Uncertainty in social dilemmas

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Uncertainty in Social Dilemmas

Proefschrift

ter verkrijging van

de graad van Doctor aan de Universiteit Leiden,

op gezag van Rector Magnificus prof.mr. P.F. van der Heijden,

volgens besluit van het College voor Promoties

te verdedigen op dinsdag 9 oktober 2007

klokke 15.00 uur

door

Erik Willem de Kwaadsteniet

geboren te Groningen

in 1977

Promotiecommissie

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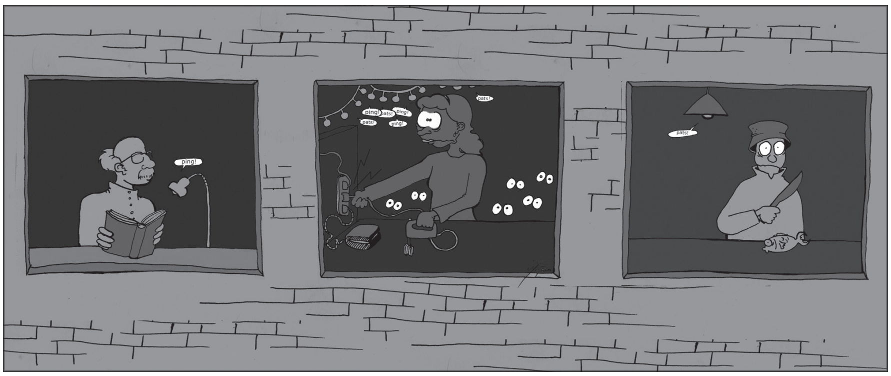
“The moral force of fairness is greatly reinforced by the power of a fair result to focus attention, if it fills the vacuum of indeterminacy that would otherwise exist.”

Thomas C. Schelling (1960, p.73)

Contents



A real-world social dilemma: the electricity blackout

Chapter 1
Introduction

In many real life situations, people experience a conflict between their own personal interest and the interest of the group to which they belong. For instance, people are often confronted with situations in which they have access to scarce or limited common resources, such as energy, fish, oil or water. Whereas people might be tempted to further their self-interest by harvesting excessively from these common resources, such resources should be consumed wisely and sparingly in order to prevent them from becoming depleted. After all, depletion of the common resource is detrimental to the whole group (Hardin, 1968). A well-known real-life example of such a situation is the environmental problem of over-fishing. In this situation, a group of fishermen have access to a natural common resource, namely the fish population. When individual fishermen choose to further their self-interest by catching as many fish as they can, the collective interest is jeopardized because excessive fishing increases the chance of the fish stock becoming depleted. So whereas individual fishermen may be tempted to overuse the common resource, the collective interest calls for moderate consumption.

Situations such as the one described above are generally referred to as *social dilemmas*. In such social dilemmas, people thus have to choose whether they want to further either their self-interest or the interest of their group. When they choose to further their self-interest this is called *defection* or *non-cooperation* and when they choose to further the collective interest this is called *cooperation*. A non-cooperative choice yields the best pay-off to individual group members (in at least one of the possible outcome configurations; Liebrand & Messick, 1996), whereas all individual group members are better off if all cooperate than if all defect (see Komorita & Parks, 1995; Kopelman, Weber, & Messick, 2002; Weber, Kopelman, & Messick, 2004, for reviews). Social dilemmas in which a group of people have access to a limited common resource are usually referred to as *common resource dilemmas*.[1] A real-life example of a common resource dilemma is the problem of electricity blackouts. Such blackouts occur when the electricity grid breaks down because the collective demand for electricity is higher than the available supply (for more real-life examples, see Ostrom, 1990; Ostrom, Gardner, & Walker, 1994).

1 The common resource dilemma is one specific type of social dilemma. Another well-known type of social dilemma is the public good dilemma, in which a group of people can contribute endowments to realize a public good. In the present dissertation, I focus primarily on common resource dilemmas. However, in the general discussion I will also discuss the implications of our findings for public good dilemmas.

Environmental Uncertainty in Social Dilemmas

In real life, common resource dilemmas are often characterized by *environmental uncertainty* (Messick, Allison, & Samuelson, 1988). Environmental uncertainty is uncertainty regarding characteristics of the task environment of a social dilemma. In many real-life social dilemmas, it is uncertain how large the common resource is and how many people have access to the common resource. For example, electricity consumers often do not know how large the capacity of the electricity grid is. Experimental studies on single-trial common resource dilemmas are designed to capture the primary elements of the interdependence described in this blackout example. Such studies have shown that environmental uncertainty can have a substantial impact on people's decisions, often leading to over-harvesting and overestimation of the size of the common resource (e.g., Budescu, Rapoport, & Suleiman, 1990; Gustafsson, Biel, & Gärling, 1999a, 1999b, 2000; Rapoport, Budescu, Suleiman, & Weg, 1992; Suleiman & Budescu, 1999). Therefore, in earlier research it was repeatedly concluded that environmental uncertainty is detrimental to the collective interest. However, it should be noted that the bulk of earlier studies have only focused on one specific type of environmental uncertainty, namely uncertainty about the size of the common resource (also referred to as *resource size uncertainty*).

The finding that resource size uncertainty leads to over-harvesting and overestimation of the common resource can be explained in a number of different ways. Two plausible explanations are (a) the *outcome-desirability explanation* and (b) the *egoism-justification explanation* (for descriptions and tests of these two explanations, see Biel & Gärling, 1995; De Kwaadsteniet, Van Dijk, Wit, & De Cremer, 2006; Gärling, Gustafsson, & Biel, 1999; Gustafsson et al., 1999a, 1999b, 2000). The outcome-desirability explanation suggests that people are overoptimistic about the size of the uncertain common resource and that they therefore overestimate the size of this resource. As a result of this over-optimism, they harvest excessively from uncertain common resources. The egoism-justification explanation, by contrast, suggests that people may use environmental uncertainty as a means to justify their own non-cooperative harvesting decisions. In other words, under uncertainty people can justify their over-harvesting by giving higher estimates of the size of the common resource. Experimental studies by Gustafsson et al. (1999a; 1999b; see also De Vries & Wilke, 1992) have yielded results that corroborate the outcome-desirability explanation.

Although these earlier studies have expanded our understanding of the underlying psychological effects of over-harvesting, it should be noted that these studies have primarily focused on the effects of environmental uncertainty on harvesting decisions and resource size estimates. However, groups are characterized by more than just harvests and estimates. After all, groups may be characterized by a broad spectrum of interpersonal processes. In the context of common resource dilemmas, people may try to (tacitly) coordinate their decisions with their fellow group members; They may try to make decisions they can easily justify to these group members; And they may become angry at one another when they assume that their fellow group members have harvested more than they were entitled to. In order to obtain a more comprehensive picture of the consequences of environmental uncertainty in social dilemmas, such interpersonal processes deserve further investigation. Therefore, the present dissertation will not only focus on effects of environmental uncertainty on harvests and estimates, but also on the influence of uncertainty on interpersonal processes in social dilemmas. It will be argued that environmental uncertainty may have important consequences for several key aspects of these interpersonal processes

To investigate how environmental uncertainty influences interpersonal processes, a new perspective on this topic will be presented. It will be argued that environmental uncertainty can severely hamper the application of the equal division rule. In turn, the notion that the application of this rule is hampered has various different consequences for what happens within groups. More specifically, the present dissertation will show that environmental uncertainty influences three key aspects of interpersonal processes in social dilemmas, namely (a) how people tacitly coordinate their choice behavior, (b) how they justify their decisions to others, and (c) how they respond affectively to other people's choice behavior.

The Importance of the Equal Division Rule

In a typical experimental common resource dilemma, participants are collectively endowed with a resource of money or chips from which each group member can harvest. As long as the total group harvest does not exceed the resource size all individual harvests are granted. If the collective harvest, however, exceeds the amount available in the common resource, the resource becomes depleted and all group members receive zero outcomes (e.g., Budescu et al., 1990; Gustafsson et al., 1999a, 1999b; Rapoport et al., 1992), as in the case of an electricity blackout. Therefore, it is in the interest of each individual group member as well as in the interest of the group that the total group harvest does not exceed the size of the common resource.

In common resource dilemmas, it is therefore important for people to coordinate their harvesting decisions efficiently. To prevent individual and collective interests from being harmed, group members must make sure that the common resource is not overused. However, efficient coordination is often hampered by the fact that group members cannot communicate with one another. Furthermore, group members often do not know what their fellow group members will decide. In other words, in most social dilemmas people are confronted with *social uncertainty* (also referred to as *strategic uncertainty*; Messick et al., 1988). How can people coordinate under social uncertainty? The answer to this question lies in the concept of *tacit coordination* (Schelling, 1960).

The concept of tacit coordination was developed by the Nobel prize winning economist Thomas Schelling (1960). Schelling argued that even in the absence of communication people can often coordinate their decisions. To illustrate this, he gave an example of two people who want to meet each other in New York City without having a prior understanding on where and when to meet. Where would one go and at what time? Schelling asked participants this question and found that the majority of the people answered that they would go to Central Station at 12.00 noon. If people would indeed act accordingly this would mean that tacit coordination would be highly effective. Van Dijk and colleagues (e.g., Van Dijk & Wilke, 1995, 1996; Van Dijk, Wilke, Wilke, & Metman, 1999) applied this concept of tacit coordination to social dilemmas. They argued that in social dilemmas, people can successfully coordinate their choice behavior by anchoring their decisions on so-called coordination rules.

Which coordination rule is most often applied in social dilemmas? Earlier research (e.g., Allison, McQueen, & Schaerfl, 1992; Allison & Messick, 1990; De Cremer, 2003; Rutte, Wilke, & Messick, 1987; Van Dijk & Wilke, 1993, 1995; Van Dijk et al., 1999) has shown that in *symmetric* common resource dilemmas (i.e., all group members have equal access to the common resource), most people request an equal share of the common resource. For instance, if a common resource of 500 coins is owned by five group members, most group members will decide to harvest one-fifth – or 100 coins – from that common resource. In other words, most people will decide to base their harvesting decisions on the *equal division rule*. If all group members do so, the common resource is optimally used and there is a perfect balance between individual and collective interests. Thus, by anchoring their decisions on coordination rules – such as the equal division rule – people can successfully coordinate their choice behavior.

However, the equal division rule is not only useful because it facilitates efficient coordination, but also because it is a rule that generates decisions that are considered to be "fair" (e.g., Messick, 1993; Stouten, De Cremer, & Van Dijk, 2005; 2006). After all, when all group members decide to adhere to the equal division rule, all individual group members end up with an equal share of the common resource. In symmetric common resource dilemmas, an equal division is generally considered to be a fair outcome. Thus, the application of the equal division rule may not only be helpful to ensure optimal use but may also help to establish a fair division of the common resource.[2] Furthermore, since the equal division rule is such a fair rule it also generates decisions that can be easily justified to fellow group members. Altogether, these characteristics make the equal division rule highly appealing (Messick, 1993).

Additionally, since the equal division rule may promote group efficiency and

2 It may be interesting to note that Schelling himself (1960, p.73) already hinted at the coordinating potential of fairness by writing that "the moral force of fairness is greatly reinforced by the power of a fair result to focus attention, if it fills the vacuum of indeterminacy that would otherwise exist."

fairness – and the rule is only successful when all group members use it – people also want their fellow group members to adhere to it. Therefore, they may try to enforce the use of the equal division rule. As a consequence, when they learn that their fellow group members have violated this rule, they will react quite negatively to these group members. More specifically, when they learn that someone has harvested more than an equal share they will become angry at this person and they will try to punish this rule violator for his/her defection (e.g., Stouten, De Cremer, & Van Dijk, 2005, 2006). Thus, the equal division rule may not only influence people's own harvesting decisions, but also how they respond to their fellow group members' decisions. In several different ways, the equal division rule thus seems to be important for how people behave in social dilemma situations.

The Equal Division Rule and Environmental Uncertainty

Can people always apply the equal division rule? What happens, for instance, when there is uncertainty about the environmental characteristics of a social dilemma? In the present dissertation, I will argue that under uncertainty the application of the equal division rule is severely hampered. After all, in order to apply the equal division rule people need specific and accurate information about the task environment of the social dilemma. For instance, to calculate an equal share people need to know exactly how large the common resource is and how many group members are sharing the common resource. When they do not have such accurate environmental information they cannot easily calculate how large an equal share is and application of the rule is hampered. As a consequence, environmental uncertainty may influence several factors that are related to the application of the equal division rule, such as the interpersonal processes described above, namely: tacit coordination, justifying decisions, and emotional and retributive reactions to others.

As was mentioned earlier, environmental characteristics are often uncertain in real-life common resource dilemmas. Therefore, the importance of environmental uncertainty has been widely acknowledged by social dilemma researchers. In the past two decades, numerous experimental studies have been conducted to investigate this topic (e.g., Au & Ngai, 2003; Budescu et al., 1990; De Vries & Wilke, 1992; Gustafsson et al., 1999a, 1999b, 2000; Hine & Gifford, 1996; Rapoport et al., 1992; Roch & Samuelson, 1997; for overviews, see Biel & Gärling, 1995; Van Dijk, Wit, Wilke, & Budescu, 2004; Suleiman & Budescu, 1999). However, as I mentioned before, earlier research on environmental uncertainty has mainly focused on harvesting decisions and resource size estimates. By also focusing on how such uncertainty influences interpersonal processes in social dilemmas, the present dissertation aims to add new insights to the existing literature in order to generate a more comprehensive picture of how people deal with environmental uncertainty in social dilemmas.

Overview of the Present Dissertation

The present dissertation focuses on how environmental uncertainty in social dilemmas influences several different factors. As was mentioned earlier, the fact that environmental uncertainty hampers the application of the equal division rule has a number of different consequences. In the above, it was argued that the equal division rule influences three key aspects of interpersonal processes, namely: (a) how people tacitly coordinate their decisions, (b) how they justify their decisions to others, and (c) how they respond to the decisions of their fellow group members. Until now, it has hardly been investigated how these important issues relate to environmental uncertainty. In the present dissertation, I will therefore investigate how these factors are influenced by environmental uncertainty in social dilemmas.

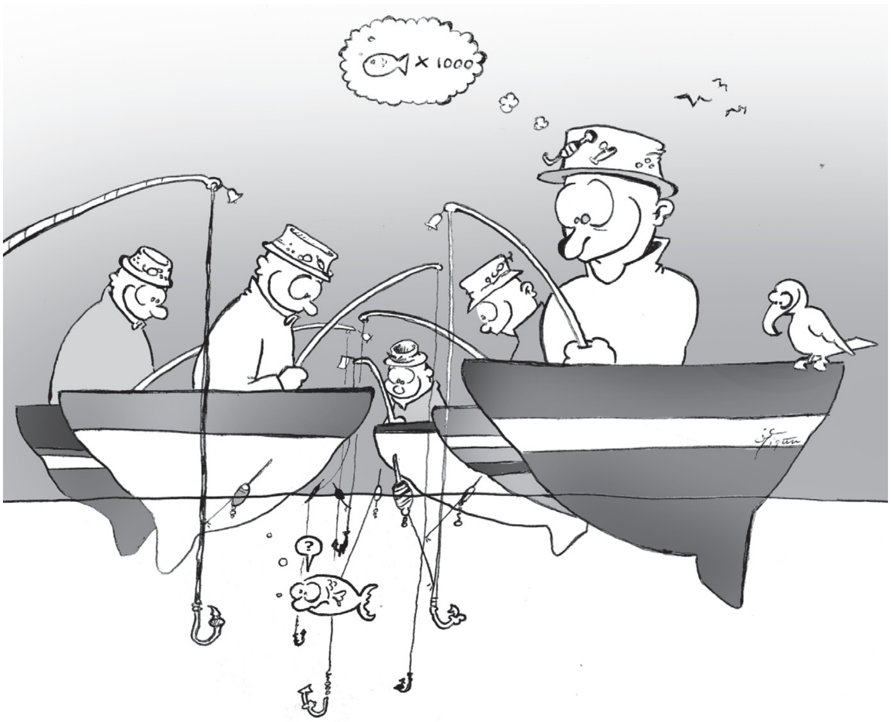
The first two empirical chapters (i.e., Chapters 2 and 3) focus on how environmental uncertainty affects tacit coordination and how such uncertainty interacts with individual differences (i.e., people's social value orientations). This topic is investigated by manipulating uncertainty about the size of the common resource (referred to as *resource size uncertainty*; see Chapter 2) and by manipulating uncertainty about the size of the group (referred to as *group size uncertainty*; see Chapter 3). In these chapters, it is argued that uncertainty hampers tacit coordination. These two chapters show that whereas under certainty people base their harvesting decisions on external cues (i.e., the equal division rule), under uncertainty they base their decisions on internal cues (i.e., their own social value orientations).

In Chapter 4, it is investigated how people justify their own harvesting decisions to their fellow group members when there is uncertainty about the size of the common resource. To do so, (a) participants are asked about the justifiability of different hypothetical harvests and (b) it is investigated how justification pressures influence their own harvesting decisions under varying levels of resource size uncertainty. This chapter shows that under certainty people justify their harvesting decisions by adhering to the equal division rule, whereas under uncertainty they justify their decisions by restricting their harvests.[3]

In Chapter 5, it is investigated how people respond to overuse under resource size uncertainty. More specifically, in a series of three studies people's emotional and retributive reactions to overuse are investigated. Furthermore, it is argued how these reactions can be explained by their causal attributions. This chapter demonstrates that the same negative outcome (i.e., overuse) can elicit different affective and retributive reactions, depending on whether or not the social dilemma is characterized by environmental uncertainty.

3 I would like to note that Chapters 2, 3 & 4 were based on papers that have either been published or that have been submitted for publication. Consequently, these chapters can be read separately and there exists some overlap between them (especially between the introductions of these chapters).

In Chapter 6, all of the findings of this dissertation will be summarized and discussed. Additionally, the general implications of these findings will be discussed and suggestions for future research will be presented.



Over-harvesting and overestimation of the common resource

Chapter 2
Social Dilemmas as Strong versus Weak Situations[4]

Social dilemmas are situations in which people are faced with a conflict between furthering their personal interests (called *defection*) and furthering the interests of their group (called *cooperation*). In such dilemmas, a choice to defect yields the best pay-off to individual group members in at least one of the possible outcome-configurations, whereas all individual group members are better off if all cooperate than if all defect (Liebrand & Messick, 1996; see Komorita & Parks, 1995; Kopelman, Weber, & Messick, 2002, for reviews).

A well-known type of social dilemma is the *common resource dilemma* (also referred to as commons dilemma). This dilemma refers to the problem of maintaining scarce common resources. A real-life example is the world-wide social dilemma of energy consumption. Whereas the collective interest calls for moderate energy consumption, personal interests may lead to excessive usage. On a smaller scale, an example of the energy consumption dilemma is the problem of electrical blackouts. Such blackouts occur when the electricity grid is overloaded because the demand for electricity is higher than the available supply. As long as the collective use does not exceed a certain threshold, the use of electricity is beneficial to people's personal interests. However, if this threshold is exceeded, the electricity grid breaks down and both collective and personal interests are harmed.

Experimental studies on common resource dilemmas are designed to capture the primary elements of the interdependence structure described above (e.g., Budescu, Rapoport, & Suleiman, 1990; Gustafsson, Biel, & Gärling, 1999a; Rapoport, Budescu, Suleiman, & Weg, 1992). In a typical experiment, participants are collectively endowed with a resource of money or chips from which each group member can request an amount. As long as the total group request does not exceed the resource size, all individual requests are granted. If the collective request, however, exceeds the amount available in the common resource, the resource becomes depleted and all group members receive zero outcomes. It is thus in the interest of each individual group member as well as in the interest of the group that the total group request does not exceed the size of the common resource.

Therefore, in common resource dilemmas, it is important for people to coordinate their choice behavior efficiently (i.e., by not over-using the common resource).

4 This chapter is based on De Kwaadsteniet, Van Dijk, Wit and De Cremer (2006).

In order to do so, people may use their expectations of what their fellow group members will decide. However, in most social dilemma situations, people cannot communicate with one another and therefore they are uncertain about the decisions of their fellow group members. To deal with this *social uncertainty* (Messick, Allison, & Samuelson, 1988), people use so-called tacit coordination rules to make inferences about their group members' choice behavior (Van Dijk & Wilke, 1996). Moreover, people use such coordination rules as *focal points* for their own choice behavior (Schelling, 1960).

Tacit Coordination in Common Resource Dilemmas

Which coordination rule is most often applied in common resource dilemmas? Earlier research (e.g., Allison, McQueen, & Schaerfl, 1992; Allison & Messick, 1990; De Cremer, 2003; Rutte, Wilke, & Messick, 1987; Van Dijk & Wilke, 1993, 1995; Van Dijk, Wilke, Wilke, & Metman, 1999) has shown that in *symmetric* common resource dilemmas (i.e., all group members have equal access to the common resource), most people request an equal share of the common resource. For instance, in the experimental set-up we described earlier, when a common resource contains 500 coins and is owned by a group of five group members, participants will often decide to request one-fifth of that resource, namely 100 coins. In other words, in this kind of social dilemma, group members anchor their choice behavior on the *equal division rule* (Allison et al., 1992; Samuelson & Allison, 1994). Note that this logic only applies to social dilemma situations with a coordination point in which individual and collective interests converge (which is the case in almost all experiments on environmental uncertainty; see e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al.,1992). In such situations, when all group members adhere to the equal division rule the resource is optimally used and a perfect balance between personal and collective interests is realized.

Furthermore, to employ the equal division rule, the size of the common resource has to be common knowledge to all group members. In order to deal with social uncertainty, people need specific and exact information about the task environment of the social dilemma. Many real-life common resource dilemmas, however, do not provide such environmental information. In the blackout example, for instance, it is very unlikely that people know with certainty how large the available supply of electricity is. What do people base their decisions on under such *environmental uncertainty* (i.e., uncertainty about characteristics of the task environment of a social dilemma; Messick et al., 1988)? One possible answer to this question may be provided by looking at social dilemmas with environmental certainty as "strong" situations versus looking at social dilemmas with environmental uncertainty as "weak" situations.

Social Dilemmas as Strong Versus Weak Situations

According to Snyder and Ickes (1985), an environment can create either a psychologically “strong” or a psychologically “weak” situation. Strong situations have a high degree of structure and definition and therefore provide salient cues for behavior. Weak situations, by contrast, do not offer such cues for behavior because they are relatively unstructured and ambiguous. In strong situations, behavior is thus largely guided by the constraints of the situation, resulting in little interpersonal differences in people’s responses. In weak situations, on the other hand, behavior is more strongly influenced by dispositional factors, resulting in more interpersonal variation.

Van Lange (1997; see also Roch & Samuelson, 1997) has suggested that this strong-weak distinction is also applicable to social dilemma situations. If we apply this perspective to environmental uncertainty, we can define the typical experimental common resource dilemma as a strong situation as it provides participants with the clear focal point that applying the equal division rule is the most “appropriate” way to behave. By contrast, a common resource dilemma in which the size of the resource is uncertain does not provide such a clear focal point to guide behavior. As a result, the equal division rule may lose its coordinating potential. In such situations, we suggest that participants will rely more on relevant internal cues such as their dispositional preferences for engaging in either cooperation or non-cooperation. Therefore, we suggest that in common resource dilemmas with environmental uncertainty, participants use their own social value orientations as a guideline for choice behavior.

Social Value Orientations

Social value orientation (SVO) is a personality variable that indicates how people evaluate outcomes for themselves and others (Messick & McClintock, 1968; Van Lange & Liebrand, 1991). Generally, a distinction is made between three types of social value orientations (e.g., Van Lange, 1999): (a) cooperation, i.e., the preference to maximize joint outcomes and establish an equal distribution, (b) individualism, i.e., the preference to maximize own outcomes, and (c) competition, i.e., the preference to maximize the relative advantage of own outcomes. Cooperators are commonly referred to as prosocials, and individualists and competitors as proselfs (e.g., Kramer, McClintock, & Messick, 1986; McClintock & Liebrand, 1988; Van Lange & Kuhlman, 1994). In social dilemmas, prosocials generally show more cooperative behavior than proselfs (e.g., Kramer et al., 1986; Liebrand & Van Run, 1985).

However, as we have argued before, whether proselfs and prosocials behave differently in social dilemma situations may depend on the environmental characteristics of the dilemma (cf. Parks, 1994; Roch & Samuelson, 1997). In the typical common resource dilemma, it is beneficial to both proselfs and prosocials to request an equal share of the resource because it furthers personal as well as collective interests. From this perspective it is “efficient” as well as “fair” to adhere to the equal division rule, making the rule appealing to both proselfs and prosocials (see De Cremer & Van

Lange, 2001; Stouten, De Cremer, & Van Dijk, 2005; Van Lange, 1999). Consequently, we expect that under environmental certainty, the effect of SVO on individual requests will be constrained by the focal point to adhere to the equal division rule (i.e., in a "strong" social dilemma), whereas SVO will more strongly influence choice behavior under environmental uncertainty (i.e., in a "weak" social dilemma).

Based on the above, we can formulate the following hypotheses. First, we expect to replicate the finding from earlier studies (e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992), that under resource size uncertainty, people request significantly more than under resource size certainty (Hypothesis 2.1). Second, we predict an interaction between resource size uncertainty and SVO on individual requests. Under resource size certainty, we expect a limited difference between proselfs' versus prosocials' individual requests, whereas proselfs are expected to request more than prosocials under resource size uncertainty (Hypothesis 2.2). As in earlier studies on resource size uncertainty in social dilemmas, these hypotheses will be tested by manipulating different levels of resource size uncertainty as a within-subjects factor.

