Test of an Egoism-Bias Explanation of
Noncooperation in Social Dilemmas with Resource
Uncertainty

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Gustafsson, M, Biel, A & Gärling, G. Optimism and overharvesting in resource dilemmas. Göteborg Psychological Reports, 1998, 28, No. 1. Uncertainty about the size of a resource has been found to lead to overharvesting in a common-pool resource (CPR) dilemma where participants can request as much as they want from the resource. It is suggested that this finding reflects an individual outcome-desirability bias rather than misperceptions of resource size or egoism. In Experiment 1 we investigated whether participants in a CPR dilemma request more or less from an uncertain resource when they are informed about other group members’ pessimistically biased estimates of its size. In Experiment 2 we similarly investigated whether participants in a public-good (PG) dilemma contribute more or less when they are informed about others’ pessimistically biased estimates of the uncertain provision threshold. Refuting an egoism bias, participants in both experiments cooperated more when they were informed about others’ estimates. Since the results of Experiments 1 and 2 were replicated in Experiment 3 when the outcome did not depend on others’ requests or contributions, it is concluded that information about others’ pessimistically biased estimates reduce the outcome-desirability bias. It was also shown that the bias disappeared when the information about others’ estimates were presented before rather than after the information about the resource size or provision threshold.

Keywords: Social dilemmas, uncertainty, decision making.

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In deciding how to allocate scarce common resources, members of
groups sometimes face the choice of maximizing the outcome for the group
or maximizing the outcomes for themselves. However, if they do the latter,
it will lead to a worse outcome for all. As has been pointed out (Hardin,
1968; Ostrom, 1990; Ostrom, Gardner, & Walker, 1994), many resource
management problems in the society have these characteristics. Dawes
(1980) coined the broader term social dilemma for which he proposed two
defining properties: (1) The payoff to each individual acting in his or her
own interest (called defecting) is higher than the payoff for acting in the
interest of the group (called cooperating) regardless of what other group
members do, but (2) all individuals receive a lower payoff if all defect than
if all cooperate. When an explicit time dimension is evoked, the terms
social trap and social fence have been used (Platt, 1973; Messick &
Brewer, 1983).

In common-pool resource (CPR) or take dilemmas (Gardner et al.,
1990) which are a subcategory of social dilemmas, the issue is whether or
not people will take from a resource to which they have free access despite
that it will be depleted. In public-good (PG) or give dilemmas, another
subcategory, people act as part of a group faced with the choice to give or
not give to a common resource. If a sufficient amount is contributed, all
will benefit from the resource regardless of their contribution. Exactly as
in the prisoner’s dilemma game (Komorita, 1976; Komorita & Parks, 1995;
Luce & Raiffa, 1957), the payoff matrix as well as uncertainty about what
others will do or social uncertainty are important factors affecting
cooperation. However, there are several other factors which also are
important (Biel & Gärling, 1995; Van Lange, Liebrand, Messick, & Wilke,
1992; Schroeder, Sibicky, & Irwin, 1995).

Cooperation in CPR and PG dilemmas has been subject to extensive
research (see, e.g., Komorita & Parks, 1995; Messick & Brewer, 1983; Van
Lange et al, 1992, for reviews). For instance, effects have been
investigated of payoff structure (e.g., Komorita & Barth, 1985; McCusker
& Carnevale, 1995), actor characteristics such as group size,
communication, and group identity (e.g., Brewer & Kramer, 1986), and
social and personal norms such as fairness (e.g., Biel, Eek, & Gärling,
1997; Wilke, 1991), reciprocity (e.g., Axelrod, 1984, Dawes, McTavish,
& Shacklee, 1977), and commitment (e.g., Kerr & Kaufman-Gilliland, 1994;
Orbell, Van de Kragt, & Dawes, 1988). In these studies the size of the
resource has been common knowledge among participants. However, such
is not the case in many real-life social dilemmas. For example,
groundwater levels cannot be estimated precisely, exact knowledge is
lacking about the size of fish populations, and it is not known with
certainty how much tax citizens must pay to sustain the welfare of a
society. As argued by Biel and Gärling (1995) and Liebrand, Messick, and Wilke (1992), resource or environmental uncertainty should be an important additional factor to study.

