 4) form in the social categories pathway where deductive identities are primed, compared to the inductive, interpersonal ties pathway. Further, in Chapter 3, we see that for groups formed in the inductive path (i.e., Interpersonal Ties condition), it takes longer for cooperation to reach the same high levels as the deductive pathway (i.e., Social Categories condition). As such, it appears that cooperation with the group may arise more frequently and quicker when the emphasis is on homogeneous group characteristics.

However, our results also show (in Chapter 3 and 4) that in groups that cooperate more (regardless of the pathway to social identification), social identification (or solidarity, in the case of Chapter 4) is higher at the end of the group interaction, once group norms are firmly established and when shared identities appear to have formed. Further, there are no differences between pathways in the end levels of social identification. Therefore, since 1) cooperation is associated with higher social identification, and 2) there appears to be slightly more cooperation in social categories, this at least suggests a self-reinforcing mechanism of social identification on cooperation. In other words, establishing social identification in groups through cooperation, and/or enhancing the saliency of social categories, may serve in a feedback mechanism that encourages future cooperation. While this potential feedback mechanism (social identification → cooperation → identification etc.) was not directly studied in this thesis, future research could test this hypothesis.

In sum: under ideal conditions (for example, where there are normative goal frames and existing social identities), it appears that group members can fairly quickly and easily align their decision rules of cooperative behavior to create highly stable, normative and cooperative

groups (as in the Committed and Responsive Co-ops in Chapter 2,3 and Resilient Co-ops in Chapter 4). However, when the conditions are not ideal, unstable groups emerge which cannot develop such cooperative norms (in particular, see the Breakdown and Struggling Co-ops in Chapter 4), although these groups can still contain a small proportion of cooperators, providing hope for future cooperative emergence.

Theoretical Implications

Finally, we should consider the results of this thesis for theory, especially as it relates to cooperation. First, the Interactive Model of Social Identity Formation (IMIF; Postmes, Haslam, et al., 2005) has already extended ideas of social identity theory by arguing that in addition to deduction from social categories, groups and their concomitant social identities can be induced through interaction and communication over time. As such, the social identity perspective allows for the dynamic emergence of identities. Having said that, there did appear to be slightly higher levels of cooperation when social categories were made salient and overall, high levels of cooperation seemed to be associated with higher levels of social identification at the end of interaction. Furthermore, in Chapter 2 there appeared to be more variation with respect to cooperation among inductively formed co-ops and in Chapter 3, inductively formed groups took longer to reach the same levels of cooperation as deductive groups. These findings suggests two things: 1) the process of induction may be more time-consuming which means that cooperation may take longer to emerge and may not emerge consistently across all inductively formed groups; and 2) there is a possible self-reinforcing mechanism whereby social identification (for example, through categorization) can increase cooperation leading to higher levels of identification over time. But for this to happen, communication and interaction over time plays an important role.

Indeed, our research found that endogenous group processes can far better explain the emergence of cooperation compared to the primed social identity pathway. This finding itself confirms the idea that induction is important in the process of emergence: what happened within the co-ops/groups themselves (behaviorally and through particular communication patterns) can much better account for the development of cooperation than the static manipulations of identity at the beginning of the experiment. In other words, induction seems to be a process that occurs in most cooperative groups.

In this thesis, we have argued that the emergence of group phenomena is enabled by group members' ability to interact with each other over time. To further extend this idea, it might be of interest to explore the role of *dyadic ties* on the emergence of group level outcomes.

Statistical advances in social network analysis provide scope to study social phenomena that arise in emerging networks of cooperation and competition, providing a way to integrate social identity theory with a social network approach. In other words, the idea that networks evolve through interpersonal (dyadic level) interaction within a large intergroup (social level) setting – wherein there is the emergence of group norms – could be explored with statistical methods other than the multilevel latent class Markov model presented here. Such an approach would be interesting because it removes the constraint of having to study these group dynamics in small groups: indeed the dynamics of cooperation in very large networks are an important next step for researchers to take.

On the other hand, in addition to studying dyads, interdependence theory (Kelley et al., 2003; Kelley & Thibaut, 1978; Rusbult & Van Lange, 2008; Thibaut & Kelley, 1959) could also explore more complex group dynamics – using methods such as those presented here – in order to study the kinds of emergent processes that the theory is interested in (such as cooperation in groups). This is because emergent group phenomena may not follow directly from interpersonal, dyadic ties. In our research, we found that individual preferences for how to behave cannot be seen as static and independent of emergent group processes. While there has been some research on how one's social value orientation, for example, can interact with other factors to alter one's individual goal behavior in a social dilemma (e.g., Balliet et al., 2009), it is of interest to further consider the situations in which collective preferences come into being through interaction and communication over time at the collective, group level of "us". As such, there is scope for both the social identity perspective and interdependence theory to explore what kinds of interaction (collective or dyadic or a combination) may account for emergence, and under what conditions.

Finally, and more broadly in terms of future research on social dilemmas, it would be important to further study the dynamic emergence of cooperation within groups. While social dilemma research has explored many static individual-level and group-level factors that could influence cooperation, there has been less focus on emergent social norms for cooperation that develop in interaction over time. Our methodologies employed in this thesis (data analysis and collection) could aid researchers interested in studying emergent group phenomena. Quantitatively, future development of the specification of the multilevel latent class Markov model should more closely consider the first three or four rounds of interaction (which in the current set-up appeared to be crucial for most co-ops) in order to better understand the processes by which social norms emerge. Qualitatively, Chapter 5 of this thesis highlights the

added value of detailed analysis of group communication: these proved a tremendous help in understanding the process of emergence and we believe that future work in this direction could be very fruitful and insightful.

Limitations

While the studies in this thesis have taught us many things, there are of course limitations. First, it seems very likely that multiple static and dynamic factors interact with one another, leading to cooperative or non-cooperative outcomes in groups. In this dissertation, we did not explore all possible static and dynamic factors which may come into play and, between studies, we also varied some factors simultaneously, making it impossible to unconfound some of the explanations for the between-study differences we found. For example, related to the differences between Chapter 2 and 3 on one hand and Chapter 4 on the other, we acknowledge that we did not fully anticipate the consequences of taking the final study to South Africa *and* changing the incentives at the same time. In retrospect we should have included pre-measures in all three studies about culture and generalized trust, and perhaps other measures of societal differences too. In that way we could have more easily been able to causally establish the reasons for such a drastic change between the first two, compared to the final study. Further, we chose to run all our experiments with a normative goal frame in which the experiment was presented to participants as a community-type game where “farming and farming co-operatives” are central. The initial framing of the experiment – that is, requesting participants to imagine that they arrived on a deserted island and would be farming – could be problematic in the South African context. Although ‘deserted’ implies no existing group of people on the fictional island, this experimental framing could be a reminder of colonization in South Africa – which led to many serious subsequent problems, including Apartheid.

As such, this metaphor may have primed general mistrust and ultimately led to defection, especially given that the experiment was conducted after the much publicized “Fees Must Fall” student protest movement in which activists were arguing for the reduction of university fees as well as the decolonization of education. Specifically, future research could test how different goal frames (such as the one used in this thesis) may operate given the context and history of a particular society. More generally, research could disentangle the other possible explanations for the change in cooperation in the final study – for example, by comparing how monetary incentives operate differently across different societies or by

exploring what other factors may interact with incentivization (for example, generalized levels of societal trust or mistrust).

Second, in practice it proved difficult to experimentally manipulate deductive and inductive routes to social identification. The use of social categories in order to simulate a deductive route to social identification and the use of non-categorization and interpersonal ties to stimulate an inductive route, could not be cleanly teased apart in the experiments. This was because we also had to maintain experimental equivalence between the two conditions. As a result, social categories communicated and interacted over time while inductive groups could see a possible outgroup onscreen and thus perhaps draw intergroup comparisons. Additionally, in the second two experiments, inductive groups could not self-form. While, theoretically, we would not expect there to be large differences in overall cooperation between these two pathways (although we would expect the trajectory to be different) – it is also possible that the differences were not so great due to the similarities in the experimental manipulations. Future research could find additional ways to test these pathways in a more distinct manner. In addition, more meaningful group identities could be stimulated. One example of this would be to use demographic factors to activate social categories more strongly.