Resource Size Estimates

In the present chapter, we will not focus exclusively on people's choice behavior. Although not our primary aim, we will also investigate whether resource size uncertainty influences people's estimates of the size of the resource. In agreement with findings from earlier studies (e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992), we expect that people will not only increase their individual requests under resource size uncertainty, but also their resource size estimates (Hypothesis 2.3). There are two plausible explanations for these findings (Hine & Gifford, 1996).[5] One explanation is that people try to justify their non-cooperative behavior by increasing their resource size estimates together with their individual requests. We will refer to this explanation as the *egoism-justification explanation*. A second plausible explanation for this finding is that under environmental uncertainty, people are overoptimistic about the size of the resource and therefore have the tendency to give relatively high estimates. We will refer to this explanation as the *outcome-desirability explanation*.

We will investigate the two above-mentioned explanations in an exploratory manner. Based on the egoism-justification explanation, following the prediction that proselfs request more than prosocials under resource size uncertainty, we can predict that proselfs will also give higher resource size estimates than prosocials. In this way, proselfs may justify their relatively high individual requests. From this perspective, we

5 There is a third explanation of this overestimation effect, namely, that there might be a perceptual bias in people's resource size estimates. However, Gustafsson et al. (1999a, 1999b) have presented results that refute this possibility.

can thus expect that under resource size uncertainty, proselfs' resource size estimates will be higher than the estimates of prosocials. The outcome-desirability explanation would not be able to explain such a finding. After all, there is no reason to assume that people with different social value orientations differ in the extent to which they are optimistic about the size of the resource, especially because a large common resource is beneficial to both personal and collective interests. However, in order to check whether SVO is related to optimism, we will also explore whether people with different social value orientations differ in dispositional optimism.

Study 2.1

Method

Participants and Design

Participants were 126 students at Leiden University (42 men and 84 women, *M* age = 20.98 years) who volunteered for the study. At the beginning of the experiment each participant's SVO was assessed. Subsequently, resource size uncertainty was manipulated as a within-subjects factor. Accordingly, a 2 (SVO: Proselfs vs. Prosocials) × 3 (Resource Size Uncertainty: No vs. Low vs. High) factorial design was used.

Preliminary inspection of the data showed that the individual request of one proself in the High Resource Uncertainty condition was more than three standard deviations higher than the mean request in this condition, which indicates that this participant was an outlier. Therefore, the data of this participant were excluded from analyses.[6]

Procedure

The participants were invited to participate in a study on "decision making". Upon arrival at the laboratory they were seated in separate cubicles, each containing a personal computer. This computer was used to give instructions to the participants and to register the dependent measures.

Assessment of Social Value Orientation

At the beginning of the experimental session, participants completed the nine-item version of the decomposed games measure to assess their social value orientations (Van Lange, De Bruin, Otten, & Joireman, 1997). The decomposed games measure has excellent psychometric qualities. It is internally consistent (e.g., Parks, 1994), reliable over substantial time periods (Eisenberger, Kuhlman, & Cotterell, 1992), and is not

6 Inclusion of this outlier did not alter the pattern of results.

related to measures of social desirability (e.g., Platow, 1994). The task consists of nine items, each containing three alternative outcome distributions with points for oneself and an anonymous other. For each of these nine items the participants had to choose which of the three distributions they preferred. Each item contained a prosocial (e.g., self: 500, other: 500), an individualistic (e.g., self: 560, other: 300), and a competitive choice (e.g., self: 490, other: 90).

Participants were classified as prosocial, individualistic, or competitive when at least six out of nine choices were consistent with one of these three orientations (e.g., Van Lange & Kuhlman, 1994). Out of 126 participants, 56 (44%) were classified as prosocials, 47 (37%) as individualists, and 8 (6%) as competitors. Fifteen participants (12%) could not be classified and were therefore excluded from further analyses. As in many earlier studies (e.g., Kramer, McClintock, & Messick, 1986; McClintock & Liebrand, 1988; Van Lange & Kuhlman, 1994), individualists and competitors were combined to form one group of proselfs (n = 55; 44%).

Assessment of Dispositional Optimism

After filling in the decomposed games measure, we asked participants to fill in a revised version of the *Life Orientation Test* (LOT-R), a widely-used scale with good psychometric properties (i.e., good predictive and discriminant validity, high internal consistency and test-retest reliability) that is used to measure dispositional optimism (Scheier, Carver, & Bridges, 1994). After that, participants responded to some filler questionnaires. Next, they were presented with the common resource dilemma.

The Common Resource Dilemma

Participants were informed that they were part of a group of five people, that each group member was sitting in a separate cubicle and that there was no communication possible among participants. Furthermore, participants were not aware of the identity of their fellow group members. Decisions had to be made privately and anonymously.

The participants learned that as a group they would be presented with three situations. These three situations had identical task structures. In each of these situations, each group member could request any number of coins from a common resource. Each coin was worth € 0.01 (€ 1 is approximately US $ 1.65). For each of the three situations, it held that if the group's collective request would be smaller than or equal to the resource size, the requests would be granted and each group member would earn the amount of money he or she had requested in that situation. However, if the group's collective request would exceed the resource size in a situation, all group members would earn zero outcomes in that situation. During and between the three situations, no feedback was given about the decisions of the other group members nor about the group's collective request.

Manipulation of Resource Size Uncertainty

The three situations only differed in the extent to which there was uncertainty about the size of the common resource. Resource size uncertainty was manipulated by varying the range of the uniform distribution of the resource size (cf. Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992). The midpoint of these ranges was kept constant across the three conditions, namely 500. Under *No Uncertainty*, resource size was certain, namely 500 coins (midpoint = 500, range = 0). Under *Low Uncertainty*, the resource would contain at least 400 and at most 600 coins (midpoint = 500, range = 200). Under *High Uncertainty*, the resource would contain at least 100 and at most 900 coins (midpoint = 500, range = 800). Participants learned that the exact size of the common resource in the two uncertainty conditions would be randomly drawn from these uniform distributions by a computer at the end of the experimental session (i.e., independently for each of the two uncertainty conditions). The three conditions were counter-balanced to check for order effects. Preliminary analyses revealed no significant order effects on any of the dependent variables (all Fs < 1).

After the participants read the instructions of the common resource dilemmas, five practice questions were posed to ensure comprehension of the three situations. For example, participants were asked how much group members would earn if the total group request would exceed the size of the common resource in one of the three situations. On average, each question was answered correctly by 97% of all participants. After each question, the correct answer was disclosed and the most important characteristics of the dilemmas were repeated. After that, the three situations were presented.

Dependent Measures

In all three conditions, exactly the same questions were posed. In each condition, participants requested a number of coins from the common resource. Subsequently, they were asked to estimate the size of the common resource.

At the end of the experimental session, which lasted about one hour, all participants were debriefed, thanked and paid for their participation. In the debriefing, we explained participants that we would pay all participants the same amount of money for their participation (i.e., € 7.25, approximately US $ 12.00). We also explained them that we could not pay them according to their choice behavior because the groups they had been part of did not really exist. All participants agreed to this payment procedure.

Results

Manipulation Checks

Unless stated otherwise, all analyses were performed with 2 (SVO) × 3 (Resource Size Uncertainty) ANOVAs with repeated measures on the latter factor.

In each of the three conditions, after participants had given their resource size estimates, we asked them to indicate how uncertain they were about these estimates (1 = very certain; 7 = very uncertain). A 2 × 3 ANOVA on this measure only yielded a highly significant main effect of Resource Size Uncertainty, $F(1.94, 209.54) = 397.28$, $p < .0001$, $\eta^2 = .79$ (Huynh-Feldt correction of *dfs*). As expected, participants indicated that they were least uncertain about their estimates under No Uncertainty ($M = 1.26$), more uncertain under Low Uncertainty ($M = 4.64$), and most uncertain under High Uncertainty ($M = 5.50$, all $ps < .05$, HSD). These results show that we were successful in manipulating resource size uncertainty.

Individual Requests

In each of the three conditions, the participants individually requested a number of coins from the common resource. A 2 × 3 ANOVA on participants' individual requests yielded a significant main effect of Resource Size Uncertainty, $F(1.40, 151.14) = 10.78$, $p < .001$, $\eta^2 = .09$, and a significant SVO × Resource Size Uncertainty interaction effect, $F(1.40, 151.14) = 3.51$, $p < .05$, $\eta^2 = .03$ (Greenhouse-Geisser correction of *dfs*). It should be noted, however, that the variances in the High Resource Size Uncertainty conditions were considerably larger than the variances in the No and the Low Resource Size Uncertainty conditions. In order to reduce this heterogeneity of variances, we applied a square root transformation on participants' individual requests. After applying this transformation, which successfully reduced the heterogeneity of variances, a 2 × 3 ANOVA still yielded the same significant main effect of Resource Size Uncertainty, $F(1.45, 156.24) = 5.52$, $p < .05$, $\eta^2 = .05$, and the same significant SVO × Resource Size Uncertainty interaction effect, $F(1.45, 156.24) = 3.49$, $p < .05$, $\eta^2 = .03$ (Huynh-Feldt correction of *dfs*). The main effect of Resource Size Uncertainty indicated that under High Uncertainty participants requested more coins from the common resource ($M = 142.28$) than under No Uncertainty ($M = 109.72$) and under Low Uncertainty ($M = 106.85$). These findings support Hypothesis 2.1, i.e., that under resource size uncertainty people request more than under resource size certainty.

To interpret the interaction effect, we tested whether the individual requests of proselfs differed from those of prosocials within each separate level of Resource Size Uncertainty (See Table 2.1). Independent t-tests showed no significant differences between proselfs' and prosocials' individual requests under No Uncertainty ($M = 108.50$ vs. 110.89, respectively), $t(108) = .3$, $p = .74$, nor under Low Uncertainty

(*M* = 112.69 vs. 101.21, respectively), *t*(108) = 1.4, *p* = .16. Under High Uncertainty, however, proselfs requested significantly more coins than prosocials (*M* = 163.63 vs. 121.70, respectively), *t*(108) = 2.1, *p* < .05. These results support Hypothesis 2.2, i.e., that under resource size uncertainty proselfs would request more coins from the common resource than prosocials, although it should be noted that this difference was only significant under High Uncertainty.

Table 2.1. *Individual Requests by Social Value Orientation and Resource Size Uncertainty (2 × 3)*

Social Value Orientation	Resource Size Uncertainty		
	No	Low	High
Proselfs (*n* = 54)	108.50 (35.05)	112.69 (40.51)	163.63 (123.49)
Prosocials (*n* = 56)	110.89 (38.99)	101.21 (43.51)	121.70 (82.95)

Note. Higher scores denote higher individual requests. Standard deviations are given in parentheses.

Resource Size Estimates

After participants had made their individual requests, they were asked to estimate the size of the resource. The No Uncertainty condition was excluded from the analysis of these estimates. After all, in this condition, participants knew the exact size of the common resource with certainty. A 2 (SVO) × 2 (Resource Size Uncertainty: Low vs. High) ANOVA on participants' resource size estimates yielded a significant main effect of Resource Size Uncertainty, *F*(1, 108) = 8.73, *p* < .01, η^2 = .08, and a significant main effect of SVO, *F*(1, 108) = 4.66, *p* < .05, η^2 = .04. In agreement with the egoism-justification explanation, the main effect of Resource Size Uncertainty indicates that participants gave significantly higher estimates of the resource size under High Uncertainty (*M* = 554.77) than under Low Uncertainty (*M* = 482.61).

As an additional test of the egoism-justification explanation, we tested whether the resource size estimates of proselfs were higher than those of prosocials in each separate level of resource size uncertainty (See Table 2.2). Independent t-tests showed that proselfs gave significantly higher resource size estimates than prosocials under Low Uncertainty (*M* = 498.15 vs. 469.73, respectively), *t*(108) = 2.46, *p* = .05, as well as under High Uncertainty (*M* = 592.59 vs. 511.96, respectively), *t*(108) = 1.71, *p* = .05 (one-sided). Taken together, these results support the egoism-justification explanation.

Table 2.2. *Resource Size Estimates by Social Value Orientation and Resource Size Uncertainty (2 × 2)*

Social Value Orientation	Resource Size Uncertainty	
	Low	High
Proselfs (*n* = 54)	498.15 (60.63)	592.59 (222.48)
Prosocials (*n* = 56)	469.73 (60.56)	511.96 (267.85)

Note. Higher scores denote higher resource size estimates. Standard deviations are given in parentheses.

SVO and Dispositional Optimism

Proselfs and prosocials did not differ significantly in their scores on the LOT-R (M = 4.60 vs. 4.71, respectively), $t(108) = .65$, $p = .52$, which indicates that people differing in SVO do not differ in dispositional optimism. Additionally, no significant relations were found between participants' dispositional optimism and any of the dependent variables (all absolute *r*s < .13, all *p*s > .17).

Application of the Equal Division Rule

To assess to what degree participants anchored their decisions on the equal division rule in the different Resource Size Uncertainty conditions, we investigated to what extent their individual requests deviated from an equal share of their own resource size estimates. To do so, we calculated the absolute difference between participants' individual requests and an equal share of their own resource size estimates. A 2 × 3 ANOVA on this calculated deviation only yielded a significant main effect of Resource Size Uncertainty, $F(1.63, 176.23) = 6.04$, $p < .001$, $\eta^2 = .08$ (Huynh-Feldt correction of *dfs*), indicating that participants' requests deviated significantly more from an equal share under High Uncertainty (M = 44.75) than under No Uncertainty (M = 13.03; $p < .05$, HSD) and under Low Uncertainty (M = 14.25; $p < .05$, HSD). Closer inspection of these data showed that participants mostly deviated in the direction of harvesting more than an equal share.[7] Further, additional analyses showed that with increasing resource size uncertainty, a smaller proportion of the participants requested exactly an equal share of their own resource size estimates (80% vs. 71% vs. 51%, respectively), $\chi^2(4, N = 110) = 33.00$, $p < .001$. Taken together, these results suggest that with increasing resource size uncertainty, people are less inclined to anchor their decisions on the equal division rule.

[7] To check in which *direction* participants' requests deviated from the equal division rule, we divided their requests by their own resource size estimates. Additional analyses on this calculated proportion showed that, on average, participants requested significantly more than an equal share of their own resource size estimates in each of the three Resource Size Uncertainty conditions (all *t*s > 2.7, all *p*s < .01).

Discussion

In this chapter, we focused on environmental uncertainty in common resource dilemmas. We showed that under resource size certainty (i.e., in a "strong" social dilemma), people anchor their decisions on the equal division rule,[8] whereas they base their decisions on their own social value orientations under resource size uncertainty (i.e., in a "weak" social dilemma). On a more general level, Study 2.1 generates new insights into the relation between social uncertainty and environmental uncertainty by showing that the way in which people deal with social uncertainty is affected by the uncertainty people may experience regarding environmental information (cf. Van Dijk et al., 1999). Our findings indicate that in situations of environmental certainty, people may adequately deal with social uncertainty by focusing on environmental cues (e.g., the size of the resource) and by using these environmental cues to apply the equal division rule. However, when such environmental cues are absent or ambiguous, the environment loses its coordinating potential (cf. Van Dijk, Wit, Wilke, & Budescu, 2004; see Wit & Wilke, 1998, for a similar argument in public goods dilemmas).

A closer inspection of our data provided additional support for this line of reasoning. When we compared people's individual requests with their own resource size estimates, their requests appeared to deviate more from an equal share under resource size uncertainty than under resource size certainty. As expected, these results suggest that under resource size uncertainty, people are less inclined to anchor their decisions on the equal division rule. In such situations, people rely more on relevant internal cues (i.e., their SVO) to determine their choice behavior.

At this point, it might be interesting to compare our results with findings reported by Roch and Samuelson (1997), who studied how people's reactions to a declining common resource were affected by replenishment rate uncertainty (i.e., uncertainty regarding the regenerating capacity of the resource). The results showed that prosocials versus proselfs did not react differently in the first phase (i.e., when the common resource was abundant) and the last phase (i.e., when the common resource was almost completely depleted) of the experimental trials. Only in the middle trials, an interaction between replenishment rate uncertainty and SVO on cooperation emerged: under replenishment rate uncertainty, proselfs harvested more than prosocials. In their discussion of this unexpected pattern of results, Roch and Samuelson suggested that the interaction between replenishment rate uncertainty and SVO might only emerge in the temporal dynamics of a social dilemma, i.e., after group members have become acquainted with the gradual decline of the resource. The present study, however,

8 A large majority of the participants (i.e., 80%) harvested an equal share under No Uncertainty. Not surprisingly, most of the participants who did deviate from an equal share, harvested more (rather than less) than an equal share. As a consequence, under No Uncertainty, the mean harvest was slightly higher than 100 coins.

in which we introduced resource size uncertainty in a *single-trial* common resource dilemma, suggests a more pervasive and eminent role of SVO in how people deal with environmental uncertainty. Moreover, our additional analysis, that assessed participants' adherence to the equal division rule, reveals that the influence of environmental uncertainty can best be understood by acknowledging its possible detrimental effects for tacit coordination.

Although not our primary interest, we also investigated the egoism-justification and the outcome-desirability explanations in an exploratory manner. A possible limitation of our study is that the procedure of first eliciting harvesting decisions and after that asking for resource size estimates may have facilitated the use of resource size estimates as a justification for behavior and may therefore not provide a stringent comparative test of the two explanations. Nevertheless, the obtained results seem to be in accordance with the egoism-justification explanation. Not only did proselfs request more coins from the common resource under resource size uncertainty, they also gave higher resource size estimates. Furthermore, SVO appeared to be unrelated to dispositional optimism. Altogether, these results suggest that, under environmental uncertainty, proselfs justify their "greedy" behavior by increasing their resource size estimates.[9] In this way, resource size uncertainty provides proselfs with a convenient "excuse" for being selfish, thereby coloring their estimates with self-interest (cf. Hine & Gifford, 1996).

In a series of studies on environmental uncertainty in social dilemmas, Gustafsson et al. (1999a, 1999b) also investigated the egoism-justification explanation and the outcome-desirability explanation. These studies showed that participants not only over-harvest from an uncertain *common resource*, but even from an uncertain *private* resource (i.e., a situation in which an individual [instead of a group] owns a resource with an uncertain size). As Gustafsson et al. noted, this latter finding cannot be explained by the egoism-justification explanation, whereas it can be explained by the outcome-desirability explanation. However, as Gustafsson et al. (1999a) also pointed out, it is important to note that the different mechanisms described by these two explanations are not mutually exclusive, and that both mechanisms might be operative under resource size uncertainty. Consequently, the support Gustafsson et al. found for the outcome-desirability explanation does not necessarily falsify the egoism-justification explanation. Likewise, our present support for the egoism-justification explanation does not rule out the outcome-desirability explanation.

[9] Interestingly, proselfs did not seem to use the equal division rule in justifying their harvests under uncertainty, i.e., they did not increase their resource size estimates to such an extent that their harvests would amount to one-fifth of these estimates.

In conclusion, by looking at social dilemmas as “weak” versus “strong” situations, the present study sheds a new light on the topic of environmental uncertainty in social dilemmas. In “strong” social dilemmas, people anchor their decisions on (tacit) coordination rules. However, to determine their choice behavior in “weak” social dilemmas, people rely more on their own social value orientations.

Group size uncertainty

Chapter 3
Group Size Uncertainty[10]

Social dilemmas are situations in which people face a conflict between their personal interests (called *defection*) and the interests of their group (called *cooperation*). In such dilemmas, people thus have to choose whether to defect or to cooperate. A choice to defect yields the best payoff to individual group members (i.e., in at least one of the possible outcome configurations; Liebrand & Messick, 1996), whereas all individual group members are better off if all cooperate than if all defect (see Komorita & Parks, 1995; Kopelman, Weber, & Messick, 2002, for reviews).

A well-known type of social dilemma is the *common resource dilemma* (or commons dilemma). In this type of social dilemma, a group of people have access to a limited common resource. A real-life example of such a resource dilemma is the environmental problem of over-fishing. In this resource dilemma, a group of fishermen have access to a natural common resource, namely the fish population. When individual fishermen choose to further their self-interest by catching as much fish as they can, the collective interest is jeopardized because excessive fishing increases the chance of the resource becoming depleted. So whereas individual fishermen may be tempted to overuse the common resource, the collective interest calls for moderate use. Moreover, to further complicate matters, fishermen often do not know how large the fish population is or how many fishermen are fishing from the same pool (Ostrom, 1990; Takigawa & Messick, 1993).

Many real-life social dilemmas are thus characterized by *environmental uncertainty*, or uncertainty regarding the characteristics of the task environment of a social dilemma (Messick, Allison, & Samuelson, 1988). Earlier research has shown that environmental uncertainty can have a large impact on people's choice behavior. For instance, earlier studies have repeatedly shown that uncertainty regarding the size of the resource (i.e., *resource size uncertainty*) leads to over-harvesting (e.g., Budescu, Rapoport, & Suleiman, 1990; De Kwaadsteniet, Van Dijk, Wit, & De Cremer, 2006; Gustafsson, Biel, & Gärling, 1999a; Hine & Gifford, 1996; see Van Dijk, Wit, Wilke, & Budescu, 2004, for an overview of the effects of uncertainty). However, until now very little experimental research has been done to investigate other types of environmental uncertainty, such as uncertainty about the number of group members sharing a resource (see Au & Ngai, 2003, for an exception).

In real life, group sizes are often uncertain. In many social dilemma situations, people do not know precisely how many group members there are. For instance, water

10 This chapter is based on De Kwaadsteniet, Van Dijk, Wit and De Cremer (conditionally accepted).

consumers often do not know how many people are consuming water in their water district (see Ostrom, 1990; Takigawa & Messick, 1993, for numerous other real-life examples). Therefore, more experimental research is needed to obtain more insight into this type of environmental uncertainty (Van Dijk et al., 2004). In the present research, we will investigate how *group size uncertainty* influences choice behavior in common resource dilemmas.

Earlier Research on Group Size Uncertainty

To our knowledge, only one experimental study has been conducted to investigate group size uncertainty in social dilemmas. In an earlier study, Au and Ngai (2003) investigated the effects of group size uncertainty in a single choice step-level common resource dilemma under different protocols of play. Each of their participants made only one harvesting decision in a series of successive rounds, either in a pre-specified order (called a *sequential protocol*) or whenever (s)he decided to do so (called a *self-paced protocol)*. Overuse of the common resource would destroy its value and none of the harvests would be granted. In the group size certainty condition, participants were told that the group size was five. In the group size uncertainty condition, they were told that their group was equally likely to be any size between three and seven persons. In all conditions, after the first round participants were fully informed about the combined harvests of all the preceding players in the sequence, but in the self-paced protocol participants were also informed about the number of players who had made requests in the previous round.

The authors were primarily interested in effects on total requests, i.e., effects at the collective level. Their analyses showed that collective overuse was less likely to occur under group size uncertainty than under group size certainty. Under group size uncertainty, participants apparently acted as if the group size was large and requested less, to avoid collective overuse. Ancillary analyses showed that in the self-paced protocol of play, group size uncertainty resulted in participants delaying their harvest decision to a later round until they knew the combined harvests of all the preceding players in the sequence, reducing the risk of collective overuse. By contrast, participants who were certain that the group size was five did not wait and were more likely to make a request in the first round. Given that they – on average – requested somewhat more than their equal share (i.e., 1/5th of the common resource) the pool was more likely to be overused under group size certainty than under group size uncertainty. It may be suggested that the self-paced protocol allowed participants to coordinate their actions. Under group size uncertainty, a participant could gain useful information about the number and the (combined) size of others' requests by delaying his or her own harvest decision to a later round. This raises the question as to what will happen if uncertainty about the number and size of other's requests cannot be reduced by strategic timing of one's decisions.

In order to disentangle the effects of group size uncertainty on the *size* and on the *timing* of participants' harvests, the present study uses a simultaneous protocol of play, in which participants will not be informed about the harvests of their fellow group members. By doing so, we can obtain more insight into the inhibiting effects of group size uncertainty on tacit coordination. Moreover, to answer the question as to how people make decisions when the possibility for tacit coordination is limited, we draw on Snyder and Ickes' (1985) framework of strong versus weak situations. On the basis of this conceptual framework, we will argue and demonstrate that under group size uncertainty people base their harvesting decisions on their own social value orientations.

Tacit Coordination and Group Size Uncertainty as a Weak Situation

In social dilemmas such as the one described above, it is important for people to coordinate their choice behavior effectively (e.g., Van Dijk & De Cremer, 2006; Van Dijk & Wilke, 1996). In resource dilemmas, it is best for people to coordinate their decisions in such a way that the collective resource does not become depleted, which would be detrimental to individual as well as collective interests. However, effective coordination is hampered when group members do not know what their fellow group members will decide. This uncertainty about the decisions of other group members is called *social uncertainty* (or strategic uncertainty, Messick et al., 1988). Earlier research has shown that people can often deal with such social uncertainty by means of *tacit coordination* (Schelling, 1960; Van Dijk & Wilke, 1996). That is, group members can predict their fellow group members' decisions by using so-called tacit coordination rules (such as the equal division rule; see also Allison & Messick, 1990). Furthermore, people also use such coordination rules to determine their own choice behavior.

Imagine a resource dilemma with the same payoff structure as to the one Au and Ngai used (2003). In this dilemma, a group of five people own a collective resource of 500 coins. Each individual group member can request a number of coins from this resource. However, if the total group request exceeds the number of coins available in the collective resource, the resource becomes depleted and no-one receives any coins. The five group members cannot communicate with one another and do not know what their fellow group members will decide (i.e., social uncertainty). Research has shown that people tend to solve this social dilemma by using a tacit coordination rule, in this case the *equal division rule*. In other words, most group members will request an equal share from the collective resource (e.g., Allison & Messick, 1990), in this case 100 coins. If all group members decide to do so the resource is optimally used and all group members receive 100 coins. Thus, under uncertainty in a resource dilemma, people can tacitly coordinate their decisions by applying the equal division rule.