Effects of resource uncertainty on cooperation in social dilemmas was first investigated by Budescu, Rapoport, and Suleiman (e.g., Budescu, Rapoport, & Suleiman, 1990; Rapoport, Budescu, Suleiman, & Weg, 1992; Suleiman, & Rapoport, 1988). In these studies Budescu et al. used a repeated one-shot CPR dilemma in which members of a group could request an amount from a resource (a sum of money) which they would receive unless the total request of the group exceeded its size in which case no one would receive anything. Participants knew that the size of the resource on each trial was a uniformly distributed random variable. Information about resource size was presented as an interval from the smallest to the largest possible value. Uncertainty was manipulated by changing the size of the interval.

Budescu et al. (1990) investigated both the effects of resource uncertainty and asymmetric payoffs (i.e., payoffs distributed unequally to participants). The main finding was that as resource uncertainty increased so did participants’ requests, thus resulting in overharvesting (i.e., total requests exceeding the mean of the distribution). In one of several subsequent replications of this overharvesting effect, Rapoport et al. (1992) also found that the effect is independent of social uncertainty. On some trials participants were asked to estimate the size of the resource. Indicating that participants in the five-person groups adhered to an equal-share fairness norm (see also Messick & Schell, 1992), a majority requested approximately one fifth of their estimates of the resource size.

Gustafsson, Biel, and Gärling (1997a) noted a possible problem with defining resource uncertainty as an interval since it directs participants’ attention to the lower and upper bounds. Emphasizing the random nature of the resource, they instead presented different numbers representing resource size in a sequence. Uncertainty was defined as the variance of the numbers. However, also under these conditions overharvesting increased with resource uncertainty.

Why does overharvesting due to resource uncertainty occur? As one possible explanation Rapoport et al. (1992) suggested that participants perceive a positive relationship between measures of central tendency and variability. Under increasing resource uncertainty, this would thus lead participants to overestimate the size (expected value) of the resource and therefore to request too much. Such a perceptual explanation is in line with the big-pool illusion (Messick and McClelland, 1983) that a resource of uncertain size is perceived as larger than a resource of known size.
Rapoport et al. (1992) also offered another possible explanation. This explanation rests on the assumption that participants weigh the upper and lower bounds of resource size in order to make an estimate. It is further suggested that participants overweigh the upper bound of the interval resulting in an upward shift of their estimates, and thus they request too much. In contrast to the first explanation, motivational reasons are highlighted such as, for instance, that participants are optimistic or risk taking. The assumption is therefore consistent with research demonstrating a bias to judge desirable outcomes to be more likely (Buckley & Sniezek, 1992; Budescu & Bruderman, 1995; Fischer & Budescu, 1995; Olsen, 1997; Weinstein, 1980; Zakay, 1983). Labels that have been used to refer to essentially the same phenomenon are outcome-desirability bias, optimism bias, and wishful thinking.

The explanations outlined do not take into account that in a CPR or PG dilemma individual outcomes depend on and are influenced by others’ choices. The constrained-egoism hypothesis proposed by Wilke (1991) states that although individuals are greedy and try to maximize their own outcomes, their greed is constrained by the motives to maintain the resource efficiently and to achieve fairness among group members. In line with this hypothesis, adhering to an equal-share fairness norm may feel less compelling when the size of the resource is uncertain. Participants may therefore want to request more than an equal share of the resource. At the same time they may however not believe that a sufficient number of others will request less than an equal share. Thus, the goal of efficient resource use is in conflict with egoism. Nevertheless, an egoism-bias may also result in misperceptions of resource size when the outcomes depend on others’ choices leading to unintentional overharvesting. If previous research findings demonstrating egoism biases in how payoffs are perceived (e.g., Kelley & Thibaut, 1978), generalize to an uncertain resource size, such might well be the case. Support for an egoism bias was found in a study conducted by De Vries and Wilke (1992). Under conditions of resource uncertainty, overharvesting was observed in a CPR dilemma but not in a coordination game where overharvesting resulted in a lower own payoff.

The three proposed explanations could in combination or by themselves explain overharvesting under resource uncertainty. If a perceptual bias is the explanation, the effect should emerge irrespective of whether outcomes are desirable or not. In contrast, if the overharvesting effect is only found under conditions where the resource represents value to participants, it would support an explanation in terms of egoism or optimism bias rather than a perceptual explanation. Support for an egoism-bias explanation is indicated if interdependence is a necessary
condition for it to occur. On the other hand, if the effect emerges only under conditions where no interdependence is present, an outcome-desirability bias is a more plausible explanation.