Third, in all three studies, at least two co-ops appeared onscreen at the same time. While the co-ops could not exchange with one another, participants were able to see – through the feedback image of token contributions to each co-op after every round – how the other co-op was doing. However, in the data analysis, no particular attention was given to the possibility of competition between the co-ops. Part of the reason for this was that there was not high variance at the experimental game level (only at the co-op level) and therefore we reasoned that co-op's perhaps did not strongly influence one another. However, future research could explore any possible effects that witnessing another group interact has on the ingroups' behavior.

We end this discussion by providing a table (Table 20) summarizing key ideas explored in this dissertation as well as their implications, and end by making concluding remarks.

Conclusion

In this thesis, we set out to understand how *cooperative norms emerge over time* in small, interactive groups, as well as the impact that different pathways to social identification

(i.e., the deductive and inductive path) have on cooperation. First, we found evidence for the fact that through both social identification pathways, similarly high or low levels of cooperation can be reached – albeit through different trajectories. But more significantly, we found that groups tend to form norms of cooperation based on similar decision making rules, which subsequently has an impact on the overall level of cooperation which the group may achieve. In other words, decision-making behavior regarding cooperation was an emergent property of the group and groups aligned on different patterns of decision-making. Therefore, an individual's choice of cooperative behavior is not a fixed and stable trait – for example, due to a cooperative personality – but may be almost entirely dependent on the people with whom one interacts, how the interaction unfolds, and the setting in which this interaction takes place. Finally, we found that changing the societal context and the monetary outcome of the final experiment, led to a vast decline in cooperation compared to our first two studies. Taken together, the results of the behavioral data for cooperation across studies (i.e., the amount contributed to the Public Good), as well as the content of the messages sent, suggests that static factors – such as macro-level variables that can explain differences between societies, as well as gains goal frames activated by monetary incentives *etc.* – may predict initial contributions to the Public Good. However, dynamic factors – which can only come into play through interaction and communication over time – subsequently direct how cooperation further evolves. Crucially, the nature of social interaction – specifically, whether groups coordinate activity at the level of “us”, while also promoting group solidarity – appears to foster social norms that maximize cooperation

Table 20.

Summary of key findings across chapters

Ideas explored	Chapter 2 (Study 1)	Chapter 3 (Study 2)	Chapter 4 (Study 3)	Chapter 5 (Messages)	Implications
Category membership promotes higher cooperation overall, compared to inductive groups	Evidence	Evidence	Partial evidence (not strong)		Categorisation as a static factor has some effect in promoting cooperation but it is not guaranteed.
Non-categorised and interpersonal ties groups reach the same levels of cooperation as categorized groups over time, while categorized groups are higher from the beginning.	Partial Evidence (but both started at the same level)	Evidence	No evidence. Both started similarly low and declined over time		Given these and the above findings, endogenous group processes are more important in determining the progress of cooperation in groups than statically manipulated pathways to social identification.
While the levels of social identification, entitativity and belonging will be the same at the end of interaction for categorized and non-categorized groups, there will be other measurable differences to distinguish them (e.g., in perception of personal value, independence, competition between co-ops, closeness to own co-op etc).	Evidence for the first part but not the second (unreliable measure of personal value)	Evidence for the first part but not the second	Evidence for the first part but not the second		The social psychological measures were naturally confounded with group interaction during the experiment. Endogenous group processes were more important than the pathway and we found that groups that cooperated more (regardless of pathway) had higher measures of social identification etc.
Latent class Markov models are suitable for modelling (dynamic) inductive processes	Evidence	Evidence	Evidence		Without this model we would not have seen the overlap between individual and co-op, where people aligned their decision rules. However, a future challenge is to model the first rounds to determine the <i>process</i> of this norm emergence.

Table 20 continued

Ideas explored	Chapter 2 (Study 1)	Chapter 3 (Study 2)	Chapter 4 (Study 3)	Chapter 5 (Messages)	Implications
When groups cooperate, this is due to norm formation in the initial rounds of the collaboration, during which behaviour of individuals becomes almost perfectly aligned with the group norm.	Evidence	Evidence	Evidence		As above
When groups fail to cooperate, no norm formation takes place and alignment does not happen			Evidence		Study 1 and 2 showed overall high levels of cooperation so this pattern was not found. In Study 3, despite overall low levels of cooperation, in the Breakdown and Struggling Co-ops some people (Marginal and Resilient Cooperators) kept trying to build relationships despite having many defectors in their group: they gave up their short-sighted interest for the future of the group.
Emergent cooperation co-occurs with a particular style of communication which encourages mutual solidarity				Evidence	Cooperative groups were able to coordinate at the level of “us” and promote group solidarity. These messages emerged naturally but future work could test these effects more systematically.
Sanctioning has a negative effect on emergent cooperation and is associated with a failure of intra-group alignment of cooperative behaviors				Evidence	Negative signalling embedded in sanctioning appears detrimental. Again, this could be more systematically tested in future work.

Supplementary Information

All the supplementary information for this dissertation can be found online:

<https://osf.io/35kdy/>

References

References

- Axelrod, R. (1984). *The evolution of cooperation*. New York: Basic Books, Inc.
- Axelrod, R., & Hamilton, W. D. (1981). The evolution of cooperation. *American Association for the Advancement of Science*, 211(4489), 1390–1396.
- Balliet, D. (2010). Communication and cooperation in social dilemmas: A meta-analytic review, 54(1), 39–57. <https://doi.org/10.1177/0022002709352443>
- Balliet, D., Mulder, L. B., & Van Lange, P. A. M. (2011). Reward, punishment, and cooperation: A meta-analysis. *Psychological Bulletin*, 137(4), 594–615. <https://doi.org/10.1037/a0023489>
- Balliet, D., Parks, C., & Joireman, J. (2009). Social value orientation and cooperation in social dilemmas: A meta-analysis. *Group Processes and Intergroup Relations*, 12(4), 533–547. <https://doi.org/10.1177/1368430209105040>
- Balliet, D., & Van Lange, P. A. M. (2013). Trust, punishment, and cooperation across 18 societies: A meta-analysis. *Perspectives on Psychological Science*, 8(4), 363–379. <https://doi.org/10.1177/1745691613488533>
- Balliet, D., Wu, J., & De Dreu, C. K. W. (2014). Ingroup favoritism in cooperation: A meta-analysis. *Psychological Bulletin*, 140(6), 1556–1581. <https://doi.org/http://dx.doi.org/10.1037/a0037737>
- Barrera, D. (2014). Mechanisms of cooperation. In G. Manzo (Ed.), *Analytical Sociology: Actions and Networks* (pp. 173–191). John Wiley & Sons, Ltd.
- Batagelj, V., & Bren, M. (1995). Comparing resemblance measures. *Journal of Classification*, 12(1), 73–90.
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Bicchieri, C. (2005). *The grammar of society: The nature and dynamics of social norms*. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9780511616037>
- Bicchieri, C., & Lev-On, A. (2007). Computer-mediated communication and cooperation in social dilemmas: An experimental analysis. *Politics, Philosophy & Economics*, 6, 139–168. <https://doi.org/10.1177/1470594X07077267>
- Boda, Z., & Néray, B. (2015). Inter-ethnic friendship and negative ties in secondary school. *Social Networks*, 43, 57–72. <https://doi.org/10.1016/j.socnet.2015.03.004>
- Boyd, R., & Richerson, P. J. (2009). Culture and the evolution of human cooperation.