In order to apply the equal division rule, however, people need specific and accurate information about the task environment of a social dilemma. To calculate an equal share people have to divide the size of the collective resource by the number of group members. In order to do so, they need to know exactly how large the resource is and how many people the group consists of. Thus, when the group size is uncertain it becomes much more difficult for group members to apply the equal division rule. So what do people base their decisions on under such group size uncertainty?

The answer to this question may be found in Snyder and Ickes' framework of weak versus strong situations (1985; see also Roch & Samuelson, 1997; Van Lange, 1997). Snyder and Ickes distinguish two types of situations. Strong situations are situations that provide salient cues for people to base their decisions on. In strong situations, people base their decisions on these salient environmental cues. As a result, strong situations lead to little interpersonal variation in their decisions. Weak situations, by contrast, do not provide people with such salient environmental cues. In weak situations, people cannot use external cues to base their decisions on, but they base their decisions on their own dispositional preferences.

When we apply this framework to group size (un)certainty in social dilemmas, we can characterize social dilemmas with group size certainty as strong situations. After all, under group size certainty most people may decide to base their choice behavior on the equal division rule. By contrast, social dilemmas with group size uncertainty can be characterized as weak situations that do not provide people with the salient cues to apply the equal division rule. Under group size uncertainty, we can therefore expect people to base their decisions on their own dispositional preference for either cooperation or non-cooperation, i.e., their social value orientation.

Social value orientation (SVO) is a personality variable that indicates how people evaluate outcomes for themselves and others (Messick & McClintock, 1968; Van Lange & Liebrand, 1991). Generally, a distinction is made between three types of social value orientations (e.g., Van Lange, 1999): (a) cooperation, i.e., the preference to maximize joint outcomes and establish an equal distribution, (b) individualism, i.e., the preference to maximize own outcomes, and (c) competition, i.e., the preference to maximize the relative advantage of own outcomes. Cooperators are commonly referred to as prosocials, and individualists and competitors as proselfs. In social dilemmas, prosocials generally show more cooperative behavior than proselfs (e.g., Kramer, McClintock, & Messick, 1986).

Study 3.1

Hypotheses

Based on the above, we can formulate the following hypotheses. First, we predict an interaction between group size uncertainty and SVO on individual requests. Under group size certainty (i.e., a strong situation), we expect that proselfs as well as prosocials will base their harvesting decisions on the equal division rule and therefore we predict a limited difference between proselfs' and prosocials' individual requests (Hypothesis 3.1). Under group size uncertainty (i.e., a weak situation), by contrast, we expect that participants will base their decisions on their own social value orientation, and therefore we predict a (significant) difference between the individual requests of proselfs versus prosocials, i.e., prosocials' requests being lower than those of proselfs (Hypothesis 3.2).

Second, although not our primary aim, besides testing hypotheses about people's individual harvests, we will also test whether proselfs and prosocials differ in their estimates of the size of their group. Earlier research on resource size uncertainty (e.g., De Kwaadsteniet et al., 2006) has shown that proselfs and prosocials give different estimates of the size of an uncertain common resource. That is, earlier findings showed that proselfs - besides harvesting larger amounts than prosocials - also gave higher estimates of the size of the common resource than prosocials. When we generalize this finding to group size uncertainty, we can expect group size estimates also to be affected by social value orientations: Prosocials will give higher estimates of the size of the group than proselfs (i.e., when the group is large there are less resources available per group member; Hypothesis 3.3).[11]

Method

Participants and Design

Participants were 120 students at Leiden University (15 men and 105 women, *M* age = 20.80 years) who volunteered for the study. At the beginning of the experiment each participant's SVO was assessed. Group size uncertainty was manipulated as a within-subjects factor. Accordingly, a 2 (SVO: Proselfs vs. Prosocials) × 2 (Group Size Uncertainty: No vs. Yes) factorial design with repeated measures on the latter factor was used.

[11] Another possibility is that people are over-optimistic about the size of the group under group size uncertainty (i.e., the outcome-desirability explanation; cf. Gustafsson et al., 1999). If this is the case, we can expect that people will give relatively low group size estimates. However, this explanation would not predict a difference between the group size estimates of proselfs versus prosocials, also because earlier research has shown that proselfs and prosocials do not differ in dispositional optimism (De Kwaadsteniet et al., 2006).

Procedure

The participants were invited to participate in a study on "group decision making". Upon arrival at the laboratory they were seated in separate cubicles, each containing a personal computer. This computer was used to give instructions to the participants and to register the dependent measures.

Assessment of Social Value Orientation

At the beginning of the experimental session, participants completed the nine-item version of the decomposed games measure to assess their social value orientations (Van Lange, De Bruin, Otten, & Joireman, 1997). The decomposed games measure has excellent psychometric qualities. It is internally consistent (e.g., Parks, 1994), reliable over substantial time periods (Eisenberger, Kuhlman, & Cotterell, 1992), and not related to measures of social desirability (e.g., Platow, 1994). The task consists of nine items, each containing three alternative outcome distributions with points for oneself and an anonymous other. For each of these nine items the participants had to choose which of the three distributions they preferred. Each item contained a prosocial (e.g., self: 500, other: 500), an individualistic (e.g., self: 560, other: 300), and a competitive option (e.g., self: 490, other: 90).

Participants were classified as prosocial, individualistic, or competitive when at least six out of nine choices were consistent with one of these three orientations (e.g., Van Lange & Kuhlman, 1994). Out of 120 participants, 54 (45%) were classified as prosocials, 40 (33%) as individualists, and 12 (10%) as competitors. Fourteen participants (12%) could not be classified and were therefore excluded from further analyses. As in many earlier studies (e.g., Kramer, McClintock, & Messick, 1986; McClintock & Liebrand, 1988; Van Lange & Kuhlman, 1994), individualists and competitors were combined to form one group of proselfs (n = 52; 43%). After completing the SVO measure, participants responded to some filler questionnaires. Next, they were presented with the resource dilemma.

The Resource Dilemma

Participants were informed that they would be part of a group of people, that each group member was sitting in a separate cubicle and that there was no communication possible among participants. Furthermore, participants were not aware of the identity of their fellow group members. Decisions had to be made privately and anonymously.

The participants were presented with two similar resource dilemmas that only differed in the degree of group size uncertainty. Participants learned that at the end of the experimental session a computer would randomly select one of these two situations and that this selected situation would be used to calculate the amount of money each individual group member would earn. Each of these two situations was thus an independent single-trial resource dilemma.

In each of these resource dilemmas, each group member could request any number of coins from a collective resource of 500 coins. Each coin was worth € 0.01 (€ 1 was approximately US $ 1.65). For each of these resource dilemmas it held that if the group's collective request would be smaller than or equal to the resource size, the requests would be granted and each group member would earn the amount of money he or she had requested in that situation. However, if the group's collective request would exceed the resource size all group members would earn zero outcomes. This resource dilemma is similar to the one used by Au and Ngai (2003) but in the present study participants had to make their decisions simultaneously. Moreover, during and between the two resource dilemmas no feedback was given about the decisions of the other group members nor about the group's collective request.

Manipulation of Group Size Uncertainty

The two situations only differed in the degree of uncertainty about the size of the group. Group size uncertainty was manipulated by varying the range of the uniform distribution of the group size. The midpoint of these ranges was kept constant across the two conditions, namely five. Under *No Uncertainty*, the group size was certain, namely five group members (midpoint = 5, range = 0). Under *Uncertainty*, the group would consist of at least two and at most eight group members (midpoint = 5, range = 6). Participants learned that the exact size of the group in the uncertainty condition would be randomly drawn from these uniform distributions by a computer at the end of the experimental session (i.e., participants were told that their group was equally likely to be any size between two and eight persons). The two conditions were counter-balanced to check for order effects. Preliminary analyses revealed no significant order effects on any of the dependent variables (all Fs < 1).

After the participants had read the instructions of the resource dilemmas, three practice questions were posed to ensure comprehension of these dilemmas. For example, participants were asked how much each group member would earn if the total group request would exceed the size of the collective resource. Ninety-nine % of all participants answered all three questions correctly. After each question the correct answer was disclosed and the most important characteristics of the dilemmas were repeated. After that, the two dilemmas were presented.

Dependent Measures

In both (un)certainty conditions, exactly the same questions were posed. In each condition, participants requested a number of coins from the common resource and they were asked to estimate the size of the group.

At the end of the experimental session, which lasted about half an hour, all participants were debriefed, thanked and paid for their participation. In the debriefing, we explained that we would pay all participants the same amount of money for their participation, namely € 6 (i.e., approximately US $ 10), plus the extra money they had earned in one of the two the resource dilemmas. All participants agreed with this payment procedure.

Results

Manipulation Checks

Unless stated otherwise, all analyses were performed with 2 (SVO) × 2 (Group Size Uncertainty) ANOVAs with repeated measures on the latter factor.

In each of the two conditions, we asked participants to indicate how uncertain they were about the size of the group (1 = very certain; 7 = very uncertain). A 2 × 2 ANOVA on this measure only yielded a highly significant main effect of Group Size Uncertainty, $F(1, 104) = 2417.61$, $p < .0001$, $\eta^2 = .96$. As expected, participants were more uncertain about their estimates under Group Size Uncertainty ($M = 6.25$) than under No Group Size Uncertainty ($M = 1.10$). These results show that we were successful in manipulating group size uncertainty.

Individual Requests

In each of the two conditions, the participants individually requested a number of coins from the common resource (See Table 3.1). A 2 × 2 ANOVA on participants' individual requests yielded a significant main effect of SVO, $F(1, 104) = 5.07$, $p < .05$, $\eta^2 = .05$, which was qualified by a significant SVO × Group Size Uncertainty interaction effect, $F(1, 104) = 6.18$, $p < .05$, $\eta^2 = .06$. It should be noted, however, that in accordance with our expectations, the variance in the Group Size Uncertainty condition was considerably larger than the variance in the No Group Size Uncertainty condition. In order to reduce this heterogeneity of variances, we applied a square root transformation on participants' individual requests in all conditions. After applying this transformation, which successfully reduced the heterogeneity of variances, a 2 × 2 ANOVA still yielded a significant main effect of SVO, $F(1, 104) = 4.93$, $p < .05$, $\eta^2 = .05$, and a significant SVO × Group Size Uncertainty interaction effect, $F(1, 104) = 7.01$, $p < .01$, $\eta^2 = .06$, as well as a significant main effect of Group Size Uncertainty, $F(1, 104) = 8.32$, $p < .01$, $\eta^2 = .07$, which was also qualified by the interaction.

Table 3.1. *Individual Requests by Social Value Orientation and Group Size Uncertainty*

Social Value Orientation	Group Size Uncertainty	
	No	Yes
Proselfs (*n* = 52)	95.15 (16.92)	100.25 (70.36)
Prosocials (*n* = 54)	95.26 (26.44)	73.17 (33.23)

Note. Higher scores denote higher individual requests. Standard deviations are given in parentheses.

To interpret the interaction effect, we tested whether the individual requests of proselfs differed from those of prosocials in each condition of Group Size Uncertainty. In accordance with Hypothesis 3.1, independent t-tests on the individual requests showed no significant difference between proselfs and prosocials under No Uncertainty (M = 95.15 vs. 95.26, respectively), $t(104) = 0.02$, $p = .98$. Under Uncertainty, however, prosocials requested significantly lower amounts of coins than proselfs (M = 100.25 vs. 73.17, respectively), $t(104) = 2.55$, $p < .01$. This latter finding corroborates Hypothesis 3.2.

Further, we also looked at the effect of group size uncertainty for proselfs and prosocials separately. To do so, we conducted two separate repeated measures ANOVAs (i.e., one for each SVO) with Group Size Uncertainty as the independent variable (i.e., No vs. Yes) and individual requests as the dependent variable. These analyses showed that the requests of proselfs did not differ significantly between the two uncertainty conditions, $F(1, 51) = .27$, $p = .61$, $\eta^2 = .01$, whereas prosocials requested significantly lower amounts of coins in the Uncertainty condition than in the No Uncertainty condition, $F(1, 53) = 18.44$, $p < .001$, $\eta^2 = .26$.[12] Thus, prosocials respond more strongly to group size uncertainty than proselfs. We will elaborate on this finding in the discussion.

Group Size Estimates

After participants had made their individual requests, they were asked to estimate the size of the group (See Table 3.2). The No Uncertainty condition was excluded from the analysis of these estimates. After all, in this condition, participants knew the exact size of the group with certainty. An ANOVA on participants' group size estimates under Uncertainty yielded a significant effect of SVO, $F(1, 103) = 8.14$, $p < .01$, $\eta^2 = .07$. In accordance with Hypothesis 3.3, prosocials gave significantly higher estimates of the group size than proselfs (M = 6.26 vs. 5.37, respectively).

12 These analyses were also done on proselfs' and prosocials' transformed requests (i.e., transformed by applying square root transformations), which yielded the same results.

Table 3.2. *Group Size Estimates by Social Value Orientation under Group Size Uncertainty*

Social Value Orientation	Group Size Uncertainty
Proselfs (*n* = 52)	5.37 (1.60)
Prosocials (*n* = 54)	6.26 (1.63)

Note. Higher scores denote higher group size estimates. Standard deviations are given in parentheses.

The Relation between Individual Requests and Group Size Estimates

To investigate the relationship between individual requests and group size estimates, we looked at the correlations between participants' individual requests and their group size estimates. These analyses showed that there was a highly significant negative relation between their requests and their estimates, which was similar for proselfs and prosocials (both *r*s < -.61, both *p*s < .001). Thus, participants who requested less from the common resource made higher group size estimates.

Additionally, to assess to what degree participants anchored their decisions on the equal division rule in the two Group Size (Un)certainty conditions, we investigated to what extent their individual requests deviated from an equal share. In the Uncertainty condition we calculated this equal share by dividing the resource size (i.e., 500 coins) by the participants' own group size estimates. After that, we calculated the absolute difference between participants' individual requests and this equal share (for a similar procedure to assess adherence to coordination rules, see e.g., Van Dijk & Wilke, 2000). A 2 × 2 ANOVA on the deviation scores only yielded a significant main effect of Group Size Uncertainty, $F(1, 103) = 8.12$, $p < .01$, $\eta^2 = .07$: Participants' requests deviated significantly more from an equal share under Group Size Uncertainty (*M* = 18.05) than under No Group Size Uncertainty (*M* = 7.98). This finding further corroborates our reasoning that under group size uncertainty people anchor their decisions less strongly on the equal division rule than under group size certainty.

Discussion

In the present chapter, we investigated the influence of group size uncertainty and SVO in social dilemmas. First, we showed that under group size uncertainty, people may harvest less for themselves than under group size certainty. Second, we showed that that group size uncertainty has important consequences for how people tacitly coordinate their behavior. Under group size certainty, people can effectively coordinate their behavior by applying the equal division rule. By contrast, under group size uncertainty tacit coordination is hampered because the task environment does not provide people with the salient cues to apply the equal division rule. In that case, people rely on internal cues (i.e., their SVO) to determine their harvesting decisions.

Thus, on the one hand our results show that group size uncertainty hampers effective coordination. At the same time, however, our results corroborate and extend Au and Ngai's (2003) findings by showing that group size uncertainty is not necessarily detrimental to collective interests, even when people make their harvesting decisions simultaneously (and they cannot know their fellow group members' decisions). Interestingly, whereas earlier research has shown that uncertainty about the size of the common resource leads to non-cooperative behavior, the present findings indicate that uncertainty about the size of the group may lead to more cooperation. Thus, not all types of environmental uncertainty necessarily lead to non-cooperative behavior. But why may group size uncertainty lead to cooperation? Two possible explanations may be derived from earlier research.

Au and Ngai (2003) suggested that group size uncertainty may lead to cooperation because lower harvests have a higher expected utility. In an appendix to their paper (i.e., Appendix B), they calculated the rational strategy under group size uncertainty, suggesting that individual requests should decrease as the size of the group becomes more uncertain. A group member's expected utility is largest when he/she determines his/her harvesting decision based on the largest possible group size (assuming that all group members use the equal division rule). In other words, if group members want to maximize their own payoffs, it is best for them to determine their individual harvests by dividing the common resource by the largest group size possible.

Suleiman, Rapoport and Budescu (1996) suggested that people tend to perceive the variability and central tendency (i.e., the mean) of probability distributions to be positively correlated. In other words, when faced with probability distributions with higher levels of variability, people are perceptually biased towards overestimating the central tendency (mean) of these distributions (see also Gustafsson et al., 1999a). Suleiman and colleagues used this perceptual bias to explain why people overestimate the size of an uncertain common resource. In the present study, this perceptual bias may explain why people overestimate the uncertain group size. Whereas overestimation of the size of an uncertain common resource leads to over-harvesting, overestimation of the size of the group leads to relatively low individual harvests. After all, when there are more group members there are fewer coins available per group member.

Note, however, that the observed effect of group size uncertainty in our study was particularly due to prosocials' self-restraint. This raises the question as to whether the above explanations can also explain why prosocials respond more strongly to group size uncertainty than proselfs. At first glance, there seems to be no reason to assume that the above-mentioned two explanations are more applicable to prosocials than to proselfs. However, what our data as well as these two explanations do imply is that group size uncertainty may induce a drive towards self-restraint. When group size uncertainty induces such a drive, it is plausible that prosocials will respond more strongly to this drive than proselfs. After all, this drive is in line with the dispositional preference of prosocials to cooperate. Thus, based on this line of reasoning it seems plausible that prosocials are more affected by group size uncertainty than proselfs.

For the current purposes, it is especially worthwhile to acknowledge the fact that the data provide firm support for the suggestion that Snyder and Ickes' (1985) weak-strong distinction is highly applicable to social dilemma situations (see also Van Lange, 1997; Roch & Samuelson, 1997). In the present research, we showed that when the task environment of a social dilemma provides a salient cue to guide behavior, people will base their decisions on that cue (e.g., the equal division rule under group size certainty), whereas they will base their decisions on their own disposition when the task environment does not provide such a cue (e.g., their SVO under group size uncertainty). These findings thus clearly show that Snyder and Ickes' framework (1985; see also Van Lange, 1997; Roch & Samuelson, 1997) on strong vs. weak situations can be fruitfully used to explain and predict choice behavior in social dilemmas.

Although not our primary focus, we also investigated people's estimates of the size of their group (i.e., their group size estimates). In accordance with Hypothesis 3.3, we found that prosocials did not only harvest less than proselfs under group size uncertainty, but that they also gave higher estimates of the size of the group. These findings can be related to findings from an earlier study on resource size uncertainty (De Kwaadsteniet et al., 2006), in which it was found that proselfs not only harvested more from an uncertain common resource than prosocials, but also gave higher resource size estimates. These earlier findings suggest that proselfs tried to justify their relatively high harvests by means of their own estimates of the size of the resource (called egoism-justification, see also Gustafsson et al., 1999a; Hine & Gifford, 1996). In other words, they might have justified their "egoistic" behavior by reasoning: "I may have harvested a lot but I just thought that there were a lot of coins in the collective resource." In the present study, however, it may be less appropriate to speak about egoism-justification. Namely, we found that under group size uncertainty people do not show over-harvesting and therefore they do not have to justify their "egoistic" behavior by means of their group size estimates. What our data do show is that people who harvest relatively small amounts give relatively high group size estimates, inducing prosocials to give higher estimates than proselfs.

In an additional analysis, we took a closer look at the relationship between participants' group size estimates and their individual requests. In this analysis, we looked at participants' (absolute) deviations from an equal share. Under group size uncertainty we calculated this equal share by dividing the resource size (i.e., 500 coins) by the participants' own group size estimates. When we compared participants' individual requests with this equal share, their requests appeared to deviate more from an equal share under group size uncertainty than under group size certainty. These results further corroborate our idea that under group size uncertainty people are less inclined to base their decisions on the equal division rule than under group size certainty.

To summarize, the present study has generated a number of interesting findings. First, we showed that group size uncertainty may induce people to show more self-restraint and that this type of uncertainty is not detrimental to collective interests. Second, we showed that group size uncertainty hampers effective coordination, inducing people to base their decisions on internal cues (i.e., their SVO) instead of external ones (i.e., the equal division rule), which corroborates the suggestion that Snyder and Ickes' (1985) weak-strong distinction can fruitfully be applied to social dilemmas. Third, we showed that prosocials respond more strongly to group size uncertainty than proselfs, inducing prosocials to lower their harvests and to make higher group size estimates under uncertainty. Taken together, by investigating the topic of group size (un)certainty in social dilemmas and relating this topic to tacit coordination and social value orientation, the present study has generated a number of new insights into this largely unexplored type of environmental uncertainty.

Fishermen often keep a close eye on each other

Chapter 4
Justifying Decisions in Social Dilemmas[13]

In many real-life situations, people face a conflict between their personal interests and the interests of their group. Such situations, in which people have to choose between furthering their personal interests (often called *defection*) or furthering the interests of their group (often called *cooperation*), are generally referred to as *social dilemmas*. A well-known type of social dilemma, called the *resource dilemma*, concerns the problem of maintaining scarce common resources, such as energy, fish, oil or water. Whereas people may further their self-interest by harvesting excessively from these resources, such resources should be consumed wisely and sparingly to prevent depletion.

Many experimental studies have investigated decision-making in social dilemmas (for overviews, see e.g., Komorita & Parks, 1995; Weber, Kopelman, & Messick, 2004). In these studies, it was repeatedly shown that people base their decisions on division rules. For instance, in *symmetric* resource dilemmas – which are dilemmas in which group members have equal interests in the common resource – most people base their harvesting decisions on the *equal division rule* (e.g., Allison, McQueen, & Schaerfl, 1992; Rutte, Wilke, & Messick, 1987; Van Dijk & Wilke, 1995). That is, when a resource is owned by a group of five people most group members will decide to harvest an equal share (i.e., one-fifth) from that resource.

According to Messick (1993), equality has three characteristics that make it highly useful and appealing. First, the equal division rule is easy to implement and requires little cognitive effort. Second, the rule is efficient because it generates clear decisions which often lead to successful coordination. And third, decisions that conform to this rule can be easily justified to fellow group members because in *symmetric* resource dilemmas such decisions are in accordance with a general norm of fairness. Whereas earlier research mainly focused on the first two characteristics of equality, namely its simplicity (see e.g., Allison et al., 1992) and efficiency (see e.g., Van Dijk & Wilke, 1995), little research has investigated the third characteristic, specifically, its justifying potential. This latter characteristic is certainly worth investigating because people are often concerned about justifying their decisions to others (e.g., Tenbrunsel, 1995) and this concern often has a large impact on their decisions (e.g., De Cremer, Snyder & Dewitte, 2001; Tetlock, 1992). In the present research, we extend previous research by

[13] This chapter is based on De Kwaadsteniet, Van Dijk, Wit, De Cremer and De Rooij (in press).

addressing this largely unexplored characteristic of equality. However, we will not only focus on how people justify their decisions using equality, we also investigate how they do this when equality cannot be so easily employed.

Thus, the main aim of this paper is to extend previous research by not only focusing on social dilemma situations in which people can easily apply the equal division rule, but also by focusing on situations in which the application of this rule is hampered. More specifically, we argue and show that whether or not equality prescribes one unequivocal amount to harvest largely depends on uncertainty regarding the environmental characteristics of the social dilemma.

Justifying Decisions in Resource Dilemmas: Equality and Self-restraint

In a typical resource dilemma experiment (see e.g., Budescu, Rapoport & Suleiman, 1990; Gustafsson, Biel & Gärling, 1999a; Rapoport, Budescu, Suleiman & Weg, 1992), participants are collectively endowed with a resource of money or chips from which each group member can request an amount. As long as their total group request does not exceed the resource size, all individual requests are granted. If the collective request exceeds the amount available in the common resource, the resource becomes depleted and all group members receive zero outcomes. Now let us assume that the resource contains 500 coins and that the group consists of five group members. What would be the most justifiable harvest in this situation?

In such a resource dilemma, we can expect that harvesting an equal share of the resource can be most easily justified to fellow group members, mainly because this decision is in line with a general norm of fairness (Messick, 1993). Thus, in this situation, we can expect that group members will be especially inclined to adhere to equality when they have to justify their decisions to fellow group members. Group members can do so by simply dividing the size of the resource by the number of group members. When five people share a resource of 500 coins, the equal division rule prescribes that group members should harvest 100 coins from the resource (500/5 = 100). Harvesting 100 coins can be most easily justified to fellow group members. After all, when all decide to do so, the social dilemma results in a "fair" distribution of coins.

But what happens when equality does not prescribe such a specific level of harvesting? In social dilemmas, it is not always clear what an equal division would be (cf. Allison et al., 1992). To calculate an equal share, people need exact information about both the size of the resource and the size of the group sharing that resource. In many real-life social dilemmas, people are uncertain about such environmental characteristics. In other words, social dilemmas are often characterized by *environmental uncertainty* (Messick, Allison, & Samuelson, 1988; for a review, see Van Dijk, Wit, Wilke, & Budescu, 2004). In resource dilemmas, for instance, there can be uncertainty about the total number of resources that can be harvested without jeopardizing the state of the resource (i.e., resource size uncertainty). For example, electricity consumers often do not know how large the available supply of electricity is (for more real-world examples, see Ostrom, 1990). In this case, it is difficult for group members to calculate their equal share. What is an equal share of an uncertain common resource? Thus, when the size of a common resource is uncertain, the equal division rule does not prescribe a specific level of harvesting, and therefore it is much more difficult to apply this rule. How will people justify their decisions to fellow group members under such *resource size uncertainty*?