In a series of recent experiments (Gustafsson et al., 1997a; Gustafsson, Biel, & Gärling, 1997b), in an one-shot CPR dilemma different groups of participants either made perceptual estimates of resource size, requested from the resource when the outcome only depended on resource size, or requested from the resource when the outcome depended both on resource size and requests by others. Results showed that when uncertainty of the resource size increased, participants did not make less accurate perceptual estimates although as expected they were less confident. In contrast, Rapoport et al. (1992) found that participants overestimated the resource. However, in their study the same participants who requested from the resource also estimated its size. Therefore, the possibility cannot be ruled out that they tailored their estimates to fit their requests. In support of an outcome-desirability bias, Gustafsson et al. (1997a, 1997b) also found an overharvesting effect when the outcome only depended on resource size. However, there was no evidence for an egoism bias since overharvesting was not larger when the outcome depended on both resource size and others’ request. Suggesting that the overharvesting effect generalizes to other CPR dilemmas, in one of the experiments (Gustafsson et al., 1997a; Experiment 2) it was also observed in a step-level CPR dilemma, despite that participants did not overestimate the uncertain provision threshold (i.e., the number of requests that could be made without depleting the resource). Again, the results did not differ whether the outcome only depended on resource size or both on resource size and others’ requests.

Although most of our previous results (Gustafsson et al., 1997a, 1997b) suggest an outcome-desirability bias as the most likely explanation of overharvesting due to resource uncertainty, it should not be overlooked that De Vries and Wilke (1992) found evidence for an egoism-bias explanation. Also, the results of Wit and Wilke (1995) showing an overharvesting effect only when there is social uncertainty speak to the same point. Since Wit and Wilke employed a PG dilemma, the question may however be raised whether their results in such a dilemma differ from a CPR dilemma.

The aim of the present experiments was to investigate if an egoism bias is observed under conditions in which participants know that other group members underestimate an uncertain resource. Such knowledge may either be used to correct one’s own estimate or to exploit others. In contrast to a study by Messick et al. (1983) showing that participants became less cooperative when they experienced increased variance
(deviations from an equal share) of other group members’ estimates, knowing the other group members’ estimates presumably has a different effect. In this case actors may assume (although does not know) that others only request their fair share. Therefore, in contrast to when actors know that others violate the equal-share rule, they are not likely to feel free to do this themselves. Nevertheless, by ignoring others’ estimates, actors may feel justified to request more since they only claim a fair share of their estimates of the resource. Furthermore, even though this leads to that the actors obtain more than others, given that actors trust their estimates of resource size they will not believe that they deplete the resource but instead use it more efficiently. However, if all group members have equal knowledge, it is clearly a bias to place less or no weight on the average of the others’ estimates as compared to the weight placed on one own’s estimate.

In Experiment 1, in a CPR dilemma two groups of participants were informed about the other group members’ estimates of resource size before they themselves made requests. In a control group no information was given. Since the prediction of the egoism-bias explanation concerns the effect of information about others’ requests in all groups the outcome depended both on resource size and others’ request. For comparisons, additional groups of participants were also included to provide perceptual estimates as well as confidence ratings.

In Experiment 2 participants faced a PG dilemma. In addition to the primary aim of investigating the generality of the effect of information about others’ estimates across the two main types of dilemmas, a secondary aim was to replicate the finding reported in Wit and Wilke (1995) that in a PG dilemma participants contribute less when uncertainty about the provision threshold increases. This was in particular important to do since Wit and Wilke observed that the effect of uncertainty was only found when social uncertainty was induced. Furthermore, we also included an individual condition were outcomes only depended on provision threshold. The reason for this was to ascertain whether underestimation of the provision threshold was due to an egoism bias or an optimism bias, as found in our earlier research on CPR dilemmas (Gustafsson et al., 1997b). If the effect of resource uncertainty is due to an egoism bias, it should only emanate under conditions of interdependence. However, if the effect is observed when there is no interdependence, an explanation in terms of an optimism bias is more plausible.

Since the results of Experiments 1 and 2 in fact indicated that participants decreased their requests or increased their contributions when they knew about others’ estimates of resource size, the issue was
raised in Experiment 3 whether or not these results reflect a reduced outcome-desirability bias or a desire not to request more (contribute less) than the other group members. In both a CPR and PG dilemma, participants were informed about others’ estimates of the resource although the outcome of their requests or contributions were only dependent on resource size. Furthermore, in order to investigate whether the temporal sequence of information played any decisive role for the effect of resource uncertainty to emerge, the order of information was varied so that subjects received information about others’ estimates either before or after information about the resource size/provision threshold.