- Philosophical Transactions of the Royal Society B: Biological Sciences*, 364, 3281–3288. <https://doi.org/10.1098/rstb.2009.0134>
- Brewer, M. B., & Kramer, R. M. (1986). Choice behavior in social dilemmas: Effects of social identity, group size, and decision framing. *Journal of Personality and Social Psychology*, 50(3), 543–549. <https://doi.org/10.1037/0022-3514.50.3.543>
- Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality*, 54(1), 106–148.
- Brooke, D., Postmes, T., Jetten, J., & Dyson, S. (2009). *Can we put “I” in “Team”? How the group dynamics of social identity formation influence team performance*. Unpublished Manuscript.
- Chalmers, D. J. (2006). Strong and weak emergence. In P. Clayton & P. Davies (Eds.), *The re-emergence of emergence* (pp. 244–256). Oxford: Oxford University Press.
- Chen, C. C., & Chen, X. (1998). How can cooperation be fostered? The cultural effects of individualism-collectivism. *The Academy of Management Review*, 23(2), 285–304. <https://doi.org/10.2307/259375>
- Chen, X. (1996). The group-based binding pledge as a solution to public goods problems. *Organizational Behavior and Human Decision Processes*, 66(2), 192–202. <https://doi.org/10.1006/obhd.1996.0048>
- Chen, X., & Komorita, S. S. (1994). The effects of communication and commitment in a public goods social dilemma. *Organizational Behavior and Human Decision Processes*. <https://doi.org/10.1006/obhd.1994.1090>
- Christensen, P. N., Rothgerber, H., Wood, W., & Matz, D. (2004). Social norms and identity relevance: A motivational approach to normative behavior. *Personality and Social Psychology Bulletin*, 30(10), 1295–1309. <https://doi.org/10.1177/0146167204264480>
- Cox, T. H., Lobel, S. A., & Mcleod, P. L. (1991). Effects of ethnic group cultural differences on cooperative and competitive behaviour on a group task. *Academy of Management Journal*, 34(4), 827–847.
- Dal Bó, P. (2005). Cooperation under the shadow of the future: Experimental evidence from infinitely repeated games. *American Economic Review*, 95(5), 1591–1604. <https://doi.org/10.1257/000282805775014434>
- Dawes, R. M., McTavish, J., & Shaklee, H. (1977). Behavior, communication, and assumptions about other people’s behavior in a commons dilemma situation. *Journal of Personality and Social Psychology*, 35(1), 1–26.

- Dawes, R. M., Van de Kragt, A. J. C., & Orbell, J. M. (1990). Cooperation for the benefit of us—Not me, or my conscience. In J. J. Mansbridge (Ed.), *Beyond self-interest* (pp. 97–110). Chicago, IL,: University of Chicago Press.
- De Cremer, D., Van Knippenberg, D., Van Dijk, E., & Van Leeuwen, E. (2008). Cooperating if one's goals are collective-based: Function of goal transformation. *Journal of Applied Social Psychology*, 38(6), 1562–1579.
- De Cremer, D., & Van Vugt, M. (1999). Social identification effects in social dilemmas: A transformation of motives. *European Journal of Social Psychology*, 29, 871–893.
- Deaux, K., & Martin, D. (2003). Interpersonal networks and social categories: Specifying levels of context in identity processes. *Social Psychology Quarterly*, 66(2), 101–117.
- Diekmann, A., & Lindenberg, S. (2015). Cooperation: Sociological aspects. In *International Encyclopedia of the Social and Behavioural Sciences* (2nd ed., Vol. 4, pp. 862–866). Oxford: Elsevier.
- Dunbar, R. I. M. (2008). Cognitive constraints on the structure and dynamics of social networks. *Group Dynamics: Theory, Research, and Practice*, 12(1), 7–16.
- Durrheim, K., Quayle, M., Tredoux, C. G., Titlestad, K., & Tooke, L. (2016). Investigating the evolution of ingroup favoritism using a minimal group interaction paradigm: The effects of inter-and intragroup interdependence. *PloS One*, 11(11), e0165974. <https://doi.org/https://doi.org/10.1371/journal.pone.0165974>
- Easterbrook, M., & Vignoles, V. L. (2013). What does it mean to belong? Interpersonal bonds and intragroup similarities as predictors of felt belonging in different types of groups. *European Journal of Social Psychology*, 43(6), 455–462. <https://doi.org/http://dx.doi.org/10.1002/ejsp.1972>>
- Easterbrook, M., & Vignoles, V. L. (2015). Different groups , different motives : Identity motives underlying changes in identification with novel groups. *Personality and Social Psychology Bulletin*, 38(8), 1066–1080. <https://doi.org/10.1177/0146167212444614>
- Edwards, W. (1962). Subjective probabilities inferred from decisions. *Psychological Review*, 69(2), 109–135.
- Farrell, J. (1987). Cheap talk, coordination, and entry. *The RAND Journal of Economics*, 18(1), 34–39.
- Fearon, J. D. (1998). Bargaining, enforcement, and international cooperation. *International Organization*, 52(2), 269–305.
- Fehr, E., & Fischbacher, U. (2004). Social norms and human cooperation. *Trends in Cognitive*

- Sciences*, 8(4), 185–190. <https://doi.org/10.1016/j.tics.2004.02.007>
- Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. *Economics Letters*, 71(3), 397–404.
- Flache, A. (1996). *The double edge of networks: An analysis of the effect of informal networks on cooperation in social dilemmas*. Groningen: Thesis.
- Flache, A., & Macy, M. W. (1996). The weakness of strong ties: Collective action failure in a highly cohesive group. *Journal of Mathematical Sociology*, 21(1–2), 3–28.
- Frohlich, N., & Oppenheimer, J. (1998). Some consequences of e-mail vs. face-to-face communication in experiment. *Journal of Economic Behavior & Organization*, 35(3), 389–403.
- Gintis, H., Bowles, S., Boyd, R., & Fehr, E. (2003). Explaining altruistic behavior in humans. *Evolution and Human Behavior*, 24, 153–172. [https://doi.org/10.1016/S1090-5138\(02\)00157-5](https://doi.org/10.1016/S1090-5138(02)00157-5)
- Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review*, 25(2), 161–178.
- Guala, F. (2012). Reciprocity: Weak or strong? What punishment experiments do (and do not) demonstrate. *Behavioral and Brain Sciences*, 35, 1–59. <https://doi.org/10.1017/S0140525X11000069>
- Hardin, G. (1968). The tragedy of the commons. *Science*, 162(3859), 1243–1248.
- Haslam, S. A., Oakes, P. J., Reynolds, K. J., & Turner, J. C. (1999). Consensus, social identity salience, and the emergence of stereotypes. *Personality and Social Psychology Bulletin*, 25(7), 809–818.
- Henrich, J., & Boyd, R. (2005). “Economic man” in cross-cultural perspective: Behavioral experiments in 15 small-scale societies. *Behavioral and Brain Sciences*, 28, 795–855.
- Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., & McElreath, R. (2001). In search of homo economicus: Behavioral experiments in 15 small-scale societies. *American Economic Review*, 91(2), 73–78.
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, 33(2–3), 61–83.
- Hiltz, S. R., & Turoff, M. (1978). *The network nation*. Cambridge, MA: MIT Press.
- Hofstede, G. (1980). Motivation, leadership, and organization: Do American theories apply abroad? *Organizational Dynamics*, 9(1), 42–63.
- Hogg, M. A. (1992). *The social psychology of group cohesiveness: From attraction to social*

- identity*. New York: New York University Press.
- Horne, C. (2001). Sociological perspectives on the emergence of social norms. In K. Opp & M. Hechter (Eds.), *Social Norms* (pp. 3–34). New York, NY: Russell Sage Foundation.
- Hyslop, J. (2005). Political corruption: Before and after Apartheid political corruption. *Journal of Southern African Studies* ISSN:, 31(4), 773–789.
<https://doi.org/10.1080/03057070500370555>
- Inglehart, R., & Baker, W. E. (2000). Modernization, cultural change, and the persistence of traditional values. *American Sociological Review*, 65(1), 19–51.
- Jaccard, P. (1900). Contribution au problème de l’immigration post-glaciare de la flore alpine. *Bull Soc Vaudoise Sci Nat*, 36, 87–130.
- Jans, L., Postmes, T., & Van der Zee, K. I. (2011). The induction of shared identity: The positive role of individual distinctiveness for groups. *Personality and Social Psychology Bulletin*, 37(8), 1130–1141.
- Jans, L., Postmes, T., & Van der Zee, K. I. (2012). Sharing differences: The inductive route to social identity formation. *Journal of Experimental Social Psychology*, 48(5), 1145–1149.
<https://doi.org/10.1016/j.jesp.2012.04.013>
- Jetten, J., Postmes, T., & McAuliffe, B. J. (2002). “We’re all individuals”: Group norms of individualism and collectivism, levels of identification and identity threat. *European Journal of Social Psychology*, 32(2), 189–207. <https://doi.org/10.1002/ejsp.65>
- Jordan, J. J., Peysakhovich, A., & Rand, D. G. (2014). Why we cooperate. In J. Decety & T. Wheatley (Eds.), *The Moral Brain: Multidisciplinary Perspectives* (pp. 87–101). Cambridge, Massachusetts: The MIT Press.
- Katz, N., Lazer, D., Arrow, H., & Contractor, N. (2004). Network theory and small groups. *Small Group Research*, 35(3), 307–332. <https://doi.org/10.1177/1046496404264941>
- Kelley, H. H., Holmes, J. G., Kerr, N. L., Reis, H. T., Rusbult, C. E., & Van Lange, P. A. M. (2003). *An atlas of interpersonal situations*. Cambridge, Massachusetts: Cambridge University Press.
- Kelley, H. H., & Thibaut, J. W. (1978). *Interpersonal relationships: A Theory of Interdependence*. New York, NY: Wiley.
- Kerr, N. L., & Kaufman-Gilliland, C. M. (1994). Communication, commitment, and cooperation in social dilemmas. *Journal of Personality and Social Psychology*, 66(3), 513–529.
- Kerr, P., Durrheim, K., & Dixon, J. (2017). Beyond the two-group paradigm in studies of