Our basic premise is that people will then try to justify their harvesting decisions differently – by displaying self-restraint in their harvests. In particular, we argue that relatively low harvests are easier to justify to fellow group members than relatively high harvests because they are in line with a general *norm of cooperation* (see De Cremer & Bakker, 2003; Fehr & Fischbacher, 2004; Kerr, 1995; Komorita & Parks, 1995). Moreover, under resource size uncertainty low harvests decrease the chance that the common resource will become depleted, which would be detrimental to collective interests. Therefore, whereas we expect that under resource size certainty harvesting decisions adhering to equality can be most easily justified to fellow group members, under resource size *un*certainty we expect that relatively low harvests can be most easily justified.

We will investigate this line of reasoning in two experimental studies. As a first test of our ideas, in Study 4.1 we will measure the justifiability of different harvests under varying levels of environmental uncertainty. In Study 4.2, we will investigate how justifiability pressures influence actual harvesting behavior by manipulating accountability under varying levels of environmental uncertainty.

Study 4.1: The Justifiability of Harvests

We investigate our line of reasoning in a single-trial resource dilemma. In this paradigm, a group of people have access to a resource from which each of them can freely harvest. If the total amount harvested by the group exceeds the amount available in the resource, the resource becomes depleted and all group members receive zero outcomes (cf. Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992). It is important to note here that under resource size certainty the task environment allows for equality to prescribe a specific harvest level: in a group of N group members, each member should harvest 1/Nth of the resource. With an *un*certain resource, equality does not prescribe such a specific harvest level (cf. De Kwaadsteniet, Van Dijk, Wit, & De Cremer, 2006).

We predict that under resource size certainty participants will find harvests adhering to equality most justifiable. More specifically, they will find harvests adhering to equality easier to justify than harvests either lower or higher than an equal share (Hypothesis 4.1). Under resource size *un*certainty participants will find relatively low harvests easier to justify than relatively high harvests (Hypothesis 4.2).

To test these hypotheses, we assessed the justifiability of harvests under varying levels of resource size uncertainty (i.e., No vs. Low vs. High Uncertainty). To accomplish this, we presented participants with a series of three different harvests. Participants were asked to indicate how justifiable these harvests were.

Method

Participants and Design. Participants were 39 students at Leiden University (9 men, *M* age = 21.38 years) who participated voluntarily in the present study. A 3 (Resource Size Uncertainty: No vs. Low vs. High) × 3 (Harvest: 50 vs. 100 vs. 150 coins) factorial design with repeated measures on the latter factor was used.

Procedure. Participants read a written description of a resource dilemma. In this dilemma, a group of five people had access to a resource from which each group member could freely harvest a number of coins (these coins were each worth € 0.01; approximately US $ 0.013). If the collective harvest would be lower than or equal to the resource size, the harvests would be granted and each group member would earn the amount of money he or she had harvested. If, however, the group's collective harvest would exceed the resource size, all group members would earn zero outcomes.

Resource Size Uncertainty. Participants were randomly assigned to one of three Resource Size Uncertainty conditions. These three conditions differed in the extent to which there was uncertainty about the size of the common resource. Resource size uncertainty was manipulated by varying the range of the uniform distribution of possible resource sizes (cf. Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992). The midpoint of these ranges was constant across the three conditions, i.e., 500. Under *No Uncertainty* the resource size was certain, i.e., 500 coins (midpoint = 500, range = 0). Under *Low Uncertainty* the resource would contain at least 400 and at most 600 coins (midpoint = 500, range = 200). Under *High Uncertainty* the resource would contain at least 100 and at most 900 coins (midpoint = 500, range = 800). Under Low and High Uncertainty participants learned that afterwards the exact size of the resource would be randomly drawn from the uniform distribution by a computer (i.e., each possible resource size had an equal chance of being drawn from the range).

Three Different Harvests. Participants were presented with three different harvests (i.e., 50, 100 and 150 coins). For each of these harvests, participants were asked to imagine that they would have to justify this harvest to their fellow group members.

Justifiability Measure. To measure the justifiability of these harvests, participants were asked to fill in two questions about each harvest (i.e., "To what extent would you be able to justify this harvest to your fellow group members?" and "To what extent would you be able to defend this harvest to your fellow group members?"; 1 = not at all; 7 = very much so). These two items were aggregated to form one measure of justifiability (Cronbach's $\alpha > .93$).

Results

Manipulation Check of Resource Size Uncertainty. Participants indicated how uncertain they were about the size of the resource (1 = not uncertain at all; 7 = very uncertain). An ANOVA on this measure yielded a significant main effect of Resource Size Uncertainty, $F(2, 36) = 29.59$, $p < .001$, $\eta^2 = .62$. As expected, uncertainty was lowest under No Uncertainty ($M = 1.62$), higher under Low Uncertainty ($M = 4.54$) and highest under High Uncertainty ($M = 6.08$), indicating that we successfully manipulated resource size uncertainty.

The Justifiability of Harvests. For each harvest, participants answered two justifiability questions. A 3 (Resource Size Uncertainty: No vs. Low vs. High) × 3 (Harvest: 50 vs. 100 vs. 150 coins) ANOVA on the aggregated justifiability measure yielded a significant main effect of Harvest, $F(2, 35) = 35.32$, $p < .001$, $\eta^2 = .67$, and a significant Uncertainty × Harvest interaction effect, $F(4, 72) = 4.94$, $p < .01$, $\eta^2 = .22$ (see Table 4.1). The main effect of Harvest indicated that, overall, participants thought that lower harvests would be easier to justify. In line with our hypotheses, the interaction effect between Uncertainty and Harvest indicated that whereas under No Uncertainty participants indicated that harvesting an equal share (i.e., 100 coins) would be easier to justify than harvesting either less (i.e., 50 coins) or more than an equal share (i.e., 150 coins; see Hypothesis 4.1), under Uncertainty participants indicated that lower harvests would be easier to justify than higher harvests (see Hypothesis 4.2). To test these effects more specifically, we performed contrast analyses within each level of resource size uncertainty (see Table 4.1), which also corroborated our hypotheses.

Table 4.1
Study 4.1: Justifiability of Three Different Harvests under Three Levels of Resource Size Uncertainty (3 × 3)

Resource Size Uncertainty	Harvest		
	50 coins	100 coins	150 coins
No	5.42^a (1.30)	6.27^b (1.69)	2.92^a (1.91)
Low	5.88^a (1.76)	4.85^b (1.63)	3.35^c (1.82)
High	6.00^a (1.00)	4.54^b (1.85)	3.38^c (1.53)

Note. Higher scores denote harvests that are easier to justify. Standard deviations are given in parentheses. For each row, means with different superscripts differ significantly (contrast analyses, all *p*s < .05).

Discussion

The results of Study 4.1 corroborate our first two hypotheses. Under No Uncertainty participants indicated that harvests adhering to equality were easiest to justify (Hypothesis 4.1), whereas under Uncertainty they indicated that relatively low harvests were easiest to justify (Hypothesis 4.2). More specifically, under No Uncertainty participants indicated that harvests that adhered to equality were easier to justify than harvests either lower or higher than an equal share. Under (Low and High) Uncertainty participants indicated that lower harvests were easier to justify than higher harvests. But how do these justifiability judgments translate into actual harvesting decisions?

Accountability and Harvesting Decisions

Whereas Study 4.1 provided first insights into the justifiability of harvests, this study did not assess participants' actual choice behavior. In the following, we will therefore address the following question: How do justification pressures influence actual harvesting decisions? In Study 4.2, participants will make harvesting decisions themselves, and we will manipulate whether they will have to justify these decisions to fellow group members or not. We will do so by manipulating *accountability*.

Accountability can be defined as the expectation that one may have to justify one's judgments and decisions to others (Lerner & Tetlock, 1999). In many real-life social dilemmas, people are accountable for the judgments and decisions they make. For instance, as Ostrom illustrates in her book "Governing the Commons" (1990), fishermen often keep a close eye on each other to make sure that other fishermen are not fishing more than they should, which would lead to over-fishing and eventually to depletion of the fish population. Lerner and Tetlock (1999) distinguish two types of accountability: outcome and process accountability. Outcome accountability refers to accountability for the decision outcome, and process accountability refers to accountability for the process leading to the decision. Furthermore, accountability may have different psychological effects on people: Whereas several studies have shown that accountability induces systematic processing (e.g., Tetlock, Skitka & Boettger, 1989; Tetlock & Boettger, 1989), other studies have shown that accountability reduces egotism (e.g., Sedikides, Herbst, Hardin, & Dardis, 2002; De Dreu & Van Knippenberg, 2005). These findings show that, depending on the context and the nature of the accountability manipulation, accountability may have different psychological effects, which in turn may have different effects on people's decisions. Thus, to predict the effect of accountability in a certain context, it is useful to first find out what accountability does psychologically. To investigate the psychological effects of accountability in the social dilemma context we focus on, we conducted a short pilot study.

The Psychological Effects of Accountability: A Pilot Study

We presented 48 participants (18 men, *M* age = 21.88 years) with the same resource dilemma as in Study 1, using the same resource size uncertainty manipulation. Participants were randomly assigned to four conditions of a 2(Accountability: No vs. Yes) × 2(Resource Size Uncertainty: No vs. High) between-participants design. In the Accountability condition, participants were asked to imagine that they would make a harvesting decision and that afterwards they would have to justify this decision to their fellow group members. In the No Accountability condition, participants were only asked to imagine that they would make a harvesting decision. Subsequently, we measured outcome accountability using one item and process accountability using two items (based on Scholten, Van Knippenberg, Nijstad & De Dreu, in press; sample item measuring process accountability: "In this situation, I would expect that I would have to explain *how* I came to my decision."; 1 = not at all, 7 = very much so; Cronbach's α = .90), systematic processing using two items (based on De Dreu, Koole, & Steinel, 2000; sample item: "In this situation, I would try to make a thorough decision."; 1 = not at all, 7 = very much so; Cronbach's α = .63), and egotism using four items (sample item: "While making my decision, I would be focused on my own outcomes."; 1 = not at all, 7 = very much so; Cronbach's α = .73).

The results of this study showed that the accountability manipulation induced both outcome and process accountability (both *F*s > 50, both *p*s < .001). Thus, in the Accountability condition participants felt more accountable for the decision outcome (*M* = 5.46, *SD* = 1.56) as well as for the process that would lead to their decision (*M* = 5.17, *SD* = 1.65) than in the No Accountability condition (*M* = 2.00, *SD* = 1.69 vs. *M* = 1.73, *SD* = 1.27, respectively). We did not find an effect of accountability on systematic processing, $F(1, 47) = .72$, $p = .40$, $\eta^2 = .02$ ($M_{Accountability} = 5.92$, *SD* = 0.72 vs. $M_{No\ Accountability} = 5.73$, *SD* = 0.79). We did find that accountability reduced egotism, $F(1, 47) = 7.00$, $p < .05$, $\eta^2 = .14$, indicating that in the Accountability condition participants were less focused on their own outcomes (*M* = 3.74, *SD* = 1.28) than participants in the No Accountability condition (*M* = 4.57, *SD* = 0.89).

Study 4.2: Justifying Decisions

So how does accountability influence actual choice behavior in resource dilemmas with resource size certainty? In Study 4.1, we showed that under resource size certainty, harvesting an equal share is easiest to justify to fellow group members. Furthermore, the pilot study we conducted showed that accountability reduces egotism, which implies that accountability will induce people to adhere more to group norms. Based on these findings, we can expect that accountability will induce people's harvests to converge towards equality, and that under accountability people's harvests will be closer to the level prescribed by equality than under no accountability. Moreover, as we expect accountability to induce convergence, we predict that under accountability the variance of harvests will be smaller than under no accountability.

But how does accountability influence harvests in resource dilemmas with resource size *un*certainty? To answer this question, we first have to consider people's harvesting behavior under resource size *un*certainty when they are not accountable for their harvests. Earlier research on environmental uncertainty (e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992) – in which participants were *not* accountable for their decisions – has repeatedly shown that environmental uncertainty induces people to over-harvest from the common resource. To predict how accountability influences choice behavior under resource size uncertainty it is useful to consider the findings of Study 4.1 and the results of our pilot study. In Study 4.1, we showed that under resource size uncertainty relatively low harvests are easier to justify than relatively high harvests. Furthermore, our pilot study showed that accountability reduces egotism, which implies that under accountability people will be more inclined to show self-restraint. Based on these findings, we predict that under uncertainty accountability may induce a drive towards harvesting less, and that accountability may temper the over-harvesting effect that is usually found under environmental uncertainty. Moreover, under resource size *un*certainty we expect that accountability will *not* reduce the variance of harvests. After all, under *un*certainty equality does not prescribe a specific amount to harvest, and therefore we expect that accountability will not induce convergence towards a specific amount.

Based on the above, we expect that under certainty being accountable to fellow group members will induce harvests to converge towards equality. More specifically, we expect that in the accountability condition the mean harvest will be closer to the level prescribed by equality than in the no accountability condition (Hypothesis 4.3). Under *un*certainty, we expect that accountability will induce lower harvests (Hypothesis 4.4). Furthermore, we expect that under certainty accountability will reduce the variance in harvests, whereas we expect that under *un*certainty accountability will not reduce the variance (Hypothesis 4.5).

Resource Size Estimates

Hypotheses 4.3, 4.4 and 4.5 focus exclusively on how environmental uncertainty and accountability affect people's harvests. However, justification pressures may not only affect people's harvests, but may also influence their estimates of the size of the common resource. Therefore, besides investigating harvests, we will also study how environmental uncertainty and accountability influence resource size estimates. In earlier studies, environmental uncertainty induced participants to overestimate the size of the resource (Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992). We will test whether this overestimation effect also occurs under accountability. Earlier studies have generated findings that suggest that harvests and resource size estimates are strongly interrelated (cf. Wit & Wilke, 1998). Based on this, we expect that accountability will not only induce lower harvests but also lower resource size estimates (Hypothesis 4.6).

Method

Participants and Design. Participants were 110 students at Leiden University (31 men, *M* age = 19.83 years) who volunteered for the study. A 2 (Accountability: No vs. Yes) × 3 (Resource Size Uncertainty: No vs. Low vs. High) factorial design with repeated measures on the latter factor was used.

Procedure. Participants were invited to participate in a study on “group decision making”. Upon arrival, they were seated in separate cubicles, each containing a personal computer, which was used to give instructions and to register the participants’ responses.

The Resource Dilemma. The resource dilemma was identical to the one used in Study 4.1. Participants were now presented with three of these resource dilemmas (referred to as ‘situations’). Afterwards, a computer would randomly select one of these three situations. This selected situation would be used to calculate the amount of money they would earn. Each of these situations was thus an independent single-trial resource dilemma.

Resource Size Uncertainty. Resource Size Uncertainty was manipulated within participants (cf. Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992). The three Uncertainty conditions were identical to the ones used in Study 4.1. These conditions were counter-balanced to check for order effects. Preliminary analyses revealed no significant order effects on any of the dependent variables (all Fs < 1).

All characteristics of the three dilemmas were explained before the participants were presented with the actual task. After these instructions, five practice questions were posed to ensure comprehension of the dilemmas. For example, participants were asked how much group members would earn if the total group harvest would exceed the size of the resource. Each question was answered correctly by 98% of all participants. After each question, the correct answer was disclosed and the most important characteristics of the dilemmas were repeated. Subsequently, accountability was manipulated.

Accountability. In the Accountability condition, before being presented with the dilemmas, participants were instructed that afterwards their fellow group members would learn of their decisions (i.e., their individual harvests *and* their resource size estimates) and that they would have to justify these decisions to their fellow group members (for a similar accountability manipulation, see Tetlock, Skitka, & Boettger, 1989). Immediately after this accountability manipulation, the three dilemmas were presented to the participants. Participants in the No Accountability condition did not receive this accountability manipulation, but were presented with the three dilemmas immediately after the practice questions.

Dependent Measures. In all three Uncertainty conditions, participants were asked to harvest a number of coins from the resource and to estimate the size of the resource.

After the experimental session, which lasted about 45 minutes, all participants learned that they did *not* have to justify their decisions to their fellow group members. We paid all participants € 8 (i.e., approximately US $ 11.00) for their participation. All participants agreed to this payment procedure.

Results

Unless stated otherwise, all analyses were performed with 2 (Accountability) × 3 (Resource Size Uncertainty) ANOVAs with repeated measures on the latter factor.

Manipulation Checks. The manipulation of resource size uncertainty was checked by asking the participants to indicate how uncertain they were about the size of the resource in each of the three situations (1 = not uncertain at all; 7 = very uncertain). A 2 × 3 ANOVA on this measure only yielded a main effect of Resource Size Uncertainty, $F(2, 107) = 705.95$, $p < .001$, $\eta^2 = .93$. Participants indicated that their uncertainty about the size of the resource was lowest under No Uncertainty ($M = 1.16$), higher under Low Uncertainty ($M = 4.85$) and highest under High Uncertainty ($M = 6.59$), indicating that we successfully manipulated Resource Size Uncertainty.

The manipulation of accountability was checked by asking participants afterwards to what extent they had felt accountable for the decisions they had made in the resource dilemmas (1 = to a small extent; 7 = to a large extent). An ANOVA on this measure only yielded a main effect of Accountability, $F(1, 108) = 168.09$, $p < .001$, $\eta^2 = .61$. As expected, compared to the No Accountability condition ($M = 1.73$), participants felt more accountable for their decisions in the Accountability condition ($M = 5.36$), indicating that we successfully manipulated accountability.

Individual Harvests. A 2 × 3 ANOVA on participants' harvests yielded a significant main effect of Accountability, $F(1, 108) = 4.18$, $p < .05$, $\eta^2 = .04$ (See Table 4.2). In the No Accountability condition ($M = 138.70$), participants harvested more coins from the resource than in the Accountability condition (M = 106.79).[14] These results suggest that accountability induces cooperation, which is in line with findings from earlier studies on accountability in social dilemmas (e.g., De Cremer et al., 2001; Jerdee & Rosen, 1974). In the No Accountability condition, we replicated the over-harvesting effect that was found in earlier research (e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992), i.e., harvests increased with Uncertainty, $F(2, 53) = 3.00$, $p < .05$, $\eta^2 = .10$. This over-harvesting effect was not found in the Accountability condition, $F(2, 53) = .46$, $p = .64$, $\eta^2 = .02$.

Table 4.2

Study 4.2: Individual Harvests by Resource Size Uncertainty and Accountability (3 × 2)

Resource Size Uncertainty	Accountability	
	No	Yes
No	120.98 (78.99)[a]	101.82 (29.57)[b]
Low	137.89 (100.77)[a]	112.91 (95.66)[a]
High	157.24 (145.36)[a]	105.63 (110.01)[a]

Note. Higher scores denote higher harvests. Standard deviations are given in parentheses. For each row, standard deviations with different superscripts indicate that the variances in these cells differ significantly (Levene's tests).

Individual Harvests under Resource Size Certainty. To test whether under resource size certainty accountability induced participants to adhere more strongly to equality, we took a closer look at their harvests in the No Uncertainty condition. In line with our predictions, t-tests showed that whereas participants' harvests were significantly higher than an equal share (i.e., 100 coins) in the No Accountability condition (M = 120.98; $t(54) = 1.97$, $p < .05$, one-sided), in the Accountability condition their harvests did not deviate significantly from equality (M = 101.82; $t(54) = .46$, $p = .65$). These results corroborate Hypothesis 4.3 that under certainty accountability would induce harvests to converge towards equality.

Individual Harvests under Resource Size Uncertainty. To test whether under uncertainty accountability induced participants to restrict their harvests, we took a

14 In accordance with findings from earlier studies on environmental uncertainty (Budescu et al., 1990; Gustafsson et al., 1999; Rapoport et al., 1992) and in agreement with our line of reasoning (cf. De Kwaadsteniet et al., 2006), the variances under High Uncertainty were much larger than the variances under No and Low Uncertainty. To meet the requirements of the ANOVA, we applied a square root transformation on participants' harvests (cf. Rapoport et al., 1992). After applying this transformation, which successfully reduced the heterogeneity of variances, a 2 × 3 ANOVA still yielded the same significant main effect of Accountability, $F(1, 108) = 7.39$, $p < .01$, $\eta 2 = .06$.

closer look at their harvests under Low and High Uncertainty. Accountability induced participants to harvest smaller amounts under Low Uncertainty ($M_{Accountability}$ = 112.91 vs. $M_{No\ Accountability}$ = 137.89) and under High Uncertainty ($M_{Accountability}$ = 105.64 vs. $M_{No\ Accountability}$ = 157.24). However, it should be noted that this difference was only significant under High Uncertainty ($t(108) = 2.10$, $p < .05$), but not under Low Uncertainty ($t(108) = 1.33$, $p < .20$). In line with Hypothesis 4.4, these results indicate that under (high) uncertainty accountability induces people to show self-restraint in their harvests.

Variance in Harvests. There is no standard way to test the predicted interaction of Accountability and Resource Size Uncertainty on variance in harvesting decisions (Hypothesis 4.5). Testing homogeneity of variances is usually done using a Levene's test. However, standard software (e.g., SPSS) does not provide the option of a factorial Levene's test – not for between nor for (between-)within designs. Basically, a Levene's test is a one-way ANOVA on a calculated absolute difference score (see Levene, 1960): First, one should compute a new variable which indicates how much each participant's score deviates from the mean in his/her cell; Second, one should do an ANOVA on this calculated variable. We followed this procedure, but instead of the one-way ANOVA we performed a 2 (between) × 3 (within) factorial ANOVA.

Thus, we first calculated the absolute difference between each participant's individual harvest and the mean of the cell the participant was in. A preliminary inspection of these calculated difference scores indicated that the standard deviations of these scores were highly unequal (i.e., the largest SD was more than four times as large as the smallest one), thereby violating the homogeneity of variances assumption of ANOVA. To meet the requirements of the ANOVA, we applied a square root transformation on these difference scores. After applying this transformation, which successfully reduced the heterogeneity of variances, we conducted a 2 × 3 ANOVA. This ANOVA yielded a significant main effect of Accountability, $F(1, 108) = 9.39$, $p < .001$, $\eta^2 = .08$, a significant main effect of Uncertainty, $F(2, 107) = 63.68$, $p < .001$, $\eta^2 = .54$, and a significant interaction effect between Accountability and Uncertainty, $F(2, 107) = 63.68$, $p < .001$, $\eta^2 = .54$. In line with Hypothesis 4.5, this interaction effect indicated that whereas accountability significantly reduced the variance under No Uncertainty, it did not reduce the variance under Low and High Uncertainty (see Table 4.2).

Resource Size Estimates. In each of the three situations, participants estimated the resource size (see Table 4.3). The No Uncertainty condition was excluded from the analysis of these estimates because in this condition participants knew the exact size of the resource. A 2 (Accountability) × 2 (Resource Size Uncertainty: Low vs. High) ANOVA on participants' resource size estimates yielded a significant main effect of Accountability, $F(1, 108) = 13.17$, $p < .001$, $\eta^2 = .11$, and a significant interaction effect of Accountability and Uncertainty, $F(1, 108) = 8.38$, $p < .01$, $\eta^2 = .07$.

Table 4.3

Study 4.2: Resource Size Estimates by Resource Size Uncertainty and Accountability (2 × 2)

Resource Size Uncertainty	Accountability	
	No	Yes
Low	491.73 (66.35)	455.00 (63.72)
High	564.18 (232.27)	404.09 (261.48)

Note. Higher scores denote higher resource size estimates. Standard deviations are given in parentheses.

These analyses showed that in the Accountability condition (M = 429.55), participants gave lower resource size estimates than in the No Accountability condition (M = 527.96), especially under High Uncertainty (M = 404.09 vs. 564.18, respectively). The data also showed that participants' resource size estimates increased with resource size uncertainty in the No Accountability condition, $F(1, 54) = 6.94$, $p < .05$, $\eta^2 = .11$, whereas this effect was not found in the Accountability condition, $F(1, 54) = 2.45$, $p = .12$, $\eta^2 = .04$. In the Accountability condition, the resource size estimates even decreased slightly with increasing uncertainty. In accordance with Hypothesis 4.6, these results suggest that accountability induces people to give lower resource size estimates.

Application of the Equal Division Rule under Resource Size Uncertainty. As an additional analysis under Uncertainty, we also looked at the relationship between participants' harvests and their own resource size estimates.[15] Specifically, we calculated the percentage of participants who harvested an equal share of their own resource size estimates. This analysis showed that the percentage of participants who harvested an equal share of their own resource size estimates was significantly higher in the Accountability condition (66%) than in the No Accountability condition (46%), $\chi^2(1, N = 110) = 4.45$, $p < .05$. These findings show that even under uncertainty, accountability induced participants to harvest one-fifth of their own resource size estimates. We elaborate on these findings in the General Discussion.

Discussion

The results of Study 4.2 corroborate our second set of hypotheses (i.e., Hypotheses 4.3 to 4.6). Under No Uncertainty, we found that in the Accountability condition the mean harvest was closer to the level prescribed by equality than in the No Accountability condition (Hypothesis 4.3). Under Uncertainty, we found

[15] We also tested whether the effect of accountability on harvests was mediated by resource size estimates and/or whether the effect of accountability on resource size estimates was mediated by harvests. These mediation analyses (partially) corroborated both mediation models, suggesting that harvests and resource size estimates are strongly interrelated (cf. Wit & Wilke, 1998).

that accountability induced lower harvests (Hypothesis 4.4). Moreover, under No Uncertainty we found that accountability induced these harvests to converge towards a specific harvest level, whereas this as not the case under Uncertainty. In other words, under No Uncertainty we found that accountability reduced the variance in harvests, whereas under Uncertainty accountability did not reduce the variance (Hypothesis 4.5). Additionally, we found that in the Accountability condition participants' resource size estimates were smaller than in the No Accountability condition (Hypothesis 4.6).