Experiment 1

The aim of Experiment was thus to investigate if an egoism bias is observed under conditions in which participants know that other group members underestimate an uncertain resource. If all group members have equal knowledge, an egoism bias would be indicated if they place less or no weight on the average of the others’ estimates as compared to the weight placed on one own’s estimate.

Two groups of participants in a CPR dilemma were informed about the other group members’ estimates of resource size before they themselves made requests. In a control group no information was given. In all groups the outcome depended both on resource size and others’ request. Also included were three other groups of participants who differed from the former groups in that participants made perceptual estimates and confidence ratings. Such estimates were solicited for three main reasons: First, they provide a baseline against which to compare requests to make possible to determine overharvesting effects; second, since participants are unconfident in their perceptual estimates, these may also be affected by information about others’ estimates thus potentially providing an alternative explanation of the differences in the request groups; third, the confidence ratings indicate if the manipulations of uncertainty and information had the intended effects.

Those groups who received information about others’ estimates of resource size differed in that in one group participants received information about the others’ average estimates and in the other group about each of the other group members’ estimates. It was believed that the latter would make participants’ more confident in their own estimates, thereby increasing the likelihood that they would ignore the others’ estimates.
Method

Participants

Forty-eight male and 48 female undergraduate students at Göteborg University volunteered to participate in return for the equivalent of approximately US$7. An equal number of men and women were randomly assigned to each of six groups.

Procedure

Participants served individually or in groups of from two to five. On arrival to the laboratory, they were seated in private booths. In each booth a PC controlled presentation of the material.

A participant first read the instructions on the PC screen. Participants assigned to the three request groups were informed that they were part of a group of five students who had never met before and who all could request from an available resource consisting of a sum of money which varied in size from one to another occasion. If the group requested more than was available, none would receive anything. Participants were furthermore told that on each trial they would have to infer the current size of the resource from 15 numbers symbolizing its size on prior occasions. Participants in two groups were also told that they would be given information about the other group members’ estimates of resource size. In one of these groups an average of the others’ estimates were presented, in the other group each of the others’ estimates were presented.

When participants had read the instructions, a sequence of 16 self-paced trials was started. On each trial participants were informed about the size of the resource. After that information about the others’ estimates was provided in two of the groups. The sequences of numbers representing resource sizes were randomly sampled from a uniform probability distribution, either with a small or a large variance corresponding to low and high resource uncertainty, respectively. Sixteen different sequences of numbers were sampled from uniform probability distributions and transformed so that the average size was always 5,000 Swedish Crowns (approximately $700) with SDs of 625.2 and 1068.9 corresponding to low and high uncertainty, respectively. The average estimates of the other group members presented to the participants were
on average 1,000 (980, 990, 1,010, 1,020) less than the mean resource size. When individual estimates were presented, the averages were the same but one of the estimates was larger and three were smaller than the mean resource size, for instance, 780 larger and 2780, 1620 and 380 smaller than the mean resource size.

In one block consisting of half of the trials the numbers representing prior resource sizes were simultaneously presented in a column, in another block consisting of the remaining half of the trials the same numbers as in the simultaneous presentation were presented one at a time on the screen at a self-paced rate. The order between blocks was counterbalanced across participants. Four random orders of different trials were used equally often.

In another three groups participants were only told that they would be presented sequences of numbers and that their task on each trial was to guess or estimate which number would come next. They were also asked to rate their confidence in their estimates on a percentage scale. In one of the groups no information was given about others’ estimates, in the other two groups participants were told that four other participants taking part in the experiment before them had made the same kind of estimates as they were asked to make. In one of these groups the average estimates of these other participants were presented after the information about the resource, in the other group each previous participants’ estimates were presented.

No feedback was at any time given about the actual resource size or the requests by other group members. A session lasted for about 30 minutes. All participants in the request groups were told that at the end of the experiment a trial would be randomly selected and the size of the resource determined. If the group had not requested more than the available resource on that trial, each member would receive a bonus proportional to his or her request. The maximum bonus promised to participants was the equivalent of US$28. Subjects who made estimates of resource size were not promised any bonus depending on their performance. After having completed the experiment, participants were debriefed and paid. Those participants who had been promised a bonus were all paid an additional equivalent of US$7.