- intergroup conflict and inequality: Third parties and intergroup alliances in xenophobic violence in South Africa. *British Journal of Social Psychology*, 56(1), 47–63.
- Kiesler, S., Siegel, J., & McGuire, T. W. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist*, 39, 1123–1134.
- Koudenburg, N., Postmes, T., Gordijn, E. H., & Van Mourik Broekman, A. (2015). Uniform and complementary social interaction: Distinct pathways to solidarity. *Plos One*, 10(6), e0129061. <https://doi.org/10.1371/journal.pone.0129061>
- Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 33(1), 159–174.
- Lazarsfeld, P. F., & Merton, R. K. (1954). Friendship as a social process: A substantive and methodological analysis. *Freedom and Control in Modern Society*, 18(1), 18–66.
- Leach, C. W., Zebel, S., Vliek, M. L. W., Pennekamp, S. F., Doosje, B., & Spears, R. (2008). Group-level self-definition and self-investment: A hierarchical (multicomponent) model of in-group identification. *Journal of Personality and Social Psychology*, 95(1), 144–165. <https://doi.org/10.1037/0022-3514.95.1.144>
- Leckie, G., & Charlton, C. (2013). Runmlwin-a program to Run the MLwiN multilevel modelling software from within stata. *Journal of Statistical Software*, 52(11), 1–40.
- Ledyard, J. J. (1995). Public goods: A survey of experimental research. In J. H. Kagel & A. E. Roth (Eds.), *The Handbook of Experimental Economics*. Princeton, NJ: Princeton University Press.
- Leszczensky, L. (2013). Do national identification and interethnic friendships affect one another? A longitudinal test with adolescents of Turkish origin in Germany. *Social Science Research*, 42(3), 775–788. <https://doi.org/10.1016/j.ssresearch.2012.12.019>
- Leszczensky, L., Stark, T. H., Flache, A., & Munniksma, A. (2016). Disentangling the relation between young immigrants' host country identification and their friendships with natives. *Social Networks*, 44, 179–189. <https://doi.org/10.1016/j.socnet.2015.08.001>
- Liberman, V., Samuels, S. M., & Ross, L. (2004). The name of the game: Predictive power of reputations versus situational labels in determining prisoner's dilemma game moves. *Personality and Social Psychology Bulletin*, 30(9), 1175–1185.
- Lindenberg, S. (2015a). From individual rationality to socially embedded self-regulation. In R. Scott & S. Kosslyn (Eds.), *Emerging trends in the social and behavioural sciences*. Hoboken, NJ: John Wiley & Sons, Ltd.
- Lindenberg, S. (2015b). Social rationality and weak solidarity: A co-evolutionary approach to

- social order. In E. J. Lawler, S. R. Thyne, & J. Yoon (Eds.), *Order on the edge of chaos: Social psychology and the problem of social order* (pp. 43–62). Cambridge:Cambridge University Press.
- Lindenberg, S., Fetchenhauer, D., Flache, A., & Buunk, A. P. (2006). Solidarity and prosocial behaviour: A framing approach. In S. Lindenberg, D. Fetchenhauer, A. Flache, & A. P. Buunk (Eds.), *Solidarity and prosocial behaviour: An integration of sociological and psychological perspectives* (1st ed., pp. 3–19). New York: Springer US.
<https://doi.org/10.1007/0-387-28032-4>
- Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social Issues*, 63(1), 117–137.
- Lindenberg, S., & Steg, L. (2014). Goal-framing theory and norm-guided environmental behavior. In H. C. . Van Trijp (Ed.), *Encouraging sustainable behavior: Psychology and the environment* (pp. 37–54). Taylor & Francis.
- Lukočiene, O., Varriale, R., & Vermunt, J. K. (2010). The simultaneous decision (s) about the number of lower-and higher-level classes in multilevel latent class analysis. *Sociological Methodology*, 40(1), 247–283.
- Mao, A., Dworkin, L., Suri, S., & Watts, D. J. (2017). Resilient cooperators stabilize long-run cooperation in the finitely repeated Prisoner’s Dilemma. *Nature Communications*, 8, 1–10. <https://doi.org/10.1038/ncomms13800>
- McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27(1), 415–444.
- Messick, D. M. (1999). Alternative logics for decision making in social settings. *Journal of Economic Behavior & Organization*, 39(1), 11–28. [https://doi.org/10.1016/S0167-2681\(99\)00023-2](https://doi.org/10.1016/S0167-2681(99)00023-2)
- Messick, D. M., & McClintock, C. G. (1968). Motivational bases of choice in experimental games. *Journal of Experimental Social Psychology*, 4(1), 1–25.
- Molm, L. D., Schaefer, D. R., & Collett, J. L. (2007). The value of reciprocity. *Social Psychology Quarterly*, 70(2), 199–217.
- Olson, M. (1965). *The logic of collective action: Public goods and the theory of groups*. Cambridge, Massachusetts: Harvard University Press.
- Paas, L. J., Vermunt, J. K., & Bijmolt, T. H. A. (2007). Discrete time, discrete state latent Markov modelling for assessing and predicting household acquisitions of financial products. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 170(4),

955–974.

- Parks, C. D., Joireman, J., & Van Lange, P. A. M. (2013). Cooperation, trust, and antagonism: How public goods are promoted. *Psychological Science in the Public Interest*, 14(3), 119–165. <https://doi.org/10.1177/1529100612474436>
- Parks, C. D., & Vu, A. D. (1994). Social dilemma behavior of individuals from highly individualist and collectivist cultures. *Journal of Conflict Resolution*, 38(4), 708–718.
- Peysakhovich, A., & Rand, D. G. (2016). Habits of virtue: Creating norms of cooperation and defection in the laboratory. *Management Science*, 62(3), 631–647. <https://doi.org/10.1287/mnsc.2015.2168>
- Pillay, S. (2004). Corruption - the challenge to good governance: A South African perspective. *The International Journal of Public Sector Management*, 17(6/7), 586–605.
- Poppo, L., Zhou, K. Z., & Ryu, S. (2008). Alternative origins to interorganizational trust: An interdependence perspective on the shadow of the past and the shadow of the future. *Organization Science*, 19(1), 39–55. <https://doi.org/10.1287/orsc.1070.0281>
- Postmes, T., Haslam, S. A., & Jans, L. (2012). A single-item measure of social identification: Reliability, validity, and utility. *The British Journal of Social Psychology*, 52, 597–617. <https://doi.org/10.1111/bjso.12006>
- Postmes, T., Haslam, S. A., & Swaab, R. I. (2005). Social influence in small groups: An interactive model of social identity formation. *European Review of Social Psychology*, 16(1), 1–42. <https://doi.org/10.1080/104632804400000062>
- Postmes, T., Spears, R., & Lea, M. (1998). Breaching or building social boundaries? SIDE-effects of computer-mediated communication. *Communication Research*, 25(6), 689–715.
- Postmes, T., Spears, R., & Lea, M. (1999). Social identity, normative content, and “deindividuation” in computer-mediated groups. In N. Ellemers, R. Spears, & B. Doosje (Eds.), *Social identity: Context, commitment, content* (pp. 164–183). Oxford, England: Blackwell Science.
- Postmes, T., Spears, R., & Lea, M. (2000). The formation of group norms in computer-mediated communication. *Human Communication Research*, 26(3), 341–371. <https://doi.org/10.1111/j.1468-2958.2000.tb00761.x>
- Postmes, T., Spears, R., Lee, A. T., & Novak, R. J. (2005). Individuality and social influence in groups: Inductive and deductive routes to group identity. *Journal of Personality and Social Psychology*, 89(5), 747–763. <https://doi.org/10.1037/0022-3514.89.5.747>