We would like to point out that to draw the above-mentioned conclusions it was essential to not only look at the means, but also at the variance of participants' harvests. For instance, had we only looked at participants' mean harvests we would not have been able to distinguish the Accountability-No Uncertainty condition from the Accountability-Uncertainty conditions. After all, in both of these accountability conditions the mean harvest was close to an equal share of the expected value of the pool-size (i.e., 100 coins). Solely on the basis of these means one might thus conclude that accountability always (i.e., under certainty *and* under uncertainty) induces adherence to the amount prescribed by equality. However, when the variance of people's harvests is taken into account, our data provide a whole different picture. Whereas under No Uncertainty accountability significantly reduced the variance of people's harvests, under Uncertainty accountability did *not* reduce the variance. In line with our ideas, these findings imply that whereas under certainty accountability indeed induces convergence to a specific harvest level (i.e., an equal share), under *un*certainty it does not lead to such convergence.

Another point worth making is that at first glance there seems to be a discrepancy between the results of Study 4.1 and the results of Study 4.2. In Study 4.1, a harvest of 50 was found most justifiable under uncertainty, whereas in Study 4.2 participants harvested more than 50 in the uncertainty-accountability condition. We attribute this discrepancy to the fact that whereas in Study 4.1 we asked people how justifiable three hypothetical harvesting decisions were, in Study 4.2 we asked people to make *real* harvesting decisions themselves. Even under accountability real harvesting decisions are driven by more than just justifiability judgments. After all, whereas accountability may motivate people to make justifiable decisions (i.e., a drive towards harvesting less), they may at the same time still be motivated to further their self-interest (i.e., a drive towards harvesting more). The results of study 4.1 only demonstrate the drive towards cooperation that is induced by accountability, which is not the only factor that influences real harvesting behavior. This reasoning explains why the participants in Study 4.2 harvested more than 50 coins.

To conclude, the findings of Study 4.2 may be explained by the finding of our pilot study that accountability reduces egotism. Whereas under certainty such reduced egotism may have induced adherence to equality, under *un*certainty it may have induced self-restraint. Further, since harvests and resource size estimates are strongly interrelated (Wit & Wilke, 1998), this reduced egotism may also explain why participants gave lower estimates of an uncertain resource under accountability.

Group Efficiency: A Monte Carlo Study

The primary focus of this paper is on how people justify their individual harvests. Nevertheless, it is also interesting to explore whether there is a relation between accountability and group efficiency. After all, efficiency is one of the three characteristics of equality (Messick, 1993). To investigate such group efficiency, we decided to do an extra analysis on the data of Study 4.2. We focused on two aspects as indications of efficiency: (a) *overuse* of the common resource and (b) *group earnings*. To investigate these two aspects, we ran a Monte Carlo simulation in which we randomly drew 2 × 100,000 post-hoc five-person groups from the sample of Study 4.2 (100,000 groups for each Accountability condition). Under No Uncertainty, the size of the resource was always 500 coins. Under Uncertainty, the size of the resource was determined by randomly drawing a number from the uniform distribution of the resource size (which was done separately for each of the 200,000 five-person groups). For each post-hoc group, we checked whether the group harvest had exceeded the size of the common resource and we calculated the total group earnings. If the total group harvest exceeded the size of the resource, the resource was overused and the group earned zero coins. If the total group harvest did not exceed the resource size, the group earned the amount they had harvested.

Results

Overuse. As a first step, we analyzed how often these post-hoc groups overused the common resource (i.e., as a dichotomous variable: overuse vs. no overuse). To statistically qualify the differences between the percentages "overuse" in the six conditions (see Table 4.4) we calculated the Odds ratios per condition. For example, the Odds of overuse in the No Uncertainty / No Accountability condition (59.64%) were calculated as [P (overuse)] / [1 - P (overuse)] = [.5964] / [1 - .5964] = 1.48. Thereafter, the effect size of the contrast between Accountability and No Accountability was calculated as the ratio of the two Odds in these conditions (e.g., 1.48 / 0.41 = 3.56; see Table 4.4). Based on Rosenthal (1996), the effect size of accountability under No Uncertainty (3.56) can be considered 'medium to large', the effect size of accountability under Low Uncertainty (4.87) can be considered large, and the effect size of accountability under High Uncertainty (2.83) can be considered medium. In sum, accountability to a 'medium to large' extent reduces the chance of overuse across all three uncertainty conditions. Looking at the overall pattern of the effect sizes in Table 4.4, we conclude that the chances of overuse in the 2 × 3 design are a function of accountability (less frequent overuse in the Accountability condition than in the No Accountability condition) and a function of uncertainty (less frequent overuse under No Uncertainty than under Low and High Uncertainty).

Table 4.4

Monte Carlo Study: Percentage of Overuse by Resource Size Uncertainty and Accountability (3 × 2)

Resource Size Uncertainty	Accountability		
	No		Yes
No	59.64%	*3.56*	29.31%
	2.86		*2.09*
Low	80.87%	*4.87*	46.44%
	1.41		*1.22*
High	75.02%	*2.83*	51.45%
No	59.64%		29.31%
	2.03		*2.55*
High	75.02%		51.45%

Note. Effect sizes of orthogonal contrasts are displayed in italics. The lower part of this table displays the effect sizes of the contrasts between No and High Uncertainty.

Group Earnings. Additionally, we calculated the mean group earnings in the various conditions. An ANOVA on these group earnings yielded the following results. First, mean group earnings were higher in the Accountability condition (M = 252.40) than in the No Accountability condition (M = 142.69), $F(1, 199998) = 345732.45$, $p < .0001$, $\eta^2 = .63$. Second, mean group earnings were higher under No Uncertainty (M = 266.15) than under Low Uncertainty (M = 159.40) and High Uncertainty (M = 167.08), $F(2, 199997) = 19220.28$, $p < .0001$, $\eta^2 = .16$ (see Table 4.5). In accordance with our overuse data, these analyses showed that there is a main effect of accountability and a main effect of uncertainty on group efficiency.

Table 4.5

Monte Carlo Study: Mean Group Earnings by Resource Size Uncertainty and Accountability (3 × 2)

Resource Size Uncertainty	Accountability	
	No	Yes
No	196.08 (238.80)	336.22 (218.66)
Low	93.07 (192.42)	225.73 (212.85)
High	138.91 (248.69)	195.25 (224.30)

Note. Higher scores denote higher group earnings. Standard deviations are given in parentheses.

Discussion

The results of this additional Monte Carlo study clearly show that groups are more efficient under accountability. Furthermore, the findings demonstrated that groups are more efficient under certainty than under *un*certainty. We will elaborate on these findings in the General Discussion.

General Discussion

In the present paper, we investigated how justification pressures influence harvesting decisions in social dilemmas. As expected, under resource size certainty we found that people consider harvests adhering to equality as most justifiable (Study 4.1) and that people adhere more strongly to equality when they have to justify their decisions to fellow group members (Study 4.2). Under resource size *un*certainty we found that people consider relatively low harvests as most justifiable (Study 4.1) and that people restrict their harvests when they have to justify their decisions to fellow group members (Study 4.2).[16] Additionally we found that accountability induces

[16] The data of Study 2 can also be interpreted as indicating that accountability always induces adherence to the most justifiable division rule (which may explain why the mean harvest is so close to an equal share of the expected pool-size [i.e., 100 coins] in all uncertainty conditions), but that with greater uncertainty one may feel freer to depart from it (which may explain the larger variance under uncertainty). However, we would like to point out that in the light of the results of Study 1 this interpretation seems unlikely. After all, the data of this study show that under uncertainty people do not think that harvesting 100 coins is the most justifiable decision. More specifically, the participants indicated that under uncertainty a harvest of 50 coins was easier to justify than a harvest of 100 coins. This finding illustrates our point that under environmental uncertainty equality does not prescribe one specific and justifiable amount to harvest, but that under such uncertainty self-restraint yields the most justifiable decision. Altogether, the findings of these two studies corroborate our idea that under uncertainty accountability induces a drive towards self-restraint.

people to give lower estimates of the size of the resource (Study 4.2). In the following, we will address the general implications of these findings.

Accountability and Environmental Uncertainty

With the current research we obtained new insights into the effects of environmental uncertainty and accountability in social dilemmas. Earlier studies on environmental uncertainty (e.g., Budescu et al., 1990; Gustafsson et al., 1999a; Rapoport et al., 1992) have repeatedly shown that such uncertainty leads to over-harvesting. When environmental uncertainty increased, people increased their harvests. Based on these findings, it was concluded that environmental uncertainty is detrimental to collective outcomes because it increases the chance that the resource becomes depleted. As expected, we replicated the above-mentioned over-harvesting effect in the no accountability condition, and we did not find an over-harvesting effect under accountability. These findings imply that the detrimental effects of environmental uncertainty may disappear when group members have to justify their choice behavior to fellow group members. Thus, accountability may provide a solution for the detrimental effects of environmental uncertainty.

Accountability and Efficient Coordination

Our findings imply that under environmental uncertainty accountability to fellow group members is beneficial to collective interests because it induces self-restraint. This does not mean, however, that people who are held accountable for their decisions will efficiently deal with the social dilemma at hand, even if they are highly motivated to do so. To investigate how accountability influences efficient coordination, it is necessary to analyze harvesting decisions and their outcomes at the group level (which is hardly ever done in experimental social dilemma research). Our additional Monte Carlo study showed that in all three uncertainty conditions accountability made groups more efficient. More specifically, in all three conditions, accountability increased group efficiency by increasing the mean group earnings and decreasing the percentage of groups overusing the common resource.

Another issue worth noting is that groups seemed to be much more efficient under certainty than under *un*certainty, even when the group members were accountable for their decisions. At first glance, this finding might seem surprising given that in the accountability condition the mean harvest under certainty was quite similar to the mean harvest under uncertainty (i.e., all means were close to 100 coins). As we stressed earlier, however, these findings can be understood by taking the variance of people's harvests into account, which is especially relevant when it comes to efficient coordination.

Our variance data show that whereas accountability induced convergence to an equal share under certainty, it did not decrease the variance of participants' harvests under *un*certainty. This observation is important because variability constitutes a potential threat to the collective interest, especially in small group settings. In small groups, the presence of only a few over-harvesters may be enough to jeopardize the collective interest by increasing the chance that the resource becomes depleted, whereas small harvests may jeopardize the collective interest by increasing the chance that the resource is underused. As a consequence, high variability in harvests hardly ever leads to efficient use of the resource. In this respect, it is relevant to relate the current findings to what Schelling (1960) wrote on the prerequisites of efficient coordination. As he put it, a *common understanding* is crucial for the tacit coordination of decisions. In "The Strategy of Conflict", Schelling argues that to tacitly coordinate decisions people need to "read the same message in the common situation, to identify the one course of action" (Schelling, 1960, p. 54). Under environmental uncertainty such a common understanding is clearly missing, leading to a high variance in people's harvests. This high variance can (partially) explain why groups were less efficient under *un*certainty than under certainty, even though in the accountability condition the mean harvests in all three conditions were almost identical.

A related issue worth noting is that whereas accountability did *not* reduce the variability of harvests under uncertainty, accountability did strengthen the relationship between people's harvests and their own estimates of the size of the resource. Simply put, under accountability people differed in their harvests but predominantly indicated that they harvested an equal share of the uncertain resource. This finding is interesting because it shows the strength of equality as a means to justify decisions, even in a situation in which the application of this rule is severely hampered. Moreover, what these findings also imply is that one should not misinterpret the application of equality as an indication of successful coordination. Application of the equal division rule may help group members to efficiently coordinate their harvests *only* if the rule prescribes an unequivocal level of harvesting. To illustrate this, consider a simplified example of fishermen returning from a lake. Fisherman A caught 1,000 fish, whereas fisherman B caught 2,000 fish. When asked to justify their harvests, fisherman A answers that his catch constitutes an equal share of the total number of fish that can be harvested without jeopardizing the state of the fish population. Fisherman B gives the same answer and thereby indicates that he thinks that the total number of fish is larger than Fisherman A thinks. What should we conclude from this example? Did the fishermen efficiently coordinate their decisions? Our answer would be that they did not. Although the two fishermen both applied the equal division rule, this did not induce convergence to a specific level of harvesting because they gave different estimates of the size of the fish population.

Explaining Findings from Earlier Research

Our research shows that accountability can yield two different behavioral effects: convergence to equality and self-restraint. In Study 4.2, we showed that the task environment of a social dilemma plays an important role in how accountability influences choice behavior, something that has been largely overlooked in earlier accountability research. When we take a closer look at the findings of earlier accountability studies, we can conclude that these studies have generated mixed results that are in line with our reasoning. Whereas some studies showed that accountability induced people's decisions to converge to equality (Croson & Marks, 1998; De Cremer, 2003; Diekmann, 1997; Reis & Gruzen, 1976), other studies showed that accountability induced a general increase in cooperation (e.g., De Cremer et al., 2001; Fox & Guyer, 1978; Jerdee & Rosen, 1974; Kerr, 1999). By focusing on the task environment of social dilemmas, the current paper now provides an explanation for these different findings.

Taking a closer look at the experimental procedures of these earlier accountability studies, we suggest that the accountability effects observed in these studies were contingent upon the environmental characteristics of the social dilemma paradigms that were applied. When the task environment allowed for equality to prescribe a specific level of cooperation (e.g., in a step-level public good dilemma; Croson & Marks, 1998; De Cremer, 2003), accountability induced convergence towards that level. However, when the task environment did *not* allow for a division rule to prescribe a specific level of cooperation (e.g., in a continuous public good dilemma; De Cremer et al., 2001), accountability induced relatively high levels of cooperation (but *no* convergence towards a specific level). Our procedure of manipulating accountability under varying levels of environmental uncertainty, allowed us to investigate this line of reasoning in one single experimental design. By doing so, we obtained more insight into the findings of accountability studies conducted earlier. Thus, past and present research corroborates our idea that the task environment of a social dilemma plays an important role in how accountability influences choice behavior.

Limitations and Suggestions for Future Research

In this paper, we focused on how people justify their harvesting decisions to fellow group members. Of course, one could also imagine situations in which people have to justify their decisions to people outside their own group, for instance, by introducing other members whose outcomes would be dependent on one of the individual group members (i.e., introducing a subgroup). Reis and Gruzen (1976) argued and showed that it indeed matters to whom one is accountable (cf. Tetlock, 1992), and that equality becomes a less salient means for justification when people are accountable to someone outside their own group. Although we would be the first to acknowledge that our findings do not automatically generalize to justifications to such outsiders, we decided to follow earlier accountability research (e.g., De Cremer et al., 2001; Jerdee & Rosen, 1974; Kerr, 1999) by focusing primarily on how people justify their decisions to fellow group members. However, investigating whether the current findings generalize to accountability to outsiders may be an interesting suggestion for future research.

Another point worth noting is that we used an accountability manipulation that was quite strong. We not only told people that their decision would be identifiable, but also that they had to justify this decision to their fellow group members. We think that other accountability manipulations, such as identifiability, might yield weaker effects than the manipulation we used. After all, only learning that your fellow group members will know your decision is less strong than learning that you will also have to justify this decision to them. Nevertheless, we think that such a manipulation would yield a similar pattern of results. After all, earlier research has shown that identifiability manipulations also reduce egotism (see e.g., De Cremer, Snyder & Dewitte, 2001), which is the process that seems to drive our effects. However, to investigate whether our findings really generalize to other accountability manipulations, future research should address this issue.

It may also be interesting to note that the distribution of participants' harvests was slightly bimodal under high uncertainty (with a peak at 20 coins and another one at 100 coins). Such bimodality may be indicative of the influence of a personality difference, suggesting that part of the variance may be explained by a dispositional factor. A personality difference that may be relevant in this context is people's risk preference (see e.g., Weber, Blais, & Betz, 2002); Perhaps low risk-seekers were more inclined to harvest 20 coins, whereas high risk-seekers were more inclined to harvest 100 coins. After all, harvesting relatively high amounts is risky, for it increases the chance of the resource becoming depleted. Moreover, earlier research has shown that accountability often induces a cautious response set (Tetlock & Boettger, 1989), making people extra risk-avoidant when they are accountable for their decisions (Tetlock & Boettger, 1994). Therefore, investigating whether the present findings are moderated by risk preferences may be another interesting suggestion for future research.

Conclusions

To summarize, by investigating how justification pressures influence people's harvests under varying levels of environmental uncertainty, the present research has generated the following conclusions. First, by investigating the justifying potential of equality, we found empirical support for the suggestion that people apply equality when they have to justify their decisions to fellow group members (cf. Messick, 1993). Second, we showed that when equality does not prescribe a specific amount to harvest, such as under environmental *un*certainty, people display self-restraint when they have to justify their decisions to fellow group members. Third, by not only focusing on the means but also on the variance of harvests, we were able to demonstrate that accountability only induces convergence of harvests under environmental certainty. And fourth, our Monte Carlo study showed that, although accountability made groups more efficient in all uncertainty conditions, groups were more efficient under certainty than under *un*certainty. Altogether, these findings yield new insights into the interplay between cooperation, justifiability and tacit coordination.

Does overuse induce anger?

Chapter 5
Emotional Reactions after Overuse[17]

Almost forty years ago, Garrett Hardin (1968) wrote a famous and influential article named "The Tragedy of the Commons". In this article, Hardin addressed the issue of how people deal with scarce common resources. As an example, he described how a group of herdsmen have access to a common pasture. Each herdsman can decide how many animals he keeps on this pasture. It is in each herdsman's personal interest to add more and more animals to his herd. However, if all herdsmen decide to do so, the pasture becomes overgrazed, which is detrimental to all herdsmen. According to Hardin (p. 1244), since every herdsman pursues his own best interest, freedom in a commons inevitably "brings ruin to all".

A situation such as the one described by Hardin is generally referred to as a *common resource dilemma*, which is a specific type of *social dilemma*. A real-life example of a common resource dilemma is the problem of electricity blackouts. Such blackouts occur when the electricity grid breaks down because the collective use of electricity is higher than the available supply (see e.g., Ostrom, 1990, for other real-life examples). Since Hardin's theoretical analysis, numerous empirical studies have been conducted to study when overuse occurs and how overuse can be prevented (see Komorita & Parks, 1995; Kopelman, Weber, & Messick, 2002; Weber, Kopelman, & Messick, 2004, for reviews). However, very little research has been conducted to investigate how people respond to their fellow group members *when* such overuse occurs. How do people react to one another when ruin becomes reality? In the present chapter, we investigate this largely unexplored question.

In this chapter, we focus on affective and retributive reactions after overuse. We will argue and show that group members' reactions after overuse are largely determined by uncertainty regarding the environmental characteristics of a social dilemma. We demonstrate that the same negative outcome (i.e., overuse) can lead to different affective and retributive reactions, contingent upon group members' causal attributions of such an outcome, and that these attributions are largely determined by *environmental uncertainty*.

Affective Reactions after Overuse

How do people respond when a social dilemma results in overuse? Of course, it can be expected that such a negative outcome will elicit negative emotions (cf. Barclay, Skarlicki, & Pugh, 2005; Stouten, De Cremer, & Van Dijk, 2005, 2006).

[17] This chapter is based on De Kwaadsteniet, Van Dijk, Wit and De Cremer (in preparation).

However, earlier research has shown that affective reactions to negative outcomes are not only influenced by the value of the outcomes, in the sense that a negative outcome would simply induce a negative emotion, but are also determined by the way in which such outcomes are attributed (Weiner, Russell, & Lerman, 1979; McFarland & Ross, 1982; Van Dijk, Zeelenberg, & Van der Pligt, 1999; Van Dijk & Zeelenberg, 2002). Thus, in order to predict the emotional reactions after overuse, we focus on the causal attributions of such an outcome.

When a social dilemma results in overuse, group members will try to make sense of this situation by trying to find out who is responsible for the negative outcome (cf. De Cremer & Van Dijk, 2002; McFarland, & Ross, 1982; Weiner, 1985). But how do people respond affectively when they do find out who is responsible? Specifically, how do they respond to their fellow group members when they find out that these group members can be blamed for the occurring overuse? Earlier research (e.g., Tavris, 1982) has shown that blaming another person for a negative outcome is associated with outward-focused negative emotions – such as anger and hostility. Consequently, people will show anger towards their fellow group members when they think that these fellow group members have caused the common resource to become depleted. But under which circumstances will people attribute overuse to their fellow group members? In the following, we argue that this depends on the environmental characteristics of the social dilemma.

Environmental Uncertainty and Causal Attributions of Overuse

How overuse is attributed largely depends on the environmental characteristics of the social dilemma. In real life, these environmental characteristics (e.g., the size of the common resource) are often uncertain. For instance, in the blackout example described earlier, most electricity consumers do not know how large the capacity of the electricity grid is. Such environmental uncertainty (Messick, Allison, & Samuelson, 1988) plays a crucial role in how people attribute overuse in social dilemmas (cf. Rutte, Wilke & Messick, 1987), and consequently, how they respond affectively after overuse.

In many experimental studies on common resource dilemmas, participants know with certainty how large the common resource is. For instance, participants may be told that as a group of five people they share a resource of 500 coins. In that case, all group members know with certainty that the social dilemma will result in overuse if the collective harvest exceeds 500 coins. After all, when the group members collectively harvest more coins than available in the common resource, the resource becomes depleted and no-one receives any money. Often, in symmetric common resource dilemmas (i.e., all people have equal access to the resource) group members decide to harvest an equal share from the common resource (e.g., Allison, McQueen, & Schaerfl, 1992; Allison & Messick, 1990; De Cremer, 2003; Rutte et al., 1987; De Kwaadsteniet et al., 2006; Van Dijk & Wilke, 1993, 1995; Van Dijk, Wilke, Wilke, & Metman, 1999). When all group members do so, the resource is optimally used and the common resource dilemma does not result in overuse. However, when group members violate this rule by harvesting more than their equal share, the common resource is over-harvested. Thus, when the size of the common resource is known and the dilemma results in overuse, it is clear that this failure was caused by the harvesting decisions of the group members. Therefore, under resource size certainty people will attribute overuse to their fellow group members.

However, in order to know how much the group can harvest without jeopardizing the collective interest, group members need specific and exact information about the task environment of the social dilemma (cf. De Kwaadsteniet et al., 2006; Van Dijk et al., 1999). More specifically, to determine how much each group member should harvest according to the equal division rule, group members need to know exactly how large the common resource is. After all, to calculate an equal share, group members need to divide the size of the common resource by the number of group members. Consequently, in contrast to resource size certainty, under resource size *un*certainty it is unclear how much the group members can harvest without jeopardizing the common resource. Thus, under resource size uncertainty group members cannot simply conclude that overuse was caused by their fellow group members.

Based on the above, we expect that people will attribute overuse more to their fellow group members under resource size certainty than under resource size uncertainty. In accordance with this expectation – and based on the attribution-emotion link described earlier – we predict that people will show stronger negative affective reactions towards their fellow group members under resource size certainty than under resource size uncertainty.

Outline of the Present Research

We investigate our line of reasoning in a series of three experimental studies. In Study 5.1, we provide a first test of our ideas by investigating how people respond affectively after overuse under resource size (un)certainty. In Study 5.2, we extend the findings of Study 1 by not only giving people feedback about the outcome of the social dilemma (i.e., overuse), but by also investigating their affective responses to the harvesting decisions of individual group members. Furthermore, in this study we also investigate people's behavioral responses after overuse, namely, their retributive reactions towards fellow group members. Finally, Study 5.3 focuses on the affective and retributive responses to group members by outside observers, who are not members of the (overusing) group since they do not make any harvesting decisions themselves.

Study 5.1: Affective Reactions after Overuse

As a first test of our ideas, in Study 5.1 we investigated how people respond affectively after overuse. We investigated our line of reasoning in a single-trial common resource dilemma paradigm. In this paradigm, a group of people had access to a common resource from which each of them could freely harvest. However, if the total amount harvested by the group would exceed the amount available in the resource, the common resource would become depleted and all group members would receive zero outcomes (cf. Budescu et al., 1990; De Kwaadsteniet et al., 2006; Gustafsson et al., 1999a, 1999b; Rapoport et al., 1992). We presented participants with either a certain or an uncertain common resource from which they could harvest an amount. After the group members had made their harvesting decisions, we presented them with bogus feedback about the outcome of the dilemma, namely, that the common resource had become depleted (i.e., overuse). After that, the negative affect and attribution questions were posed.

Hypotheses

We formulated the following hypotheses. First, under resource size certainty we expected stronger negative affective reactions than under uncertainty (Hypothesis 5.1). Second, under resource size certainty we expected group members to attribute overuse more to group members' harvesting behavior than under resource size uncertainty (Hypothesis 5.2). Third, we expected the effect of resource size uncertainty on negative affective reactions to be mediated by causal attributions of overuse to their fellow group members (Hypothesis 5.3).

Method

Participants and Design. Participants were 122 students at Leiden University (35 men and 87 women, *M* age = 21.13 years) who were randomly assigned to either a resource size certainty or a resource size uncertainty condition. The participants received 4 for their participation.

Procedure. The participants were invited to the social-psychological laboratory to participate in a study on "group decision making". Upon arrival they were seated in separate cubicles, each containing a personal computer that was used to give instructions and to register the participants' responses.

The Common Resource Dilemma. Participants read a written description of a common resource dilemma. In this dilemma, a group of five people had access to a common resource from which each group member could freely harvest any number of coins (i.e., their individual harvests). The participants were informed that these coins were each worth € 0.03 (€ 1 is approximately US $ 1.65). If the collective harvest would be smaller than or equal to the resource size, the harvests would be granted and each group member would earn the amount of money he or she had harvested. If, however, the group's collective harvest would exceed the resource size, all group members would earn zero outcomes (cf. Budescu et al., 1990; De Kwaadsteniet et al., 2006; Gustafsson et al., 1999a, 1999b; Rapoport et al., 1992).

