Uncertainty in social dilemmas

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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, $F(1, 108) = 7.39$, $p < .01$, η2 = .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.