- Probst, T. M., Carnevale, P. J., & Triandis, H. C. (1999). Cultural values in intergroup and single-group social dilemmas. *Organizational Behavior and Human Decision Processes*, 77(3), 171–191.
- Public Protector South Africa. (2014). Secure in comfort. Retrieved from <https://dc.sourceafrica.net/documents/8074-final-report-21h00.html>
- Putnam, R. D. (2001). *Bowling alone: The collapse and revival of American community*. New York, NY: Simon and Schuster.
- R Core Team. (2016). R: A language and environment for statistical computing. Vienna, Austria. Retrieved from <https://www.r-project.org/>
- Rai, T. S., & Fiske, A. P. (2011). Moral psychology is relationship regulation: Moral motives for unity, hierarchy, equality, and proportionality. *Psychological Review*, 118(1), 57–75. <https://doi.org/10.1037/a0021867>
- Rasbash, J., Charlton, C., Browne, W. J., Healy, M., & Cameron, B. (2009). MLwiN Version 2.1. *Centre for Multilevel Modelling, University of Bristol*.
- Reicher, S., & Haslam, S. A. (2013). Towards a “science of movement”: Identity, authority and influence in the production of social stability and social change. *Journal of Social and Political Psychology*, 1(1), 112–131.
- Romano, A., & Balliet, D. (2017). Reciprocity outperforms conformity to promote cooperation. *Psychological Science*, 28(10), 1490–1502. <https://doi.org/10.1177/0956797617714828>
- Rusbult, C. E., & Van Lange, P. A. M. (2008). Why we need interdependence theory. *Social and Personality Psychology Compass*, 2(5), 2049–2070. <https://doi.org/10.1111/j.1751-9004.2008.00147.x> Why
- Samuelson, P. A. (1954). The pure theory of public expenditure. *The Review of Economics and Statistics*, 36(4), 387–389.
- Schubert, T. W., & Otten, S. (2002). Overlap of self, ingroup, and outgroup: Pictorial measures of self-categorization. *Self and Identity*, 1(4), 353–376. <https://doi.org/10.1080/152988602760328012>
- Searle, J. R. (2002). *Consciousness and language*. Cambridge, UK: Cambridge University Press.
- Shankar, A., & Pavitt, C. (2002). Resource and public goods dilemmas: A new issue for communication research. *The Review of Communication*, 2(3), 251–272.
- Short, J. A., Williams, E., & Christie, B. (1976). *The social psychology of*

- telecommunications*. Chichester, UK: Wiley.
- Simon, H. A. (1986). Rationality in psychology and economics. *The Journal of Business*, 59(4), S209–S224.
- Simpson, B. (2006). Social identity and cooperation in social dilemmas. *Rationality and Society*, 18(4), 443–470. <https://doi.org/10.1177/1043463106066381>
- Singelis, T. M., Triandis, H. C., Bhawuk, D. P. S., & Gelfand, M. J. (1995). Horizontal and vertical dimensions of individualism and collectivism: A theoretical and measurement refinement. *Cross-Cultural Research*, 29(3), 240–275.
- Sivadas, E., Bruvold, N. T., & Nelson, M. R. (2008). A reduced version of the horizontal and vertical individualism and collectivism scale: A four-country assessment. *Journal of Business Research*, 61(3), 201–210. <https://doi.org/10.1016/j.jbusres.2007.06.016>
- Smith, S., Van Tubergen, F., Maas, I., & McFarland, D. A. (2016). Ethnic composition and friendship segregation: Differential effects for adolescent natives and immigrants. *American Journal of Sociology*, 121(4), 1223–1272.
- Snijders, T. A. B., & Bosker, R. J. (2012). *Multilevel analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). Los Angeles, CA: Sage.
- Swaab, R. I., Postmes, T., & Spears, R. (2008). Identity formation in multiparty negotiations. *British Journal of Social Psychology*, 47, 167–87. <https://doi.org/10.1348/014466607X216124>
- Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, 1(2), 149–178.
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. *The Social Psychology of Intergroup Relations*, 33(47), 74.
- Tanis, M., & Postmes, T. (2005). A social identity approach to trust: Interpersonal perception, group membership and trusting behaviour. *European Journal of Social Psychology*, 35, 413–424. <https://doi.org/10.1002/ejsp.256>
- Thibaut, J. W., & Kelley, H. H. (1959). *The social psychology of groups*. New York: John Wiley & Sons, Inc.
- Turner-Zwinkels, F., van Zomeren, M., & Postmes, T. (2015). Politicization during the 2012 US presidential elections: Bridging the personal and the political through an identity content approach. *Personality and Social Psychology Bulletin*, 41(3), 433–445.
- Turner, J. C. (1985). Social categorization and the self-concept: A social cognitive theory of group behavior. In E. J. Lawler (Ed.), *Advances in group processes: Theory and*

- research* (Vol. 2, pp. 77–122). Greenwich, CT: JAI Press.
- Turner, J. C. (1991). *Social influence*. Milton Keynes, England: Open University Press.
- Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory*. Oxford, England: Basil Blackwell.
- Van Beest, I., & Williams, K. D. (2006). When inclusion costs and ostracism pays, ostracism still hurts. *Journal of Personality and Social Psychology*, 91(5), 918–928.
<https://doi.org/10.1037/0022-3514.91.5.918>
- Van de Pol, F., & Langeheine, R. (1990). Mixed Markov latent class models. *Sociological Methodology*, 20, 213–247.
- Van Dijk, F., Sonnemans, J., & Van Winden, F. (2002). Social ties in a public good experiment. *Journal of Public Economics*, 85(2), 275–299.
- Van Lange, P. A. M. (1999). The pursuit of joint outcomes and equality in outcomes: An integrative model of social value orientation. *Journal of Personality and Social Psychology*, 77(2), 337.
- Van Lange, P. A. M., Joireman, J., Parks, C. D., & Van Dijk, E. (2013). The psychology of social dilemmas: A review. *Organizational Behavior and Human Decision Processes*, 120(2), 125–141. <https://doi.org/10.1016/j.obhdp.2012.11.003>
- Van Miltenburg, N., Buskens, V., Barrera, D., & Raub, W. (2014). Implementing punishment and reward in the public goods game: The effect of individual and collective decision rules. *International Journal of the Commons*, 8(1), 47–78.
- Van Mourik Broekman, A., Gordijn, E. H., Koudenburg, N., & Postmes, T. (2018). Reshaping social structure through performances: Emergent solidarity between actors and observers. *Journal of Experimental Social Psychology*, 76, 19–32.
<https://doi.org/10.1016/j.jesp.2017.12.002>
- Van Mourik Broekman, A., Koudenburg, N., Gordijn, E. H., Krans, K. L. S., & Postmes, T. (2019). The impact of art : Exploring the social-psychological pathways that connect audiences to live performances. *Journal of Personality and Social Psychology*, Advance online publication. <https://doi.org/http://dx.doi.org/10.1037/pspi0000159>
- Van Zomeren, M., Postmes, T., & Spears, R. (2008). Toward an integrative social identity model of collective action: A quantitative research synthesis of three socio-psychological perspectives. *Psychological Bulletin*, 134(4), 504.
- Vermunt, J. K., & Magidson, J. (2016). *Technical guide for Latent GOLD 5.1: Basic*,

- advanced, and syntax*. Belmont, MA: Statistical Innovations Inc.
- Vermunt, J. K., Tran, B., & Magidson, J. (2008). Latent class models in longitudinal research. In S. Menard (Ed.), *Handbook of longitudinal research: Design, measurement, and analysis* (pp. 373–385). Academic Press: Burlington, MA.
- Voss, T. (2001). Game-theoretical perspectives on the emergence of social norms. In K. Opp & M. Hechter (Eds.), *Social norms* (pp. 105–136). New York, NY: Russell Sage Foundation.
- Weber, J. M., Kopelman, S., & Messick, D. M. (2004). A conceptual review of decision making in social dilemmas: Applying a logic of appropriateness. *Personality and Social Psychology Review*, 8(3), 281–307. <https://doi.org/10.1207/s15327957pspr0803>
- Weber, J. M., & Murnighan, J. (2008). Suckers or saviors? Consistent contributors in social dilemmas. *Journal of Personality and Social Psychology*, 95(6), 1340–1353. <https://doi.org/10.1037/a0013326>
- Wit, A. P., & Kerr, N. L. (2002). “Me versus just us versus us all”: Categorization and cooperation in nested social dilemmas. *Journal of Personality and Social Psychology*, 83(3), 616–637. <https://doi.org/10.1037/0022-3514.83.3.616>
- Wittek, R. P. M. (2003). Norm violations and informal control in organizations: A relational signalling perspective. In B. Nooteboom & F. Six (Eds.), *The trust process in organizations: Empirical studies of the determinants and the process of trust development* (pp. 168–195). Edward Elgar.
- Woolley, S. C., & Howard, P. N. (2018). *Computational propaganda: Political parties, politicians, and political manipulation on social media*. New York, NY: Oxford University Press.