Resource Size Uncertainty. Resource size uncertainty was manipulated by varying the range of the uniform distribution of possible resource sizes (cf. Budescu et al., 1990; Budescu, Suleiman & Rapoport, 1995; Gustafsson et al., 1999a; Rapoport et al., 1992). The midpoint of these ranges was kept constant across the two conditions, i.e., 500. In the *Certainty* condition, the size of the resource was certain, i.e., 500 coins (midpoint = 500, range = 0). In the Uncertainty condition, the participants read that the resource would contain at least 100 and at most 900 coins (midpoint = 500, range = 800). In the *Uncertainty* condition, participants learned that afterwards the exact size of the common resource would be randomly drawn from the uniform distribution by a computer (i.e., participants were told that each possible resource size had an equal chance of being drawn from the range).

After the participants had read the instructions of the common resource dilemma, three practice questions were posed to ensure comprehension of the social dilemma situation. For example, participants were asked how much group members would earn if the total group harvest would exceed the size of the common resource. Ninety-seven percent of all participants answered all three questions correctly. After each question, the correct answer was disclosed and the most important characteristics of the situation were repeated.

Overuse Feedback. After the participants had made their harvesting decisions we included some filler questions. We told them that these questions were posed to give all group members enough time to make their harvesting decisions. Additionally, we told them that meanwhile the computer would calculate whether the common resource had been depleted or not. Filling in these questions took about a minute. Subsequently, the participants learned that all group members had made their harvesting decisions and that the computer had calculated whether the common resource had been depleted. All participants received bogus feedback indicating that the total group harvest was larger than the amount available in the common resource and that therefore no-one would receive any money. In other words, the participants learned that the common resource dilemma had resulted in overuse. Immediately after that, the negative affect questions were posed.

Questions about Negative Affect. We asked participants to indicate on seven-point scales to what extent they experienced six negative affective reactions towards their fellow group members (i.e., angry, frustrated, irritated, indignant, agitated and hostile; 1 = not at all; 7 = very much so). These items showed good internal consistency (Cronbach's α = .92) and were aggregated to form one scale of negative affect with higher scores denoting stronger negative affective reactions.

Questions about Causal Attributions. Although the main aim of the present study was to investigate to what extent participants attributed overuse to their fellow group members, we also asked them to what extent they attributed this overuse to the uncertainty of the situation. Thus, after participants had received the overuse feedback, we asked them to what extent they thought that the overuse was caused by their fellow group members' choice behavior. To do so, we asked participants two questions: namely (a) to what extent they thought their fellow group members were responsible for the overuse, and (b) to what extent they thought their fellow group members had caused the overuse (1 = not at all; 7 = very much so). These two questions showed good internal consistency (Cronbach's $\alpha = .88$) and were aggregated to form one attribution measure with higher scores denoting stronger attributions to fellow group members. Additionally, we asked participants to what extent they attributed the overuse to the uncertainty of the situation (1 = not at all; 7 = very much so).

Results

Checks. The manipulation of resource size uncertainty was checked by asking participants to indicate how uncertain they were about the size of the resource (1 = not uncertain at all; 7 = very uncertain). An ANOVA on this measure yielded a highly significant main effect of Resource Size Uncertainty, $F(1, 120) = 829.75$, $p < .001$, $\eta^2 = .87$. As expected, resource size uncertainty was higher in the Uncertainty condition ($M = 6.36$) than in the Certainty condition ($M = 1.33$). These results show that we successfully manipulated resource size uncertainty.

The induction of overuse feedback was checked by asking participants whether the feedback they had received indicated that their group's collective harvest had exceeded the size of the resource or not (1 = yes; 2 = no). All participants correctly indicated that their group had exceeded the common resource which shows that our induction of overuse was successful.

Individual Harvests. An ANOVA on participants' individual harvests did not yield a significant effect of Resource Size Uncertainty, $F(1, 120) = .001$, $p = .98$, $\eta^2 < .001$. In the two Resource Size Uncertainty conditions, participants harvested roughly the same number of coins from the common resource (i.e., Uncertainty: $M = 104.36$; $SD = 86.97$; Certainty: $M = 103.98$; $SD = 52.61$).[18]

Negative Affective Reactions. An ANOVA on the aggregated negative affect

18 Although not relevant to our reasoning, it may be interesting to note that in accordance with earlier research (e.g., Budescu et al., 1990; Gustafsson et al., 1999a, 1999b; Rapoport et al., 1992), we found that the variance of participants' harvests was higher in the uncertainty condition than in the certainty condition. What we did not find, however, was the over-harvesting effect that is usually found under environmental uncertainty. This might be due to the fact that in earlier studies uncertainty was manipulated within participants, whereas in the present chapter it was manipulated between participants.

measure yielded a significant main effect of Resource Size Uncertainty, $F(1, 120) = 4.47$, $p < .05$, $\eta^2 = .04$. In agreement with Hypothesis 5.1, Participants showed less negative affective reactions towards their fellow group members under Uncertainty ($M = 3.17$) than under Certainty ($M = 4.07$). See Table 5.1 for the means involved in this analysis.

Table 5.1. *Negative Affective Reactions towards Fellow Group Members by Resource Size Uncertainty*

	Resource Size Uncertainty	
	No	Yes
Negative affect	4.07[a] (1.68)	3.17[b] (1.64)

Note. Higher scores denote stronger mean affective reactions. Standard deviations are given in parentheses. Means with different superscripts differ significantly ($p < .01$, t-test).

Causal Attributions of Overuse. We asked participants two questions to indicate to what extent they thought the overuse was caused by their fellow group members' harvesting behavior. An ANOVA on the aggregated attribution measure yielded a significant main effect of Resource Size Uncertainty, $F(1, 120) = 13.81$, $p < .001$, $\eta^2 = .10$. In agreement with Hypothesis 5.2, participants attributed the overuse less to their fellow group members under Uncertainty ($M = 4.93$) than under Certainty ($M = 5.91$).[19]

Additionally, we asked participants to indicate to what extent they thought the overuse was caused the uncertainty of the situation. An ANOVA on this measure again yielded a significant main effect of Resource Size Uncertainty, $F(2, 120) = 4.28$, $p < .05$, $\eta^2 = .05$. As expected, participants attributed the overuse more to the situation under Uncertainty ($M = 5.26$) than under Certainty ($M = 4.14$). See Table 5.2 for the means involved in these analyses.

Table 5.2. *Attributions of Overuse by Resource Size Uncertainty and Level of Attribution*

Level of Attribution	Resource Size Uncertainty	
	No	Yes
Fellow group members	5.91[a] (1.47)	4.93[b] (1.24)
Uncertainty of the Situation	4.14[a] (1.96)	5.26[b] (1.42)

Note. Higher scores denote stronger mean attributions. Standard deviations are given in parentheses. For each row, means with different superscripts differ significantly ($p < .05$, t-tests).

19 It is important to note here that people's attributions may also be influenced by their own harvesting decisions (e.g., whether they have adhered to the equal division rule themselves). We will elaborate on this issue later on in this chapter.

Mediation Analysis. To test whether participants' negative affective reactions could be explained their attributions of the overuse to their fellow group members (see Hypothesis 5.3), we performed a mediation analysis with Resource Size Uncertainty (i.e., No vs. Yes) as the independent variable, affective reactions as the dependent variable and attributions to the choice behavior of fellow group members as the mediator (cf. Baron & Kenny, 1986). We first performed a regression analysis on affective reactions with resource size uncertainty as the predictor. This analysis showed that resource size uncertainty significantly predicted participants' affective reactions, $\beta = -.264$, $p < .01$. Second, we performed a regression analysis on the mediator with resource size uncertainty as the predictor. This analysis showed that resource size uncertainty also significantly predicted participants' attributions to their fellow group members' choice behavior, $\beta = -.290$, $p < .01$. Third, a regression analysis with both resource size uncertainty and the mediator as independent variables showed that the mediator significantly predicted participants' affective reactions, $\beta = .540$, $p < .001$, whereas the effect of resource size uncertainty disappeared and became non-significant when the mediator was included, $\beta = -.090$, $p = .26$. Moreover, a Sobel test showed that the decrease of this latter effect was significant (Sobel test value = -3.27, $p < .01$). Altogether, these regression analyses indicate that the effect of resource size uncertainty on participants' affective reactions was significantly mediated by participants' attributions to their group members' choice behavior, which is fully in line with hypothesis 5.3.[20]

Discussion

The results of Study 5.1 support our first set of hypotheses. Under resource size certainty participants showed stronger negative affective reactions towards their fellow group members than under resource size uncertainty (Hypothesis 5.1). Additionally, under resource size certainty participants attributed the overuse more to their fellow group members than under resource size uncertainty (Hypothesis 5.2). Moreover, the effect of uncertainty on participants' negative affective reactions was mediated by their attributions of the overuse to their fellow group members (Hypothesis 5.3). Additionally, we found that under resource size certainty overuse was attributed less to the situation than under resource size uncertainty.

20 We also tested whether the effect of uncertainty on affective responses to fellow group members was mediated by participants' attributions of overuse to the uncertainty of the situation. This was not the case. This finding can be explained by the fact that we asked participants about the emotional reactions to their fellow group members and not about their emotional reactions to the situation.

Study 5.2: Reactions to Feedback about Individual Harvests

The results of Study 5.1 provide a first corroboration of our idea that under uncertainty people become less angry after overuse than under certainty. However, in this first study we only gave participants feedback about the *collective outcome* of the social dilemma, namely that the dilemma had resulted in overuse. By doing so, we showed that the same negative outcome (i.e., overuse) can elicit different affective reactions depending on the environmental characteristics of the social dilemma. However, our line of reasoning suggests that people may not only respond differently to the same collective outcome (i.e., collective overuse) under different levels of environmental uncertainty, but also to the same individual harvesting decisions. That is, our reasoning should extend to affective reactions towards individual group members. More specifically, reactions towards an individual making the same harvesting decision may be different depending on whether or not there is uncertainty about the size of the common resource. To investigate this possibility, we performed a second study in which we gave participants bogus feedback about the individual harvesting decisions of their fellow group members (i.e., in addition to feedback that the common resource had been depleted). In this Study, we aimed to investigate how people would respond to their fellow group members when they knew exactly how much these group members had harvested. Would people become less angry under uncertainty (as opposed to certainty) towards a fellow group member who had harvested a relatively large amount? This question was addressed in Study 5.2.

Under resource size certainty group members who harvested relatively large amounts (i.e., high harvesters) have jeopardized the collective interest by not adhering to the equal division rule. It can thus be expected that people will become angry at these high harvesters under resource size certainty. After all, such high harvesters have probably caused the common resource to become depleted. Under resource size uncertainty the story is quite different. Under such uncertainty it cannot be so easily concluded that high harvesters have jeopardized the collective interest. When overuse occurs under uncertainty, it is unclear whether or not these high harvesters have caused the common resource to become depleted. As a consequence, it can be expected that people will become less angry at such high harvesters under resource size uncertainty than under resource size certainty.

To test this line of reasoning, in Study 5.2 we presented participants with the same common resource dilemma as in Study 5.1. Again, we manipulated resource size (un)certainty and provided standard bogus feedback indicating that the common resource had been depleted. However, the difference between these studies was that in Study 5.2 – after giving them the feedback that the resource has been depleted

– we also gave participants bogus feedback about the individual harvesting decisions of two of their fellow group members. One of these two fellow group members had harvested a relatively large number of coins (i.e., 150 coins), whereas the other fellow group member had harvested a more moderate number of coins (i.e., 100 coins).[21] Furthermore, to keep all things equal in both (un)certainty conditions, in the resource size uncertainty condition we also gave participants feedback that the computer had determined that the common resource contained 500 coins. For each of these two fellow group members, we asked the same negative affect and attribution questions as in study 5.1.

Retributive Reactions after overuse

As we mentioned before, in Study 5.2 we also investigated people's behavioral responses after overuse, namely, their retributive reactions towards their fellow group members. Based on earlier research (e.g., Barclay et al., 2005; Stouten et al., 2006), we expected that the effects of overuse might extend to retributions, such as social exclusion and revenge. In other words, when people attribute overuse to a fellow group member, they may also be more inclined to punish this fellow group member for his/her harvesting behavior. To test this expectation, we asked participants a couple of questions about their retributive reactions to their fellow group members.

Hypotheses

Based on the above, we formulated the following hypotheses. First, under resource size certainty we expected participants to show stronger negative affective reactions to a high harvester than under resource size uncertainty (Hypothesis 5.4). Second, under resource size certainty we expected participants to attribute overuse more to the behavior of a high harvester than under resource size uncertainty (Hypothesis 5.5). Third, we expected participants' affective reactions to their fellow group members to be mediated by their causal attributions. The more they would attribute overuse to a specific fellow group member, the angrier they would become at this fellow group member (Hypothesis 5.6). Fourth, we expected participants to show stronger retributive reactions to a high harvester under resource size certainty than under resource size uncertainty (Hypothesis 5.7).

Method

Participants and Design. Participants were 122 students at Leiden University (35 men and 87 women, *M* age = 21.13 years). A 2 (Resource Size Uncertainty: No vs.

[21] Note that under resource size certainty this latter group member (i.e., the group member harvesting 100 coins) has harvested one-fifth of the common resource, and under resource size uncertainty this group member has harvested one-fifth of the midpoint of the range of the uncertain common resource.

Yes) × 2 (Feedback about Individual Harvests: 100 coins vs. 150 coins) factorial design with repeated measures on the latter factor was used. The participants were paid € 4 for their participation.

Procedure. Participants were presented with the same common resource dilemma as in Study 5.1. Again, participants were randomly assigned to one of the two resource size uncertainty conditions (i.e., Certainty vs. Uncertainty) and participants had to fill in the same three practice questions (this time 99 % of all participants answered all three questions correctly). After making their harvesting decisions, participants received bogus feedback about the outcome of the social dilemma, namely that the common resource had become depleted. In this study, we also told the participants in the resource size uncertainty condition that the computer had determined that the common resource had contained 500 coins (i.e., the same resource size as in the resource size certainty condition). After that, they received bogus feedback about the individual harvesting decisions of two of their fellow group members (i.e., Feedback about Individual Harvests). One of these group members had harvested 100 coins, whereas the other one had harvested 150 coins. For each of these two group members, participants responded to a couple of attribution, affect and retribution questions. The two Feedback about Individual Harvests conditions were counter-balanced to check for order effects. Preliminary analyses revealed no significant order effects on any of the dependent variables (all *F*s < 1).

Results

Checks. The manipulation of resource size uncertainty was checked by asking participants to indicate how uncertain they were about the size of the resource (1 = not uncertain at all; 7 = very uncertain). An ANOVA on this measure also yielded a highly significant main effect of Resource Size Uncertainty, $F(1, 120) = 354.82$, $p < .001$, $\eta^2 = .75$. As expected, resource size uncertainty was lower in the Certainty condition ($M = 1.69$) than in the Uncertainty condition ($M = 5.84$).

The manipulation of Feedback about Individual Harvests was checked by asking participants how many coins were harvested by the two fellow group members they had received feedback about. Ninety-six % of all participants correctly indicated how many coins each of the two fellow group members had harvested (i.e., 100 and 150 coins, respectively). These results indicate that all our manipulations were successful.

After participants had received feedback about the outcome of the social dilemma, the induction of overuse feedback was checked by asking participants whether the feedback they had received indicated that their group's collective harvest had exceeded the size of the resource or not (1 = yes; 2 = no). All participants correctly indicated that their group had exceeded the common resource.

Individual Harvests. An ANOVA on participants' individual harvests did not yield a significant effect of Resource Size Uncertainty, $F(1, 120) = 0.02$, $p = .89$. In both Resource Size Uncertainty conditions, participants harvested roughly the same amount of coins from the common resource (i.e., under Certainty [*M* = 88.46; *SD* = 54.45] slightly – though not significantly - less than under Uncertainty [*M* = 90.59; *SD* = 108.93]).

Affective Reactions. In each of the two Feedback about Individual Harvests conditions, we asked participants about the same six negative affective reactions as in Study 5.1 (i.e., angry, frustrated, irritated, indignant, agitated and hostile). Participants were asked to indicate on seven-point scales (1 = not at all; 7 = very much so) to what extent they experienced these affective reactions *towards* the fellow group member they received feedback about. These six items showed good internal consistency (Cronbach's $\alpha = .92$) and were aggregated to form one scale of negative affect with higher scores denoting stronger negative affective reactions. An ANOVA on this measure yielded a significant main effect of Feedback about Individual Harvests, $F(1, 120) = 157.07$, $p < .001$, $\eta^2 = .57$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 120) = 47.84$, $p < .001$, $\eta^2 = .29$.

The main effect of Feedback about Individual Harvests indicated that participants responded more negatively to a fellow group member who had harvested 150 coins (*M* = 4.83) than to a fellow group member who had harvested 100 coins (*M* = 2.00). In accordance with Hypothesis 5.4, the interaction effect showed that under Certainty reactions to a group member who had harvested 150 coins were more negative than under Uncertainty (*M* = 3.75 vs. 2.56, respectively). The affective reactions to a group member who had harvested 100 coins were close to the lower end of the scale, indicating that these reactions were not negative at all. However, under Certainty reactions to a group member who had harvested 100 coins were slightly less negative than under Uncertainty (*M* = 1.16 vs. 1.81, respectively). See Table 5.3 for the means involved in this analysis.

Table 5.3. *Negative Affective Reactions towards a Fellow Group Member by Resource Size Uncertainty and Feedback about Individual Harvests (2 × 2)*

Feedback about Individual Harvests	Resource Size Uncertainty	
	No	Yes
Harvest of 100 coins	1.16^a (0.46)	1.81^b (1.03)
Harvest of 150 coins	3.75^a (1.62)	2.56^b (1.40)

Note. Higher scores denote stronger mean affective reactions. Standard deviations are given in parentheses. For each row, means with different superscripts differ significantly ($p < .001$, t-tests).

Causal Attributions. After participants had received bogus feedback about the harvesting decisions of a fellow group member (i.e., 100 vs. 150 coins), they were asked to what extent they thought the overuse could be attributed to the harvesting decision of this fellow group member. To do so, we posed the same two personal attribution questions as in Study 5.1. Again, these two questions showed good internal consistency (Cronbach's $\alpha = .82$) and were aggregated to form one attribution measure with higher scores denoting stronger attribution. An ANOVA on this measure yielded a significant main effect of Feedback about Individual Harvests, $F(1, 120) = 342.58$, $p < .001$, $\eta^2 = .74$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 120) = 37.48$, $p < .001$, $\eta^2 = .24$.

The main effect of Feedback about Individual Harvests indicated that participants attributed overuse more to a fellow group member who had harvested 150 coins ($M = 4.83$) than to a fellow group member who had harvested 100 coins ($M = 2.00$). In accordance with Hypothesis 5.4, the interaction effect showed that under Certainty participants attributed overuse more to the behavior of a group member who had harvested 150 coins than under Uncertainty ($M = 5.32$ vs. $M = 4.33$, respectively). It should be noted that the responses to a group member who had harvested 100 coins were close to the lower end of the scale. However, under Certainty participants attributed overuse less to the group member who had harvested 100 coins than under Uncertainty ($M = 1.56$ vs. 2.44, respectively). See Table 5.4 for the means involved in this analysis.

Table 5.4. *Attributions of Overuse by Resource Size Uncertainty and Feedback about Individual Harvests (2 × 2)*

Feedback about Individual Harvests	Resource Size Uncertainty	
	No	Yes
Harvest of 100 coins	1.56^a (0.97)	2.44^b (1.51)
Harvest of 150 coins	5.32^a (1.50)	4.33^b (1.71)

Note. Higher scores denote stronger mean attributions. Standard deviations are given in parentheses. For each row, means with different superscripts differ significantly ($p < .001$, t-tests).

We also asked participants to what extent they thought the overuse was caused by the uncertainty of the situation (1 = not at all; 7 = very much so). A between-participants ANOVA on this measure showed a significant main effect of Resource Size Uncertainty, $F(1, 120) = 8.17$, $p < .01$, $\eta^2 = .06$, indicating that under Uncertainty participants attributed overuse more to the situation than under Certainty ($M = 5.15$ vs. 4.13, respectively).

Mediation Analysis. As in Study 5.1, to test whether participants' affective reactions could be explained by the attributions of overuse to their fellow group members, we performed a mediation analysis. To test this mediation (in a mixed-model design with one between- and one within-participants factor) we applied a procedure proposed by Judd, Kenny and McClelland (2001). First, we calculated the difference between the affective reactions towards the fellow group member who had harvested 100 coins and the fellow group member who had harvested 150 coins (i.e., DIF-affect). Second, we calculated the difference between the attributions towards the fellow group member who had harvested 100 coins and the fellow group member who had harvested 150 coins (i.e., DIF-attribution). Third, we conducted a mediation analysis with Resource Size Uncertainty as the predictor, DIF-attribution as the mediator, and DIF-affect as the dependent variable.

We first performed a regression analysis on DIF-affect with resource size uncertainty as the predictor. This analysis showed that resource size uncertainty significantly predicted DIF-affect, $\beta = -.534$, $p < .001$, indicating the interaction on affect we also found with the ANOVA mentioned earlier. Second, we performed a regression analysis on the mediator with resource size uncertainty as the predictor. This analysis showed that resource size uncertainty also significantly predicted DIF-attribution, $\beta = -.488$, $p < .001$, indicating the interaction effect on attributions we found earlier. Third, a regression analysis with both resource size uncertainty and the mediator as independent variables showed that the mediator significantly predicted DIF-affect, $\beta = .484$, $p < .001$, whereas the effect of resource size uncertainty on DIF-affect became smaller when the mediator was included, $\beta = -.298$, $p = .001$. Moreover, a Sobel test showed that the decrease of this latter effect was significant (Sobel test value = 4.40, $p < .001$). Altogether, these regression analyses indicate that the effect of resource size uncertainty on DIF-affect was partially (though significantly) mediated by DIF-attribution. In accordance with Hypothesis 5.6, these results show that participants' negative affective reactions can (at least partly) be explained by the attribution of overuse to their fellow group members.

Retributive Reactions. After asking participants about their causal attributions, we asked them four retribution questions towards each of the two individual group members. Participants were asked to what extent they (a) wanted to take revenge on this fellow group member, (b) wanted to sanction this fellow group member, (c) wanted to impose a fine on this fellow group member, and (d) wanted to exclude this fellow group member from the group (1 = not at all; 7 = very much so). These items showed good internal consistency (Cronbach's $\alpha = .85$) and were aggregated to form one retribution scale with higher scores denoting stronger retributive reactions.[22] An ANOVA on this measure yielded a significant main effect of Feedback about Individual Harvests, $F(1, 120) = 151.06$, $p < .001$, $\eta^2 = .56$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 120) = 47.84$, $p < .001$, $\eta^2 = .22$.

22 We also analyzed these retribution questions separately (also in Study 3). These analyses yielded similar results as the analysis on this aggregate retribution scale.

The main effect of Feedback about Individual Harvests indicated that participants showed stronger retributive reactions to a fellow group member who had harvested 150 coins (*M* = 2.81) than to a fellow group member who had harvested 100 coins (*M* = 1.28). The interaction effect showed that, in accordance with hypothesis 5.7, under Certainty participants showed stronger retributive reactions to a fellow group member who had harvested 150 coins than under Uncertainty (*M* = 3.37 vs. 2.26). Although the retributive reactions to a fellow group member who had harvested 100 coins were very low (i.e., almost 1), under Certainty participants' retributive reactions to a group member who had harvested 100 coins were even lower than under Uncertainty (*M* = 1.13 vs. 1.44). See Table 5.5 for the means involved in this analysis.

Table 5.5. *Retributive Reactions towards a Fellow Group Member by Resource Size Uncertainty and Feedback about Individual Harvests (2 × 2)*

Feedback about Individual Harvests	Resource Size Uncertainty	
	No	Yes
Harvest of 100 coins	1.13^{a} (0.46)	1.44^{b} (0.76)
Harvest of 150 coins	3.75^{a} (1.60)	2.56^{b} (1.44)

Note. Higher scores denote stronger mean retributive reactions. Standard deviations are given in parentheses. For each row, means with different superscripts differ significantly ($p < .001$, t-tests).

Discussion

The results of Study 5.2 corroborate our second set of hypotheses. Under resource size certainty participants showed stronger negative affective reactions to a high harvester than under resource size uncertainty (Hypothesis 5.4). Additionally, under resource size certainty participants attributed the overuse more to a high harvester than under resource size uncertainty (Hypothesis 5.5). Moreover, the effect of uncertainty on participants' negative affective reactions was mediated by their attributions of the overuse (Hypothesis 5.6). And finally, under resource size certainty participants were more inclined to punish a high harvester than under resource size uncertainty (Hypothesis 5.7). As in Study 5.1, in this study we also found that under resource size certainty overuse was attributed less to the situation than under resource size uncertainty.

Although not our primary focus, it may be interesting to elaborate on participants' reactions to the fellow group member who had harvested 100 coins. As was shown by the data of Study 5.2, the reactions to this fellow group member were very positive in both (un)certainty conditions. Participants were not angry at this fellow group member and they were not inclined to punish this group member for his/ her choice behavior. However, looking at the cell means, it should also be noted that even here, reactions were affected by uncertainty, i.e., the emotional and retributive reactions to this fellow group member were slightly more positive under certainty than under uncertainty. This finding may be explained by the fact that under resource size certainty this fellow group member had adhered perfectly to the equal division rule. Thus, under resource size certainty participants had no reason at all to blame this person for the overuse. After all, this fellow group member had done the right thing (cf. Messick, 1993; Stouten et al., 2005), and if all group members would have done so the common resource would not have become depleted. As a consequence, the affective and retributive responses to this fellow group member were very close to the lower end of the scale. Under uncertainty, by contrast, it was less clear whether harvesting 100 coins was the right thing to do (cf. De Kwaadsteniet et al., 2006). Therefore, the responses to a person who had harvested 100 coins were slightly less positive than under certainty (see Tables 5.3 to 5.5).

Study 5.3: Reactions from an Outside Observer

The results of Study 5.1 and 5.2 support our ideas. In these studies, however, participants own harvesting decisions may have influenced the way in which they responded to their fellow group members. After all, when you have harvested a relatively large amount yourself you may blame yourself more for the overuse, and as a consequence you will attribute the overuse less to your fellow group members. Therefore, it is important to control for participants' own harvesting decisions in investigating their attributions of overuse. One way of doing so is by including participants' individual harvests as a covariate into the ANOVAs on participants' reactions in Study 5.1 and 5.2. Therefore, we conducted all ANOVAs of Study 5.1 and 5.2 with participants' individual harvests as a covariate. Although these analyses showed that there was indeed a negative relation between participants' own harvests and their attributions of overuse (i.e., the lower their own harvests the more they attributed overuse to their fellow group members), including these harvests as a covariate did not alter our pattern of results. This analysis thus indicated that the findings of our first two studies could not be explained by participants' own harvesting decisions.

In order to make an even stronger case, we conducted a third study in which the participants did not have to make harvesting decisions themselves. This third study was identical to Study 5.2, but now participants only observed and judged the harvesting decisions of the group members involved in the social dilemma. In this way, we excluded the possibility that participants' judgments would be influenced by their own harvesting decisions. Moreover, in Study 5.3 we aimed to replicate the findings of Study 5.2 to obtain additional support for Hypotheses 5.4 to 5.7.

Method

Participants and Design. Participants were 50 students at Leiden University (16 men and 34 women, *M* age = 20.00 years). A 2 (Resource Size Uncertainty: No vs. Yes) × 2 (Feedback about Individual Harvests: 100 coins vs. 150 coins) factorial design with repeated measures on the latter factor was used. The participants were paid € 4 for their participation.

Procedure. Participants were presented with the same common resource dilemma as in Studies 1 and 2. Again, participants were randomly assigned to one of the two resource size uncertainty conditions (i.e., Certainty vs. Uncertainty) and participants had to fill in the same three practice questions as in the previous two studies (this time 98 % of all participants answered all three questions correctly). This time the participants did not have to make a harvesting decision themselves, but we told them that it was their task to judge the harvesting decisions of the group members involved in the common resource dilemma. Again, we told the participants that the common resource had become depleted. As in Study 5.2, we also told the participants in the resource size uncertainty condition that the computer had determined that the common resource contained 500 coins (which is the same resource size as in the resource size certainty condition). As in Study 5.2, they received bogus feedback about the individual harvesting decisions of two of the group members (i.e., Feedback about Individual Harvests: 100 vs. 150 coins). For each of these two group members, participants were asked respond to the same affect, attribution and retribution questions as in Study 5.2. The two Feedback about Individual Harvests conditions were counter-balanced to check for order effects. No significant order effects were found (all *F*s < 1).

Results

Checks. The same checks were administered as in Study 5.2. First, an ANOVA on the manipulation check of resource size uncertainty yielded a highly significant main effect of Resource Size Uncertainty, $F(1, 48) = 89.89$, $p < .001$, $\eta^2 = .65$. As expected, uncertainty was lower in the Certainty condition ($M = 1.82$) than in the Uncertainty condition ($M = 5.91$). Second, ninety-five % of all participants correctly indicated how many coins both group members had harvested (i.e., 100 vs. 150 coins, respectively). These results show that both manipulations were successful. Third, all participants correctly indicated that their group had exceeded the common resource.

Affective Reactions. An ANOVA on the aggregated affect measure (Cronbach's $\alpha = .95$) yielded a significant main effect of Feedback about Individual Harvests, $F(1, 48) = 90.69$, $p < .001$, $\eta^2 = .65$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 48) = 24.38$, $p < .001$, $\eta^2 = .34$. The main effect of Feedback about Individual Harvests indicated that participants responded more negatively to a group member who had harvested 150 coins ($M = 3.86$) than to a group member who had harvested 100 coins (M = 1.86). In accordance with Hypothesis 5.4, the interaction showed that under Certainty reactions to a group member who had harvested 150 coins were *more* negative than under Uncertainty (M = 4.22 vs. 3.40, respectively). As in Study 5.2, the affective reactions to a fellow group member who had harvested 100 coins were not negative at all. However, under Certainty reactions to this group member were *slightly* less negative than under Uncertainty (M = 1.36 vs. 2.49, respectively).

Attributions. An ANOVA on the aggregated attribution measure (Cronbach's α = .92) yielded a significant main effect of Feedback about Individual Harvests, $F(1, 48) = 105.51$, $p < .001$, $\eta^2 = .69$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 48) = 31.36$, $p < .001$, $\eta^2 = .40$. The main effect of Feedback about Individual Harvests indicated that participants attributed overuse more to a group member who had harvested 150 coins (M = 5.21) than to a group member who had harvested 100 coins (M = 2.69). In accordance with Hypothesis 5.5, the interaction effect showed that under Certainty participants attributed overuse *more* to the behavior of a group member who had harvested 150 coins than under Uncertainty (M = 5.33 vs. M = 5.06, respectively). As in Study 5.2, the attributions of overuse to a fellow group member who had harvested 100 coins were very close to the lower end of the scale. However, under Certainty participants attributed overuse slightly *less* to the choice behavior of this group member than under Uncertainty (M = 1.68 vs. 3.98, respectively).

As in Study 5.1 and 5.2, we also asked participants to what extent they thought the overuse was caused by the uncertainty of the situation. A between-participants ANOVA on this measure showed a significant main effect of Resource Size Uncertainty, $F(1, 48) = 12.81$, $p < .05$, $\eta^2 = .12$, indicating that under Uncertainty participants attributed overuse more to the situation than under Certainty (M = 5.59 vs. 4.57, respectively).

Mediation Analysis. In order to test the predicted mediation we applied the same procedure as in Study 5.2. First, we showed that resource size uncertainty significantly predicted DIF-affect, $\beta = -.505$, $p < .001$, indicating the interaction on affect we also found with the ANOVA mentioned earlier. Second, we showed that resource size uncertainty also significantly predicted DIF-attribution, $\beta = -.540$, $p < .001$, indicating the interaction effect on attributions we found earlier. Third, we showed that the mediator significantly predicted DIF-affect, $\beta = .653$, $p < .001$, whereas the effect of resource size uncertainty on DIF-affect became smaller and non-significant when the mediator was included, $\beta = -.152$, $p = .09$ (Sobel test value = 5.93, $p < .001$). In accordance with Hypothesis 5.6, these regression analyses thus indicate that the effect of resource size uncertainty on DIF-affect was fully mediated by DIF-attribution, which implies that participants' negative affective reactions can be explained by the attributions of overuse to their fellow group members.

Retributive Reactions. An ANOVA on the aggregated retribution measure (Cronbach's α = .86) yielded a significant main effect of Feedback about Individual Harvests, $F(1, 48) = 61.25$, $p < .001$, $\eta^2 = .56$, and a significant Resource Size Uncertainty by Feedback about Individual Harvests interaction effect, $F(1, 48) = 11.01$, $p < .01$, $\eta^2 = .19$. The main effect of Feedback about Individual Harvests indicated that participants showed stronger retributive reactions to a group member who had harvested 150 coins (M = 3.40) than to a group member who had harvested 100 coins (M = 1.70). In accordance with Hypothesis 5.7, the interaction effect showed that under Certainty participants showed stronger retributive reactions to a group member who had harvested 150 coins than under Uncertainty (M = 3.63 vs. 3.10, respectively). As in Study 5.2, participants' retributive reactions to a fellow group member who had harvested 100 coins were very low. However, under Certainty participants' retributive reactions to this group were *slightly* lower than under Uncertainty (M = 1.33 vs. 2.17, respectively).

Discussion

In Study 5.3, we fully replicated the findings of Study 5.2. By focusing on the judgments of an outside observer, we again found strong support for Hypotheses 5.4 to 5.7. These findings clearly show that our ideas still hold when the participants do not make harvesting decisions themselves, and that these ideas are also applicable to outside observers. By showing this, we demonstrated how pervasive our effects are. Evidently, people can become angry at high harvesters and are willing to punish these high harvesters *even* when their own outcomes are not at stake. Again, it was shown that these reactions were stronger under certainty than under uncertainty.

General Discussion

The results of our three experimental studies strongly corroborate our hypotheses. Our first study corroborates our first set of hypotheses (i.e., Hypotheses 5.1 to 5.3). We found that under resource size certainty people show stronger negative affective reactions after overuse because they attribute this negative outcome more to their fellow group members' choice behavior than under resource size uncertainty. Moreover, in accordance with our second set of hypotheses (i.e., Hypotheses 5.4 to 5.7), our last two studies showed that under certainty people respond more negatively to high harvesters than under uncertainty. Under resource size certainty people attribute overuse more to such high harvesters, they are angrier at these high harvesters, and they are more inclined to punish these high harvesters for their choice behavior than under resource size uncertainty. In the following, we will address the more general implications of these findings.

Reactions to High Harvesters under Environmental Uncertainty

As Hardin stated (1968, p. 1244), social dilemmas inevitably lead to "ruin to all". In a way, we took Hardin's endpoint as the starting point of our research. We wanted to know how people react when ruin becomes reality. More specifically, we focused on how people responded affectively after overuse. We showed that these reactions were less negative under resource size uncertainty than under resource size certainty. By doing so, we demonstrated that, depending on the environmental characteristics of the social dilemma, the same negative outcome (i.e., overuse) can lead to different affective reactions. Moreover, besides focusing on how people react to the overuse itself (i.e., overuse as an outcome), we also investigated how people responded to the individual harvesting decisions of their fellow group members. In line with our expectations, our results showed that under resource size uncertainty people become less angry at group members who harvest relatively large amounts and that they also show milder retributive reactions to such high harvesters than under resource size certainty. At this point, it may be interesting to relate these findings to suggestions done in other studies on environmental uncertainty.

In earlier papers on environmental uncertainty in social dilemmas (e.g., De Kwaadsteniet et al., 2006; Gustafsson, 1999a, b; Hine & Gifford, 1996; Rapoport et al., 1992), it was repeatedly argued that group members may use such uncertainty to further their own self-interest. For instance, in one of our earlier studies (De Kwaadsteniet et al., 2006), we showed that under resource size uncertainty proselfs (i.e., people with a dispositional preference to further their self-interest) harvested larger amounts than under resource size certainty. We explained this finding by arguing that under resource size uncertainty proselfs could justify relatively high harvests by arguing that they thought there would be more than enough money in the uncertain common resource (also referred to as *egoism-justification*; see Gustafsson et al., 1999a, 1999b). Proselfs seemed to think that under resource size uncertainty they could get away with harvesting such relatively large amounts. However, the question still remained as to whether this was really the case: Can people really get away with high harvests under resource size uncertainty?

The present research provides a tentative answer to this question. Our results show that under resource size uncertainty group members respond more mildly to high harvesters than under resource size certainty. After all, under uncertainty group members cannot simply determine whether high harvesters have caused the common resource to become depleted and therefore they become less angry at these high harvesters than under certainty. These findings suggest that high harvesters can indeed more easily get away with their "greedy" harvesting behavior under resource size uncertainty.

Managing an Uncertain Common Resource

The above line of reasoning also shows the importance of environmental uncertainty for the enforcement of the equal division rule. After all, this rule only prescribes an unequivocal harvest level when there is environmental certainty. In most real-life social dilemmas, however, there is uncertainty about the environmental characteristics of the dilemma. When these characteristics become uncertain – such as the resource size or the group size – people may not be able to determine whether their fellow group members have violated this rule (cf. De Kwaadsteniet et al., 2006). In line with this reasoning, our findings suggest that under such circumstances it is more difficult for group members to enforce the use of this rule (e.g., by means of retributions), even if they have full information about their fellow group members' harvesting decisions.

Thus, when the task environment does not allow for a division rule to prescribe an unequivocal amount to harvest, group members must find another way to efficiently manage the common resource. According to Ostrom (1990), group members (referred to as "appropriators") must then define the boundaries of the common resource themselves. In other words, based on the "local" conditions of the common resource, they must agree on how much each group member is allowed to harvest from the common resource. However, in many social dilemmas the group members cannot communicate with one another and therefore it is impossible for them to agree on an "appropriate" amount to harvest. In the absence of communication, resource size uncertainty may thus hamper the enforcement of division rules, which jeopardizes the collective interest by increasing the chance that the common resource becomes depleted.

Earlier Research on Causal Attributions and Environmental Uncertainty

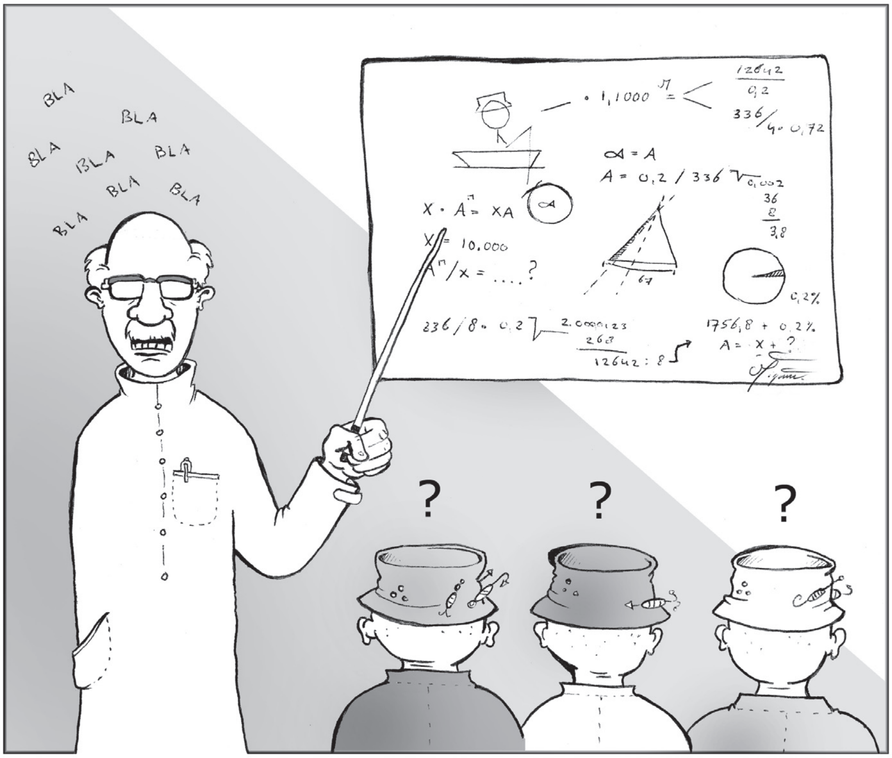
At this point, it may be interesting to relate the findings of the present research to findings from a study by Rutte, Wilke and Messick (1987). Rutte et al. investigated attributions of scarcity and abundance in a common resource dilemma. In contrast to our research – in which we used a simultaneous protocol of play – Rutte et al. used a sequential protocol of play (i.e., harvesting decisions were made sequentially). Participants were told that as a member of a six person group, they themselves were the fifth member to harvest an amount from the common resource. In this experiment, Rutte et al. also manipulated resource size uncertainty asymmetrically, i.e., in the uncertainty condition of this experiment only the first four group members were uncertain about the size of the common resource. Scarcity and abundance were manipulated by varying the amount of money left for the last two group members (i.e., group members 5 and 6). In the scarcity condition, there was *less* than an equal share left for each of the last two group members, whereas in the abundance condition there was *more* than an equal share left for each of the last two group members. In accordance with our findings, Rutte et al. found that in the certainty condition participants indicated that their fellow group members were more responsible for the outcome than in the uncertainty condition.

The above findings – which demonstrate the relation between environmental uncertainty and causal attributions – are in agreement with our line of reasoning (see also Wit, Wilke, & Van Dijk, 1989, on causal attributions of a leader's success or failure under environmental (un)certainty). However, Rutte et al. (1987) did not investigate how participants reacted affectively to fellow group members under scarcity and abundance. As we mentioned earlier, until recently (see Stouten et al., 2005, 2006, for exceptions) very little research has been done on emotions in social dilemmas. However, such emotional reactions can have important behavioral consequences. After all, research has shown that emotions can have a substantial impact on people's decisions. For instance, we argued and showed that anger-related emotions can extend to retributive reactions, such as social exclusion and revenge. Therefore, it is important to not only focus on how people attribute overuse, but to also focus on people's affective and retributive reactions towards fellow group members after such overuse.

We showed that causal attributions of overuse can affect people's affective and retributive reactions to their fellow group members. When group members attribute overuse more to their fellow group members, they become angrier at these fellow group members and they also show stronger retributive reactions to these fellow group members. By showing this, we demonstrated how and when attributions of overuse can be important. After all, attributions of overuse can have serious consequences for the group members this outcome is attributed to.

Conclusions

In the present chapter, we investigated how people deal with the "tragedy of the commons" (Hardin, 1968). Specifically, we focused on people's affective and retributive responses after overuse. By doing so, the present research has generated a number of new insights. First, we demonstrated that resource size uncertainty has a substantial impact on how people respond affectively after overuse. Second, we showed that under resource size uncertainty people attribute such overuse less to their fellow group members than under certainty. Third, we investigated how these attributions affected people's affective and retributive reactions. We showed that under resource size uncertainty people's affective and retributive responses after overuse are less negative than under certainty. Altogether, these findings underline the importance of environmental uncertainty by demonstrating that such uncertainty plays a crucial role in how people respond after overuse in social dilemmas.



To summarize...

Chapter 6
General Discussion

The main objective of the present dissertation was to provide a more comprehensive perspective on environmental uncertainty in social dilemmas. I argued that environmental uncertainty hampers the application of the equal division rule. In accordance with this idea, the present dissertation showed that environmental uncertainty affects several interpersonal processes that are related to the application of this rule. More specifically, environmental uncertainty has consequences for three key aspects of interpersonal processes in social dilemmas, namely, for (a) how people tacitly coordinate their harvesting decisions, (b) how they justify their harvesting decisions to others, and (c) how they respond affectively to their fellow group members after overuse.

In this chapter, I will briefly summarize the most important findings of the experimental studies that were presented in the previous chapters. However, the main aim of this chapter is to put these findings in a broader perspective. For this purpose, I will elaborate on the general implications of these findings and I will give suggestions for future research.

Summary of the Main Findings

Chapter 2 and 3 investigated how environmental uncertainty affects tacit coordination. These chapters focused on the influences of the equal division rule and social value orientations under resource size uncertainty (Chapter 2) and under group size uncertainty (Chapter 3). The findings showed that under environmental certainty proselfs as well as prosocials tacitly coordinated their decisions by adhering to the equal division rule, whereas under environmental uncertainty (i.e., resource size uncertainty or group size uncertainty) proselfs harvested more from the common resource than prosocials.

In Chapter 4, two experimental studies were conducted to investigate how people justify their harvesting decisions under resource size (un)certainty. These studies showed that under certainty participants indicated that harvests adhering to the equal division rule were easiest to justify and they adhered to this rule when they had to justify their harvesting decisions to their fellow group members. By contrast, under uncertainty participants indicated that relatively low harvests were easiest to justify and they restricted their harvests when they had to justify their decisions to their fellow group members.

In Chapter 5, three experimental studies were conducted to investigate how people react affectively after overuse under resource size (un)certainty. These studies demonstrated that under certainty participants' affective and retributive reactions after overuse were more negative than under uncertainty. Furthermore, the findings showed that this can be explained by the fact that under certainty participants attribute overuse more to the harvesting behavior of their fellow group members than under uncertainty.

General Implications

A central theme of the present dissertation is that the equal division rule is an important division rule in social dilemmas. But why is this rule so important? According to Messick (1993), the equal division rule has three characteristics that make it highly useful and appealing. First, the rule is easy to implement and requires little cognitive effort. Second, the rule promotes group efficiency because it generates clear decisions which often lead to successful coordination. And third, decisions that conform to this rule can be easily justified because they are in accordance with a general norm of fairness. Because of these appealing characteristics it is not surprising that people often base their harvesting decisions on the equal division rule (e.g., Allison, McQueen, & Schaerfl, 1992; Allison & Messick, 1990; Rutte, Wilke, & Messick, 1987; Van Dijk & Wilke, 1993, 1995; Van Dijk, Wilke, Wilke, & Metman, 1999).

However, in the present dissertation I also argued that there are limits to the applicability of the equal division rule. In other words, the rule cannot always be so easily applied (for articles on the limits on applying the equal division rule, see Allison et al., 1992; Allison & Messick, 1990). After all, in order to calculate an equal share people need specific and accurate information about the task environment of the social dilemma. More specifically, in a common resource dilemma group members need to know exactly how large the common resource is and how many people have access to the common resource. In many real-life social dilemmas, such environmental characteristics are uncertain and therefore the application of the equal division rule is hampered. Based on this line of reasoning, I argued that under such environmental uncertainty the three useful characteristics of the equal division cannot be employed. The present dissertation focused on the various consequences of this notion.

Environmental Uncertainty and Tacit Coordination

The first theme this dissertation focused on was tacit coordination. What are the consequences of environmental uncertainty for efficient coordination? Can people still tacitly coordinate their harvesting decisions under environmental uncertainty? To answer these questions it was useful to first take a closer look at the concept of tacit coordination. This concept was developed by the famous economist and Nobel prize winner Thomas Schelling (1960). Schelling argued that even in the absence of communication people can often efficiently coordinate their decisions. To illustrate this, he gave an example of two people who want to meet each other in New York City without having a prior understanding on where and when to meet. Where would one go and at what time? Schelling asked participants this question and found that the majority of the people answered that they would go to Central Station at 12.00 noon. If people would indeed act accordingly this would mean that tacit coordination would be highly efficient.

Van Dijk and colleagues (e.g., Van Dijk, De Cremer, & De Kwaadsteniet, in preparation; Van Dijk & Wilke, 1995, 1996; Van Dijk et al., 1999) applied this concept of tacit coordination to social dilemmas. They argued that in social dilemmas people can efficiently coordinate their choice behavior by anchoring their decisions on so-called coordination rules. To use these coordination rules people use specific cues from the task environment of the social dilemma (Van Dijk et al., 1999). When people use the same cues to base their decisions on, they can efficiently coordinate their choice behavior. According to Schelling, such a common understanding is crucial for tacit coordination. For tacit coordination to work, it is essential that people "read the same message in the common situation, to identify the one course of action" (Schelling, 1960, p. 54). In the present dissertation, I argued that it is exactly this common understanding that is missing under environmental uncertainty. Since under such uncertainty people cannot so easily apply the equal division rule – and they might even have different ideas about what constitutes an equal share (see Chapter 4) – there is no common understanding of how much to harvest. As a consequence, tacit coordination is hampered under environmental uncertainty.

Based on the above, I concluded that under environmental uncertainty people cannot (so easily) base their harvesting behavior on coordination rules such as the equal division rule. But what do people base their decisions on under such uncertainty? To answer this question, I connected Schelling's concept of tacit coordination to Snyder and Ickes' (1985) framework of weak vs. strong situations. Based on this framework, situations that provide salient cues for tacit coordination – such as social dilemmas with environmental certainty – can be defined as "strong" situations. By contrast, situations that do not provide such salient cues – such as social dilemmas with environmental uncertainty – can be defined as "weak" situations. In strong situations, people can tacitly coordinate their choice behavior by anchoring their decisions on these salient environmental cues. By contrast, in weak situations Snyder and Ickes argued that people base their decisions on relevant dispositional factors instead of cues from the environment. By applying this framework to the topic of environmental uncertainty, the present studies demonstrated that whereas under environmental certainty people can tacitly coordinate their choice behavior by applying the equal division rule, under uncertainty they base their decisions on their own social value orientations, inducing proselfs to harvest more than prosocials. These findings clearly show that Snyder and Ickes' framework can be fruitfully used to explain and predict choice behavior in social dilemmas (cf. Roch & Samuelson, 1997; Van Lange, 1997) and perhaps also in other settings in which tacit coordination is hampered, such as pure coordination games with ambiguous focal points (see e.g., Mehta, Starmer, & Sugden, 1994). Moreover, these findings show that both tacit coordination and personality differences have their boundaries, and that the weak-strong framework helps to determine which one of these two factors has the strongest influence on people's choice behavior in social dilemmas.

Is Uncertainty Always Detrimental?

The bulk of earlier studies on environmental uncertainty in social dilemmas (e.g., Budescu et al., 1990, 1995; Gustafsson et al., 1999a, 1999b; Rapoport et al., 1992) suggest that environmental uncertainty is detrimental to the collective interest. More specifically, these studies repeatedly demonstrated that resource size uncertainty induces people to harvest excessively from the common resource. Based on these findings, social dilemma researchers drew the conclusion that environmental uncertainty leads to non-cooperation, which in turn jeopardizes the collective interest by increasing the chance of the common resource becoming depleted. Although this over-harvesting effect was replicated in the present dissertation (see Studies 2.1 and 4.2), the research in this dissertation also showed that environmental uncertainty does not always lead to non-cooperation. Based on this finding, I argued that environmental uncertainty does not only have detrimental effects, but that uncertainty might sometimes even be beneficial to the collective interest. In the following, I will elaborate on the detrimental and beneficial effects of environmental uncertainty.