Dutch Summary

Acknowledgements

I would like to thank Aafke van Mourik Broekman for her help with the translation

Coöperatie is vandaag de dag, maar eigenlijk altijd, fundamenteel voor het sociale leven. Het succes van de menselijke evolutie is mede te danken aan de effectieve samenwerking binnen en tussen groepen (bijv. Boyd & Richerson, 2009). Het vermogen om samen te werken en kennis en goederen uit te wisselen, stelt mensen in staat om hun vaardigheden te diversifiëren en als collectief productiever te worden. In een geglobaliseerde wereld waarin er veel belemmeringen zijn voor coöperatie, is het belangrijker dan ooit om te begrijpen hoe we coöperatieve sociale normen kunnen ontwikkelen die coöperatie binnen gemeenschappen stimuleren.

Recentelijk wordt er steeds meer belang gehecht aan het verkrijgen van inzicht in de evolutie en het onderhoud van een coöperatieve samenleving. Dit komt onder meer door de groei in sociale ongelijkheid, de polarisatie van ideologieën en extremisme, en de politieke manipulatie door middel van algoritmen van sociale media, die allemaal een uitdaging en soms zelfs een bedreiging vormen voor het aantasten van bestaande coöperatieve sociale structuren (bijvoorbeeld Inglehart & Baker, 2000; Putnam, 2001; Woolley & Howard, 2018). Hoe kan, in het licht van al deze maatschappelijke veranderingen en de spanning tussen coöperatieve en concurrerende tendensen in de samenleving, coöperatie worden gehandhaafd en onderhouden? Veel recent onderzoek richt zich op de omstandigheden en variabelen die bestaan in coöperatieve samenlevingen (zoals persoonlijkheidsvoorkeuren, sociale en algemene normen, saillante doelen in de omgeving enz.). Er is echter minder onderzoek gedaan naar hoe coöperatieve samenlevingen ontstaan - met andere woorden, hoe de persoonlijke kenmerken, normen en doelstellingen ontstaan en ontwikkelen is niet bekend. In dit proefschrift, onderzochten we het ontstaan, de ontwikkeling en het onderhoud van coöperatie binnen nieuwgevormde groepen. Onze aanpak van het bestuderen van coöperatie maakte het mogelijk om ons begrip van *hoe deze coöperatieve gemeenschappen evolueren* te vergroten, maar ook om inzicht te krijgen in hoe coöperatieve gemeenschappen kunnen voortbestaan gedurende een langere periode.

Ons belangrijkste theoretische kader is gebaseerd op het interactieve model van sociale identiteitformatie (Interactive Model of Social Identity Formation: IMIF; Postmes, Haslam, & Swaab, 2005; Postmes, Spears, Lee, & Novak, 2005), dat een uitbreiding is van de sociale identiteitstheorie (Tajfel & Turner, 1979). Er is al veel bewijs dat suggereert dat identificatie met een groep of sociale categorie coöperatie binnen de groep faciliteert (Brewer & Kramer, 1986; De Cremer, Van Knippenberg, Van Dijk, & Van Leeuwen, 2008; De Cremer & Van Vugt, 1999; Simpson, 2006; Wit & Kerr, 2002). Iemands sociale identiteit op

basis van groepslidmaatschap kan worden geactiveerd wanneer groepslidmaatschap saillant wordt binnen een bepaalde sociale context en kan - volgens IMIF - ofwel worden gededuceerd uit brede, abstracte sociale categorieën (zoals ras, nationaliteit, geslacht, enz.) of van beneden naar boven geïnduceerd (via interpersoonlijke interactie en communicatie). Zowel kleine, interactieve groepen als brede abstracte categorieën kunnen dezelfde eigenschappen ontwikkelen. Echter, deze ontwikkeling loopt via verschillende paden. In interactieve groepen zijn dynamische processen van cruciaal belang voor de groep: sociale normen van de groep ontstaan dynamisch als gevolg van interactie gedurende de loop der tijd (inductie), in plaats van dat ze worden 'ingeschakeld' door het saillant worden van een sociale categorie (deductie). Dit inductieve proces kan verklaren hoe individuen een gevoel van gelijkheid en gemeenschappelijke sociale identiteit ervaren, wat op zijn beurt het ontstaan van sociale normen voor coöperatie binnen die groep mogelijk maakt.

In dit proefschrift hebben we dynamische 'Public Goods Games' (PGG's) gebruikt om de opkomst of het gebrek aan coöperatieve normen in kleine interactieve groepen te bestuderen. PGG's stellen mensen in staat om bij te dragen aan een gedeelde goederen 'pot' die winst genereert die evenredig is aan de investeringen, maar die het rendement voor *iedereen gelijk* verdeelt, ongeacht individuele investeringen (Olson, 1965). Als gevolg van deze opzet, presteren groepen het beste wanneer iedereen meewerkt, maar maximaliseren individuen hun winst – in ieder geval op de korte termijn én zolang anderen coöpereren - door niet te coöpereren (het zogenaamde 'free riding' effect) (Samuelson, 1954). Voorbeelden van zogenaamde publiek goederen in onze samenleving zijn: openbare televisie en radio; materiële infrastructuur (zoals wegen); intellectuele eigendom ontwikkeld in groepen, enz. (Katz, Lazer, Arrow & Contractor, 2004; Shankar & Pavitt, 2002). PGG's zijn nuttig omdat ze conceptueel weergeven hoe publieke goederen in de echte wereld werken, maar ons in staat stellen coöperatie in een gecontroleerde omgeving te bestuderen. In dit proefschrift waren we vooral geïnteresseerd in de vraag of coöperatieve sociale interacties binnen PGG's verschillen afhankelijk van of de groepsstructuur deductief of inductief was.

We hebben een dynamisch PGG geprogrammeerd in de Virtual Interaction Application (VIAPPL, zie viappl.org). VIAPPL is een experimenteel platform dat is ontworpen om sociale interactie en de evolutie van groepsprocessen en -normen te bestuderen (zie Durrheim, Quayle, Tredoux, Titlestad en Tooke, 2016). VIAPPL is gebruikt om kleine gemeenschappen te simuleren zodat de opkomst van in interactieve groepen - zogenaamde 'co-ops' - kon worden bestudeerd. Interactie tussen deelnemers vond

plaats gedurende een bepaalde tijdspanne (d.w.z. deelnemers konden bijdragen leveren aan de gedeelde goederen pot gedurende meerdere rondes) en acties van de deelnemers konden worden geobserveerd door alle groepsleden. Daarnaast was communicatie tussen de leden van de groep mogelijk, waardoor de deelnemers hun intenties konden communiceren, vragen konden stellen, of er expliciet naar konden streven elkaar te beïnvloeden door groepsnormen te uiten of door anderen verbaal te berispen. Na elke communicatie ronde, konden de deelnemers vervolgens bijdragen aan de gedeelde goederen pot. Deze belangrijke ingrediënten binnen de experimentele opzet, stelden de groepen in staat om deel te nemen aan ruilhandel terwijl ze tegelijkertijd ook sociale relaties kon ontwikkelen met andere groepsleden. Deze opzet hielp ons inzicht te krijgen in hoe coöperatieve normen in groepen gedurende de tijd ontstaan.

Samenvatting van de bevindingen in de hoofdstukken

Twee van onze studies werden uitgevoerd in Nederland (zie Hoofdstuk 2 en Hoofdstuk 3) waar we deelnemers hebben beloond met een studiepunten of een geldbedrag, maar waar de hoogte van de beloningen onafhankelijk was van de uitkomst van het experiment (de individuele prestatie op het PGG). Het laatste onderzoek werd uitgevoerd in Zuid-Afrika (zie Hoofdstuk 4), waar we de deelnemers aan het einde van het experiment hebben beloond door een betaling op basis van hun individuele prestatie op het PGG. Gebaseerd op het Interactive Model of Social Identity Formation (Postmes, Haslam, et al., 2005; Postmes, Spears, et al., 2005), werden alle drie studies ontworpen om de ontwikkeling van coöperatie te onderzoeken door middel van: a) deductieve processen (de categorisatie/sociale categorieën conditie in Hoofdstuk 2 tot 4) en b) inductieve processen (namelijk de niet-categorisatie conditie in Hoofdstuk 2 en interpersoonlijke netwerken conditie in Hoofdstukken 3 en 4).

Voor de analyse van de gegevens pasten we een ‘multilevel latent class Markov-model’ toe (Van de Pol & Langeheine, 1990; Vermunt, Tran, & Magidson, 2008) die de onderlinge afhankelijkheden die inherent zijn aan de experimentele opzet in rekening nam en die ons hielp bij het classificeren van besluitvormingsregels van ronde tot ronde, evenals het classificeren van individuele spelers en co-ops (groepen). Zonder deze statistische benadering zouden we onze meest fascinerende bevinding niet hebben gevonden: bepaalde soorten besluitvormingsregels, die worden gebruikt om te bepalen hoeveel op welk moment wordt ingezet in de pot, zijn een eigenschap van de groep die ontstaat als gevolg van hun

interactie. Met andere woorden, in een korte periode van interactie (dat wil zeggen, binnen de eerste drie tot vier rondes), stemmen mensen hun besluitvormingsgedrag af met hun groep. Dus het "type" persoon dat iemand is in een interactieve groepssituatie hangt af van de aard van de *interactie binnen de groep* en is niet puur van een vaste en stabiele eigenschap van het individu. Deze specifieke bevinding zou niet mogelijk zijn geweest door het gebruik van traditionele statistische analyses.

In het bijzonder ontdekten we allereerst, door middel van de multilevel latent class Markov analyse, dat in alle drie studies zich "co-op types" vormden, die bijna 100% overlaptten met "individuele types". Dit suggereert in sterke mate dat unieke coöperatieve normen ontstaan binnen groepen in slechts een korte periode van interactie. Hoewel er een aantal verschillen waren tussen de studies met betrekking tot het aantal co-op types die ontstonden en het aantal groepen per co-op type, waren er tussen de twee studies ook veel overeenkomsten in de bevindingen. In 'Committed Co-ops'³¹ (Hoofdstuk 2, 3) en 'Resilient Co-ops' (Hoofdstuk 4) ontwikkelde zich een norm om in bijna elke ronde maximaal bij te dragen aan de gedeelde pot. Hoewel in 'Responsive Co-ops' Hoofdstuk 2, 3) soms ook maximaal werd bijgedragen, ontstond daarin een norm om de coöperatie te baseren op wat de rest van de co-opleden deden in de vorige ronde - wat in wezen coöperatief gedrag beloonde (door individueel meer te geven in de volgende ronde), en indirect niet-coöperatief gedrag bestraftte (door minder te geven). Tenslotte, in 'Reactive Co-ops' (Hoofdstuk 2) was de norm om minder dan de Committed en Responsive Co-ops te geven en vooral negatief te reageren op lage bijdragen van de groep door zelf de volgende ronde nog minder bij te dragen. Dit is een vergelijkbare reactie als bij de Responsive Co-ops, echter, met een neerwaartse trend in plaats van een opwaartse trend. Met andere woorden, dit soort groepen was minder vergevingsgezind. In Hoofdstuk 4 vonden we ook twee andere "co-op types" (de 'Struggling' en 'Breakdown' Co-ops), die geen vergelijkbare sterke normatieve patronen vormden. In deze groepen overlaptten de individuele typen die door het model werden geclassificeerd niet 100% met de typen coöperaties. Zo waren de Struggling Coöperaties samengesteld uit 85% 'Marginal cooperators', 11% 'Resilient cooperators' en 3% 'Defectors', terwijl 'Breakdown' Co-ops bestond uit 66% 'Defectors', 30% 'Marginal cooperators' en 4% 'Resilient cooperators'.

³¹ Om verwarring te voorkomen hebben we ervoor gekozen deze termen niet te vertalen.

Ten tweede bleek convergentie binnen groepen (d.w.z. het ontstaan van overeenkomsten in de hoogte van de inzet tussen groepsleden binnen een co-op) bij hoge, zelfs maximale coöperatie te zijn geassocieerd met bepaalde vormen van sociale interactie. Uit de analyse van de inhoud van de berichten die tussen de ronden werden verzonden (Hoofdstuk 5), vonden we bijvoorbeeld dat de coördinatie van coöperatieve actie door het woordgebruik van "ons", en niet van "jij en ik", de kans vergrootte op het ontstaan van coöperatie binnen een groep. Dit gebeurde vooral wanneer het "ons"-woordgebruik werd gecombineerd met communicatie die de groepssolidariteit bevorderde, communicatie over niet-taakgerelateerde onderwerpen die interpersoonlijke relaties bevorderde, en communicatie die overeenstemming bevorderde. Bovendien was berispen in deze studies geen effectief instrument om de totstandkoming van coöperatie te bewerkstelligen - het bleek in veel groepen zelfs schadelijk te zijn. Het negatieve effect van berispen was mogelijk te wijten aan de hardheid van de verzonden berichten die, bij afwezigheid van een vooraf bestaande relatie binnen de groep, niet het belang van een goede voortzetting van de groepsrelatie communiceerde (zie bijv. Wittek, 2003). Alles bij elkaar genomen, moet er, om coöperatie te laten floreren binnen groepen van drie of meer leden, actief vorm worden gegeven aan de sociale normen voor coöperatie. Dit kan worden gerealiseerd door te communiceren op een manier die de relatie met het collectief verbetert en de duurzaamheid ervan waarborgt: Dit kan met name worden gedaan door middel van de coördinatie van de coöperatie op collectief niveau, het bevorderen van de groepssolidariteit, en het vermijden van berispingen wanneer de relatie nog niet is geconsolideerd.

Ten slotte ontdekten we in Hoofdstuk 2 en 3 dat er voor *beide sociale identificatieroutes* in het algemeen sprake was van een hoge mate van coöperatie. Echter, door het veranderen van de experimentele context in Hoofdstuk 4 en het gebruikmaken van financiële in plaats van symbolische beloningen, vonden we dat coöperatie zeldzaam was en afwijking van de coöperatie (in plaats van maximale samenwerking) gebruikelijk was. Hoewel er enkele coöperatieverbanden in de vorm van Resilient Co-ops waren in Hoofdstuk 4, werd het grootste deel van de co-ops in de laatste studie geclassificeerd als Struggling of Breakdown. Deze Struggling en Breakdown types vertoonden niet dezelfde sterke norm-ontwikkeling en bestonden uit verschillende "types" individuen die afzonderlijke patronen van besluitvormingsregels hanteerden.