Chapter 2 focused on how resource size uncertainty interacted with social value orientations. This topic was investigated by using the same experimental common resource dilemma as the one used by Budescu, Rapoport, Suleiman and colleagues (e.g., Budescu et al., 1990, 1995; Rapoport et al., 1992; Suleiman et al., 1996) and Gustafsson, Biel and Gärling (1999a, 1999b). Resource size uncertainty was manipulated in the same way as in these earlier studies, namely by varying the range of the size of the common resource. As expected, the over-harvesting effect that was found in these earlier studies was replicated, indicating that resource size uncertainty is indeed detrimental to the collective interest. However, what the present dissertation adds to these earlier studies is the finding that not all people over-harvest under environmental uncertainty. More specifically, Chapter 2 showed that only proselfs increased their individual harvests under resource size uncertainty, whereas prosocials' harvests remained unaffected by such uncertainty. These findings indicate that the over-harvesting effect that was repeatedly found in earlier research was probably caused by proselfs' non-cooperative choice behavior. Based on these findings, it can be concluded that resource size uncertainty may only be detrimental to the collective interest when (at least some of) the people involved in the social dilemma have a proself orientation.

Chapter 3 focused on another type of environmental uncertainty than resource size uncertainty, namely, group size uncertainty. This type of uncertainty has – until now – only been investigated in one earlier experimental study (Au & Ngai, 2003). Au and Ngai manipulated group size uncertainty in a single-trial common resource dilemma. Interestingly, they found that group size uncertainty did *not* induce over-harvesting. More specifically, they found that group size uncertainty induced a decrease in the collective harvest, suggesting that not all types of environmental uncertainty are necessarily detrimental to the collective interest. However, it is important to note that Au and Ngai did not find an effect of group size uncertainty on participants' *individual* harvests. In Chapter 3, I conducted an experimental study in which participants' social value orientations were measured before they were faced with a social dilemma with group size (un)certainty. This study (Study 3.1) showed that under uncertainty participants mean *individual* harvests were lower than under certainty, indicating that group size uncertainty induces cooperation. Furthermore, this study demonstrated that prosocials responded more strongly to group size uncertainty than proselfs. Prosocials decreased their individual harvests under uncertainty, whereas proselfs' harvests remained unaffected by uncertainty. These findings suggest that not all different types of environmental uncertainty have the same detrimental effect on cooperation. Group size uncertainty even seems to be beneficial to the collective, especially when (most of) the group members have a prosocial orientation.

Chapter 4 focused on how people justify their harvesting decisions under resource size uncertainty. To do so, in Study 4.2, accountability was manipulated under varying levels of resource size uncertainty. This study showed that under uncertainty accountability induced participants to decrease their mean individual harvests. As a consequence, no over-harvesting effect was found in the uncertainty-accountability condition. This finding indicates that the detrimental effects of resource size uncertainty may disappear when group members are held accountable for their harvesting decisions. In other words, accountability may provide a solution for the detrimental effects of resource size uncertainty. The findings of Chapter 4 thus clearly show that resource size uncertainty does not necessarily lead to over-harvesting.

Although the above-mentioned findings suggest that environmental uncertainty is not always detrimental to collective interests, it should be noted that this conclusion was based on analyses of participants' *mean* harvests. However, as already argued in Chapters 3 and 4, in order to investigate how environmental uncertainty affects tacit coordination it is important to not only focus on the mean harvest level – which is the way most social dilemma researchers analyze participants' choice behavior – but to also look at the variance in participants' harvests. In all of the studies in this dissertation – including the ones that showed that uncertainty does not lead to non-cooperation (i.e., Studies 3.1 and 4.2) – environmental uncertainty increased the variance of people's harvesting decisions. This finding is important because variability constitutes a potential threat to successful coordination, especially in small group settings. In small groups, the presence of only a few over-harvesters may be enough to harm the collective interest by increasing the chance that the common resource becomes depleted. Small harvests, on the other hand, may harm the collective interest by increasing the chance that the common resource is underused. As a consequence, high variability in individual harvests hardly ever leads to optimal or efficient use of the common resource. This idea was supported by the Monte Carlo analysis that was conducted in Chapter 4. Moreover, this reasoning is also fully in line with Schelling's notion that a common understanding is necessary for successful coordination (Schelling, 1960), and that environmental uncertainty undermines such a common understanding (De Kwaadsteniet et al., 2006). Furthermore, this analysis clearly demonstrates that, in order to assess the influence of environmental uncertainty on tacit coordination, it is important to not only look at the means but also at the variance of people's choice behavior.

In the previous paragraphs, the effects of environmental uncertainty on people's harvesting decisions were discussed. However, the last empirical chapter of this dissertation (i.e., Chapter 5) did not focus on people's harvesting decisions, but primarily focused on how environmental uncertainty influenced people's affective and retributive reactions after overuse. In short, the findings of this chapter demonstrated that under uncertainty people reacted much more mildly to such overuse than under certainty. More specifically, under uncertainty people became less "angry" at their fellow group members – even when these group members had harvested relatively large amounts – and they were less inclined to punish these fellow group members after such overuse than under certainty. These findings show that under environmental uncertainty people respond less negatively to negative outcomes such as overuse, which again suggests that environmental uncertainty does not always and exclusively have negative effects. However, it should be noted that the fact that under uncertainty people react less negatively to their fellow group members may in turn be detrimental to the collective interest. After all, not punishing fellow group members for overuse – and the non-cooperative choice behavior that may have caused it – might have negative consequences in the future.

Taken together, by applying a new perspective to study the effects of environmental uncertainty, the present dissertation clearly shows that the effects of environmental uncertainty are indeed more differentiated than suggested in earlier research. By focusing on individual differences (social value orientations), different types of uncertainty (resource size uncertainty and group size uncertainty), accountability, and affective and retributive reactions after overuse, I was able to show repeatedly that environmental uncertainty is not necessarily detrimental to collective interests.

Limitations and Suggestions for Future Research

Although the research presented in this dissertation has generated a number of new insights on the topic of environmental uncertainty in social dilemmas, there are still themes that are related to this topic that were not addressed. Therefore, I will now elaborate on the limitations of the present dissertation and I will give some suggestions for future research on environmental uncertainty in social dilemmas. First, I will discuss how the effects of environmental uncertainty – such as the effects observed in the present dissertation – can be investigated by focusing on other types of social dilemmas and other types of environmental uncertainty. Second, I will present some ideas about where the research on environmental uncertainty in social dilemmas might be heading in the future.

The present dissertation has primarily focused on the effects of environmental uncertainty in *common resource dilemmas*. Although it is very important that this type of social dilemma is studied and understood (see Ostrom, 1990; Ostrom, Gardner, & Walker, 1995), there is another type of social dilemma, namely the public good dilemma, which has received little attention in the present dissertation. Public good dilemmas are social dilemmas in which a group of people can contribute endowments to realize a public good. Several earlier studies have shown that people often behave quite differently in these different types of social dilemmas (e.g., Brewer & Kramer, 1986; Parks, 1994; Van Dijk & Wilke, 1995), and therefore it is important to investigate whether the findings that were obtained in the present dissertation also generalize to public good dilemmas. For instance, does the weak-strong framework (Snyder & Ickes, 1985) also apply to provision point uncertainty in step-level public good dilemmas? And what happens to tacit coordination under uncertainty in public good dilemmas?

There are a number of earlier studies on environmental uncertainty in public good dilemmas (e.g., Au, 2000; Gustafsson, Biel, & Gärling, 2000; Suleiman, Budescu, & Rapoport, 2001; Wit & Wilke, 1998). Interestingly, most of the effects observed in these studies were quite different from the effects obtained in studies on common resource dilemmas. For instance, none of the experimental studies on public good dilemmas showed that environmental uncertainty induces non-cooperation. To give just one example, a study by Suleiman and colleagues (2001), in which provision point uncertainty was manipulated, showed that the effect of this type of environmental uncertainty on cooperation depended on the mean provision threshold level. In case of a high provision threshold (relatively hard to reach) provision point uncertainty induced a decrease in contributions, whereas in case of a low provision threshold (relatively easy to reach) participants became more cooperative under uncertainty. Although this is only one example, these findings clearly illustrate that environmental uncertainty seems to have quite different effects in public good dilemmas versus common resource dilemmas. Moreover, the findings on environmental uncertainty in public good dilemmas that were observed in these earlier studies do not provide a consistent picture, and it remains unclear how these effects differ from the ones found in studies on common resource dilemmas. Thus, more research is needed to address the issue of how environmental uncertainty affects choice behavior in different types of social dilemmas.

The present dissertation focused on two distinct types of environmental uncertainty, namely, resource size uncertainty and group size uncertainty. Although the weak-strong framework can be applied to both types of uncertainty, the present studies also showed that these two types of uncertainty have very different behavioral effects. Whereas resource size uncertainty led to higher harvests, group size uncertainty induced lower harvests. These contradictory findings suggest how fruitful it is to investigate different types of environmental uncertainty. However, until now only very few types of environmental uncertainty have been investigated. Experimental research has only focused on resource size uncertainty, group size uncertainty and provision point uncertainty. Further, Van Lange and colleagues (e.g., Brucks & Van Lange, 2007; Tazelaar, Van Lange, & Ouwerkerk, 2004; Van Lange, Ouwerkerk, & Tazelaar, 2002) have investigated the influence of *noise* in social dilemmas, which is a topic that is closely related to environmental uncertainty. Although these earlier studies have broadened our understanding of uncertainty in social dilemmas, Van Dijk et al. (2004) have suggested that there are many other types of environmental uncertainty that can also be investigated, such as uncertainty about the size of the public good, uncertainty about group members' access to the common resource, and asymmetric uncertainty about the size of the common resource (e.g., when some members know how large the common resource is, whereas others do not). The effects of these unexplored types of uncertainty may be quite different from the effects found in earlier studies. For instance, in case of uncertainty about the size of the public good, optimism may lead to overestimation of the size of the public good, which may in turn increase people's willingness to contribute (i.e., uncertainty may induce cooperation). This reasoning suggests that overestimation of an uncertain public good may stimulate cooperation, whereas the present dissertation as well as earlier research has shown that overestimation of an uncertain common resource stimulates non-cooperation (see Chapter 2). Since these uninvestigated types of uncertainty often lead to such new and interesting predictions, they constitute interesting challenges for future research on environmental uncertainty in social dilemmas.

Earlier research on environmental uncertainty has mainly focused on how uncertainty influenced people's harvesting decisions and their estimates of the size of the uncertain common resource. In the present dissertation, however, I argued that groups are characterized by more than just harvests and estimates. Groups may be characterized by a broad spectrum of interpersonal processes. Therefore, the present dissertation focused on how environmental uncertainty influences interpersonal processes in social dilemmas. For instance, Chapter 5 focused on how such uncertainty influenced the way in which people responded to their fellow group members after overuse. Specifically, this chapter investigated people's negative affective reactions towards fellow group members. This chapter showed that such reactions are contingent upon the environmental characteristics of the social dilemma, i.e., under certainty these affective reactions were more negative than under uncertainty. In the social dilemma literature, research on emotions has been quite scarce. However, it is important to investigate the role of emotions in social dilemmas. After all, emotions can have a substantial impact on people's judgments and decisions (e.g., Loewenstein & Lerner, 2002). For instance, when people become angry at their fellow group members, they are more inclined to punish these group members for their non-cooperative behavior (Stouten et al., 2005, 2006). Moreover, the present dissertation showed that research on emotions can be fruitful, for it can broaden our understanding of social dilemmas. Therefore, it is important for social dilemma researchers to not only focus on the conventional dependent variables, such as people's individual harvests or contributions, but also on more unconventional topics, such as the role of emotions in social dilemmas.

The present dissertation aimed to generate more insights into the effects of environmental uncertainty on interpersonal processes in social dilemmas. Although for this purpose it was sufficient to study how uncertainty works in single-trial dilemmas, to investigate the dynamics of such interpersonal processes it may also be useful to investigate what happens *after* the first trial. After all, most groups do not cease to exist after one single encounter. Very few experimental studies have been done to investigate how environmental uncertainty affects choice behavior in multiple-trial settings (for exceptions, see Hine & Gifford, 1996; Roch & Samuelson, 1997). Roch and Samuelson (1997) showed that also in a replenishable resource dilemma an interaction of environmental uncertainty and social value orientations on harvests can be found (cf. De Kwaadsteniet et al., 2006), which implies that Snyder and Ickes' weak-strong framework can also be fruitfully applied to multiple-trial social dilemmas. However, research should not only focus on how environmental uncertainty affects harvesting decisions in multiple-trial social dilemmas, but also on how repeated interactions between group members influence the interpersonal processes that were studied in the present dissertation.

In Chapter 5, a first attempt was made to study the dynamics of such processes by investigating people's affective and retributive reactions to their fellow group members *after* receiving feedback that the dilemma had resulted in overuse. By doing so, this chapter demonstrated that, *after* people have learned that the social dilemma has resulted in overuse, they respond more negatively to their fellow group members under resource size certainty than under resource size uncertainty. These findings imply that when overuse occurs under uncertainty people's responses to their fellow group members are relatively mild, which may in turn have positive consequences for the stability of the group. Moreover, this chapter clearly illustrates that people deal differently with the same negative collective outcome depending on whether or not the social dilemma is characterized by environmental uncertainty. An interesting next question would be whether these reactions extend to preferences for structural solutions in social dilemmas, such as the installment of sanctioning systems or the endorsement of leaders. Are people more willing to install a sanctioning system after overuse under certainty than under uncertainty? To obtain more insights into how people deal with environmental uncertainty in social dilemmas such questions should be addressed in future research.

It is my hope that future research will follow the lines set out in the present dissertation. As I argued in the previous paragraphs, there is still a lot of research to be done. First, future research could address the question as to whether earlier findings extent to other types of social dilemmas and other types of environmental uncertainty. Second, future research could focus more on the interpersonal effects of environmental uncertainty. In the present dissertation, I made a first attempt at addressing these issues. By doing so, I think this dissertation has indeed provided a more comprehensive view on the topic of environmental uncertainty in social dilemmas.

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Nederlandse samenvatting (Dutch summary)

Dit proefschrift gaat over (omgevings)onzekerheid in sociale dilemma's. Sociale dilemma's zijn situaties waarin persoonlijke belangen in strijd zijn met collectieve belangen. In dit soort situaties moet men dus kiezen tussen het eigenbelang (defectie) of het groepsbelang (coöperatie). Een voorbeeld van zo'n dilemma – en het dilemma waar dit proefschrift zich vooral op richt – is het *resource* dilemma. In dit type dilemma heeft een groep mensen een gezamenlijke bron tot haar beschikking. Alle individuele groepsleden kunnen onbeperkt consumeren uit de gezamenlijke bron, maar als ze met gezamenlijk te veel consumeren dan raakt deze bron uitgeput. In dat geval blijft er uiteindelijk voor niemand iets over. Een realistisch voorbeeld van een dergelijk dilemma is het probleem van overbevissing. Hoewel individuele vissers graag veel willen vissen om op die manier veel te verdienen, is dit vaak niet goed voor de het collectief. Overbevissing leidt er immers toe dat vispopulaties uitsterven, hetgeen uiteindelijk desastreus is voor alle vissers.

Uit onderzoek is gebleken dat mensen toch vaak goed met dit soort dilemma's om kunnen gaan. Zelfs wanneer ze niet met elkaar kunnen communiceren, kunnen ze hun keuzes efficiënt op elkaar afstemmen door stilzwijgende coördinatie-regels te volgen (Schelling, 1960). In sociale dilemma's gebruiken ze daarvoor bepaalde verdelingsregels, zoals de gelijke-verdelingsregel (zie b.v. Van Dijk, Wilke, Wilke, & Metman, 1999). Wanneer een groep van 5 mensen bijvoorbeeld de beschikking heeft over een gezamenlijke voorraad van 500 eenheden, dan zullen de meeste mensen een gelijk deel uit die voorraad nemen, namelijk 100 eenheden. Als alle groepsleden dit doen, dan wordt de gezamenlijke voorraad optimaal gebruikt. De voorraad wordt dan niet overschreden en wordt eerlijk over alle groepsleden verdeeld. Door de gelijke-verdelingsregel te gebruiken kunnen groepsleden hun keuzes dus efficiënt op elkaar afstemmen. Maar is dat afstemmen wel altijd zo eenvoudig? In het huidige proefschrift laat ik zien dat dit afhangt van omgevingsonzekerheid, oftewel, onzekerheid over de taakomgeving van een sociaal dilemma.

In de werkelijkheid is het vaak niet precies duidelijk hoe groot de gezamenlijke bron is. Ook weet men vaak niet hoe groot de groep is die toegang heeft tot die bron. Visexperts weten bijvoorbeeld niet hoeveel vis er gevangen kan worden zonder dat vispopulaties daaronder lijden. Bovendien zijn de vissers zelf het vaak niet eens met de visquota die hun door deze experts worden opgelegd. Bij dit soort onzekerheid – genaamd omgevingsonzekerheid – is het dus een stuk moeilijker om te bepalen wat een gelijk deel van de bron is. Wat is immers een gelijk deel van een onzekere bron? Bij omgevingsonzekerheid kunnen groepsleden de gelijke-verdelingsregel dus niet meer gebruiken om hun keuzes op elkaar af te stemmen. Hoe gaan groepsleden met dit soort onzekerheid om? Deze vraag heb ik in het huidige proefschrift geprobeerd te beantwoorden.

In hoofdstuk 2 en 3 heb ik me gericht op stilzwijgende coördinatie in sociale dilemma's (zie ook Schelling, 1960). Hoe coördineren mensen hun keuzes als er omgevingsonzekerheid is en als ze bovendien niet met elkaar kunnen communiceren? Zoals ik hierboven al schreef, is het in dat geval erg moeilijk om te coördineren met door de gelijke-verdelingsregel toe te passen. Maar waar baseren mensen hun keuzes dan wel op? Ik vond een antwoord op deze vraag in een theorie van Snyder en Ickes (1985). Snyder en Ickes stelden dat er twee soorten situaties zijn: sterke situaties en zwakke situaties. Sterke situaties zijn situaties waarin iedereen precies weet wat hij/zij moet doen, omdat deze situaties duidelijke *cues* geven voor welke keuze mensen het beste kunnen maken. In dat geval vertonen mensen vaak identiek gedrag dat gedicteerd wordt door de situatie. Zwakke situaties geven daarentegen geen duidelijke cues voor gedrag en in dat geval gaat de persoonlijkheid van mensen een grotere rol spelen. Mensen bepalen dan hun keuzes aan de hand van hun eigen persoonlijke voorkeuren. Ze gebruiken dan dus geen externe cues om hun keuzes te bepalen, maar interne cues.

Toegepast op omgevingsonzekerheid in sociale dilemma's, is een sociaal dilemma met zekerheid te kenmerken als een sterke situatie, en een dilemma met onzekerheid als een zwakke situatie. Bij zekerheid weten de groepsleden immers precies wat ze moeten doen om hun keuzes te coördineren, en zullen de meeste mensen dan ook een gelijk deel uit de bron nemen. Bij onzekerheid is dit echter een stuk minder duidelijk en in dat geval kunnen we dus verwachten dat mensen meer afgaan op hun eigen persoonlijke voorkeuren voor coöperatie dan wel defectie. Een veel gebruikte maat om deze voorkeuren te meten is de *Decomposed Games Measure*. Deze maat meet de zogenaamde sociale-waarde-oriëntaties van mensen, oftewel hun dispositionele voorkeuren voor coöperatie of defectie (zie b.v. Van Lange, 1999). Wanneer iemand een voorkeur heeft voor coöperatie dan wordt hij/zij prosocial genoemd, en wanneer iemand een voorkeur heeft voor defectie dan noemt men hem/haar proself.

Op basis van het bovenstaande is dus te verwachten dat de meeste mensen (dus zowel prosocials als proselfs) bij zekerheid een gelijk deel zullen nemen, en dat ze bij onzekerheid hun keuzes zullen baseren op hun eigen sociale-waarde-oriëntaties. Bij onzekerheid zullen prosocials dus minder voor zichzelf nemen dan proselfs. In hoofdstuk 2 en 3 is deze gedachtegang getoetst aan de hand van twee soorten omgevingsonzekerheid, namelijk brongrootte-onzekerheid (hoofdstuk 2) en groepsgrootte-onzekerheid (hoofdstuk 3). Zoals verwacht bleek in beide hoofdstukken dat zowel prosocials als proselfs bij zekerheid een gelijk deel uit de bron namen, terwijl prosocials bij onzekerheid minder uit de bron namen dan proselfs.

In hoofdstuk 4 is onderzocht hoe mensen hun keuzes aan elkaar verantwoorden bij omgevingsonzekerheid. Uit eerder onderzoek (zie b.v. Kerr, 1999) is gebleken dat mensen de gelijke-verdelingsregel ook vaak gebruiken om hun gedrag te verantwoorden. Deze regel is immers niet alleen efficiënt maar ook nog eens eerlijk (zie Messick, 1993). Bij zekerheid is het dus weer vrij duidelijk wat men moet doen: groepsleden kunnen hun gedrag verantwoorden met behulp van de gelijke-verdelingsregel en zullen dan ook vooral geneigd zijn deze regel te gebruiken als de druk om hun keuzes te verantwoorden hoog is (i.e., onder *accountability*). Maar hoe verantwoorden ze hun gedrag dan bij onzekerheid? In dit hoofdstuk werd gesteld dat groepsleden hun keuzes dan konden verantwoorden door coöperatieve keuzes te maken, hetgeen bij onzekerheid inhoudt dat mensen hun keuzes beperken. Minder nemen is beter te verantwoorden dan meer nemen, omdat dit overeenkomt met een algemeen geldende norm van coöperatie (zie Kerr, 1995). In dit hoofdstuk werd deze gedachtegang getoetst door middel van twee experimentele studies. De resultaten van deze studies ondersteunen de bovenstaande redenering.

In hoofdstuk 5 werd onderzocht hoe groepsleden op elkaar zouden reageren als ze merkten dat het mis was gegaan bij omgevingsonzekerheid. Zouden ze boos op elkaar worden en elkaar de schuld geven als ze merkten dat de gezamenlijke bron overschreden was? Verwacht werd dat dit vooral het geval zou zijn bij zekerheid over de grootte van de bron. In dat geval weten de groepsleden immers zeker dat het mis is gegaan omdat minstens 1 van de groepsleden meer heeft genomen dan een gelijk deel. Ze zullen hun mede-groepsleden dus de schuld geven van het overschrijden van de bron en zullen daarom ook erg boos op hen worden. Bij brongrootte-onzekerheid is het echter veel onduidelijker waaraan het overschrijden te wijten is. Bovendien kunnen mensen in dit geval ook niet bepalen of groepsleden de gelijke-verdelingsregel hebben overschreden omdat het onduidelijkheid bestaat over de grootte van een gelijk deel. Verwacht werd dus dat mensen bij onzekerheid minder boos zouden worden op hun mede-groepsleden en hun minder de schuld zouden geven wanneer ze hoorden dat de bron was overschreden. Bovendien werd verwacht dat mensen bij onzekerheid hun groepsleden minder voor een dergelijke uitkomst zouden straffen dan bij zekerheid. De resultaten van 3 experimentele studies ondersteunen deze gedachtegang.

In hoofdstuk 6 worden de belangrijkste bevindingen van dit proefschrift besproken. De algemene implicaties van deze bevindingen worden behandeld en er worden suggesties gedaan voor toekomstig onderzoek.

Dankwoord (Acknowledgments)

Graag zou ik de volgende mensen heel erg willen bedanken voor hun steun tijdens het schrijven van dit proefschrift. Mijn moeder voor haar goede advies en zorg. Mijn collega's van de sectie S&O, en dan in het bijzonder Sezgin, Dancker, Belle, Krispijn, Christine, Floor, Colette, Sonja, Eveline, Elianne, Astrid, Tomas en Katherine, voor de fijne en vooral menselijke werkomgeving. Peter de Heus, Marcello Gallucci en Mark de Rooij voor hun deskundige hulp en advies bij statistische analyses. Mijn paranimfen, Marijke en Frank; Marijke voor alle steun, vriendschap en advies op de werkvloer en Frank voor de goede vriendschap daarbuiten. Mirjam voor de cartoons. En als laatste (maar zeker niet als minste natuurlijk) Saskia, voor de layout van dit proefschrift, maar vooral ook voor een mooi jaar (en alvast voor de vele mooie jaren die nog zullen volgen).

Curriculum Vitae

Erik Willem de Kwaadsteniet was born on December 31st 1977 in Groningen, the Netherlands. He grew up in Maastricht, where he finished his secondary education at the Jeanne d'Arc Lyceum in 1997. After that, he started studying psychology at Utrecht University, during which he became more and more interested in social psychology. Because of this interest he decided to write his Master thesis under the supervision of Hein Lodewijkx, which focused on the perception on so-called senseless violence. The research he did for this thesis – which he partly conducted at the University of Ljubljana in Slovenia – led to a publication in the Journal of Applied Social Psychology [Lodewijkx, H. F. M., De Kwaadsteniet, E. W., & Nijstad, B. A. (2005). That could be me (or not): Senseless violence and the role of deservingness, victim ethnicity, person identification, and position identification, *Journal of Applied Social Psychology, 35*, 1361-1383]. Moreover, the pleasant and fruitful collaboration with Hein Lodewijkx sparked his interest in social psychology even more. Therefore, after receiving his Master's degree in Social Psychology in 2002, he decided to pursue a career in science. In December 2002, he started his PhD project under the supervision of Eric van Dijk, Arjaan Wit and David De Cremer. This project – which focused on the influence of environmental uncertainty in social dilemmas – resulted in the present dissertation. Erik now works as an Assistant Professor at Leiden University.

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