Aan het einde van deze reeks studies blijven we zitten met een belangrijke vraag: Waarom hebben we afwijkende effecten gevonden tussen de eerste twee studies en de laatste

studie van dit proefschrift? In Hoofdstuk 4 hebben we enkele mogelijke verklaringen voor deze verschillen besproken. Samengevat: de verschillen in de uitkomst van coöperatie kunnen mogelijk worden verklaard door de financiële beloning die aan het spel was verbonden. In het laatste onderzoek activeerde het winstdoel (Lindenberg, 2015) een competitieve geest vanaf het begin van de interactie, wat resulteerde in de hogere aanwezigheid van gedrag ten behoeve van het eigenbelang op korte termijn. Een alternatieve verklaring is dat de maatschappelijke context verschillend was in de studies. Dat wil zeggen, het zou kunnen dat deelnemers in Zuid-Afrika in het algemeen vreemden in het lab minder vertrouwen of andere culturele waarden hebben, in vergelijking met deelnemers in Nederland. Echter, in alle drie studies wordt duidelijk dat opkomende coöperatie ofwel een duurzaam succes ofwel een systematisch falen kan zijn. Ondanks het feit dat deze studies ons begrip over succesvolle coöperatie vergroten, suggereert de diversiteit van de bevindingen dat er nog veel meer te leren valt. Hoewel we in dit stadium niet alle variantie kunnen verklaren, biedt de benadering die we hebben gebruikt (zowel het experimentele paradigma als de statistische methodologie) een waardevol hulpmiddel voor toekomstig onderzoek.

Conclusie

Het doel van dit proefschrift was om te begrijpen hoe *coöperatieve normen ontstaan* in kleine, interactieve groepen in de loop der tijd; en wat de impact van de verschillende paden naar sociale identificatie (het deductieve en het inductieve pad) is op coöperatie. Ten eerste hebben we bewijs gevonden voor het feit dat via beide paden naar sociale identificatie vergelijkbare hoge of lage niveaus van coöperatie kunnen worden bereikt - zij het via verschillende wegen. Maar wat nog belangrijker is, we ontdekten dat groepen de neiging hebben om normen voor coöperatie te vormen op basis van vergelijkbare besluitvormingsregels. Die besluitvormingsregels hebben vervolgens een impact op het algemene niveau van coöperatie dat de groep kan bereiken. Met andere woorden, het besluitvormingsgedrag ten aanzien van de coöperatie was een product van groepsprocessen en groepen bereikten overeenstemming in verschillende patronen van besluitvorming. Daarom is het coöperatieve gedrag dat een individu vertoont, geen vaste, stabiele eigenschap (bijvoorbeeld vanwege een coöperatieve persoonlijkheid), maar bijna volledig afhankelijk van de mensen met wie men samenwerkt, hoe de interactie verloopt, en de omgeving waarin dit plaatsvindt. Ten slotte ontdekten we dat de verandering van de sociale context en de toevoeging van een financiële beloning in de derde studie, leidde tot

een aanzienlijke vermindering van de coöperatie in vergelijking met onze eerste twee studies. Bij elkaar genomen, suggereert het coöperatiegedrag in alle studies (dat wil zeggen, het bedrag dat werd ingezet tijdens de PGG), evenals de inhoud van de verzonden berichten, dat initiële bijdrages in PGG's kunnen worden voorspeld door statische factoren - zoals variabelen op macroniveau die verschillen kunnen verklaren tussen samenlevingen, alsook de winstoogmerk geactiveerd door financiële prikkels, enz. Echter, dynamische factoren - die pas na verloop van tijd door interactie en communicatie zijn intrede doen - bepalen hoe de *coöperatie* coöperatie verder evolueert. Cruciaal voor het verklaren van deze variabiliteit blijkt de aard van sociale interactie – in het bijzonder of groepen gedrag coördineren op het niveau van 'ons', terwijl ze tegelijkertijd ook groepssolidariteit bevorderen. Sociale interactie tussen groepsleden lijkt ten grondslag te liggen aan het ontstaan van sociale normen die coöperatie maximaliseren.

Acknowledgements

Of course, I wouldn't have been able to complete this thesis without the help, support and advice of many great people.

First, thank you to my supervisors Tom Postmes and Tom Snijders (or, Tom²) for collaborating on this project. Tom P. thank you for flying me to the Netherlands to work on the scholarship application together in the first place. I much appreciate that you gave me the freedom to do the kind of research that I was interested in, encouraging me to have fun with designing the studies and answering interesting and complex questions. Tom S., thank you for your constant support in both work and life. I so appreciate all the time you put in with me to figure out these complex analyses. Your kindness and support helped me push through the tough times.

Thanks also to Prof. Jeroen Vermunt for providing helpful advice for the latent class modelling as well as the research assistants who helped me with data collection and content coding: Carlotta Schneider and Andrei Slach.

I also want to thank the VIAPPL team spread out across South Africa and Ireland: Kevin Durrheim, Mike Quayle, Larry Tooke, Colin Tredoux, Fouad Bou Zeineddine, Kevin Igwe, Lungelo Mlangeni, Kirsty Klipp and Simone Sribrath and many more along the way. Kevin and Mike, thank you for sparking my interest in social psychology and research back in my undergraduate days. You were both always so passionate about research which inspired me to follow this path. Thank you for the support and encouragement throughout my Honors thesis, Masters thesis and finally, PhD thesis – many years of VIAPPL-based research together! Larry, the solitary VIAPPL programmer, thank you for all the work you did getting VIAPPL to the point where I could complete my PhD in the way I imagined.

And a giant thank you to my social network for all the support! To my dear family, although we have been living far apart, your loving support (and many hours of Skype calling) have been instrumental in pushing me over the finish line. Coming home for visits, with plenty of sunshine, provided restorative periods in this journey. Also to my oldest friends back home – Lee, Nandi, Stacey and Roxanne – thank you for the laughs and adventures since junior and high school days.

And thank you to all the people I have met since moving to Groningen! To Maja and Julia for hosting me and making me feel welcome before I was even part of the department. You girls made it easy for me to imagine how great it could be to move to Groningen... and it was. To Felicity, the social organizer of the group, thank you for including me in all the social events right from the beginning. From brunches to zany treasure hunts on King's day, you had

a knack for bringing everyone together in fun ways. And of course, closely related, Tomas – thank you for all the social times and the academic help too (CodeThing really made Chapter 5 of this thesis possible). May we demolish many sheds together in the future! Jolien and Anne Marthe, my fellow Wing residents, thank you for kindness and friendship through the years. Marloes – you are one of the kindest, sweetest people I know and I appreciate all our coffee dates. And Ana, thank you for all the passion you brought to research and Game of Thrones (although I’m sorry about how the latter ended!). Elliot and Akku, thank you for the dinners and chats (and introducing Florian and I to a particularly emotional makeover show on Netflix). Thank you Berry (and your furry counterpart, Fery), for playing musical houses with me and for simply being you.

For the first few years of my PhD, I enjoyed many a Friday evening at the borrel with the Minnaars en Minaressen including Russel, Rob, Irene, Wisnu, Justin, Babet, Daniel, Luzia, Catia, Toon, Tassos, Yingqui, Frank, Martijn (also guest appearances by Ruthie, Maarten, Frederik). Thanks to you all. And Hedy – my first year office mate, from whom I borrowed a book in the first few months of my appointment and only remembered to return on my last day packing up the office! Thank you for answering all my tedious first year questions about how things worked.

Balance is sometimes difficult to achieve (especially when your job is to think a lot about difficult things all the time). So a very special thank you to Maxi Meissner and all the practitioners at Bhumi Yoga for holding a gentle space to start off every work day. Yoga has always, and continues to keep me (mostly) sane.

A big thank you to my paranymphs (and fellow plant-obsessed), Aafke and Susie. Aafke, thank you for adopting me as your office mate when Felicity left. My work days became infinitely more fun and witnessing you complete your PhD with a relaxed attitude, while still maintaining a life, gave me the hope to finish too (while also never working past 17:30 or on weekends!). And while we never did win the battle to stay in our office in the Wing, at least we gained a Wang. Susie, once house mate and later office mate, I have enjoyed sharing all kinds of spaces with you. Your laid back southern hemisphere vibe has been really appreciated up here in the north.

And finally Florian, I’m not sure I would have finished this without your kindness and support (I certainly would not have finished it with all the magical R plots you taught me how to make!). I am always learning from your extreme perseverance (some may say craziness), equanimity and thoughtfulness.

Biography

Kim Nicole Titlestad was born in Pietermaritzburg, South Africa on September 1, 1989. She finished her BA Honors in 2013 at the University of KwaZulu-Natal, South Africa and went on to complete her MSc degree in Psychology in 2015, at the same university. In August 2015 she moved to Groningen to begin her PhD at the Department of Social Psychology, Faculty of Behavioral and Social Sciences of the University of Groningen. This project was partially funded by the Erasmus Mundus Action 2 Inspire project.