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1 Only the results for the sequential presentation are reported. In the condition with simultaneous presentation the results were similar although as found previously (Gustafsson et al., 1997a), the effects were weaker. Furthermore, the results did not differ depending on the order between the sequential and simultaneous presentations.
Results

The mean confidence ratings given in Table 1 show that participants in all three groups were less confident when resource uncertainty was high than when it was low. Furthermore, they were more confident when informed about others’ estimates. A 3 (information: no vs. average-estimate vs. individual-estimate) by 2 (resource uncertainty: low vs. high) mixed analysis of variance (ANOVA) with repeated measures on the last factor yielded a significant main effect of resource uncertainty, $F(1, 45) = 23.76, p < .001, MS_e = 228.2$, and a marginally significant effect of information, $F(2, 45) = 2.16, p < .10, MS_e = 9088.3$. Bonferroni corrected separate $t$ tests showed at $p = .05$ that participants in the average-estimate and individual-estimate groups were reliably more confident than participants in the group with no information. Although not substantiated by a significant interaction effect, $F(2, 45) = 1.19, p > .25, MS_e = 228.2$, participants in the average-estimate group were more confident than participants in the other groups when resource uncertainty was high. In this group there was only a weak effect of resource uncertainty.

<table>
<thead>
<tr>
<th>Resource uncertainty</th>
<th>Low</th>
<th>High</th>
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<tbody>
<tr>
<td>No information</td>
<td>25.2</td>
<td>18.2</td>
</tr>
<tr>
<td>Average-estimate information</td>
<td>40.9</td>
<td>36.1</td>
</tr>
<tr>
<td>Individual-estimate information</td>
<td>36.3</td>
<td>25.7</td>
</tr>
</tbody>
</table>

Table 2 displays participants’ mean estimates and requests. As expected, mean requests are larger when resource uncertainty was high than when it was low. No such effect is obtained on the estimates. It may also be seen that information has an effect on the requests although not
on the estimates. However, this effect is opposed to the prediction from the egoism-bias explanation. On average participants request less when they were informed that the other group members had estimated the resource as smaller. These observations were substantiated by a 2 (outcome dependence: estimates vs. requests) by 3 (information about others’ estimates: no vs. average-estimate vs. individual-estimate) by 2 (resource uncertainty: low vs. high) mixed ANOVA with repeated measures on the last factor showing a significant effect of resource uncertainty, $F(1, 90) = 63.83$, $p<.001$, $MS_e= 16011.2$, and a significant interaction between resource uncertainty and outcome dependence, $F(2, 90) = 68.86$, $p<.001$, $MS_e= 16011.2$. Bonferroni corrected separate $t$ tests at $p=.05$ indicated that the mean difference between low and high uncertainty was only reliable in the request conditions. Information also somewhat reduced the effect of resource uncertainty on the requests as indicated by a significant interaction between resource uncertainty, outcome dependency, and information, $F(2, 90) = 5.50$, $p<.05$, $MS_e= 16011.2$. Bonferroni corrected separate $t$ tests showed at $p=.05$ that the differences between low and high uncertainty were reliable in all the request groups. However, on average participants in the information groups requested reliably less than participants in the no-information group under both low and high resource uncertainty.
Table 2
Mean Estimates and Requests by Groups of Subjects with Different Information about Others’ Estimates as Related to Resource Uncertainty

<table>
<thead>
<tr>
<th>Resource uncertainty</th>
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<tr>
<td>Estimates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No information</td>
<td>973.3</td>
<td>993.4</td>
</tr>
<tr>
<td>Average-estimate information</td>
<td>996.9</td>
<td>996.8</td>
</tr>
<tr>
<td>Individual-estimate information</td>
<td>958.6</td>
<td>956.9</td>
</tr>
<tr>
<td>Requests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No information</td>
<td>928.6</td>
<td>1138.1</td>
</tr>
<tr>
<td>Average-estimate information</td>
<td>791.2</td>
<td>937.8</td>
</tr>
<tr>
<td>Individual-estimate information</td>
<td>808.9</td>
<td>914.4</td>
</tr>
</tbody>
</table>

The means are divided by 5.

Discussion

The results replicated previous findings (e.g., Rapoport et al., 1992) in that overharvesting was observed under high resource uncertainty. Furthermore, the effect only emerged when participants requested from the resource, not when they performed perceptual estimates (Gustafsson et al., 1997a). When informed about others’ estimates, individual or average, participants requested less rather than the same amount or possibly more as was expected. Also, to some extent the effect of resource uncertainty was reduced. No effect of information was found on the perceptual estimates, although the confidence ratings confirmed that the increase of resource uncertainty made participants less confident and information made them more confident about resource size.

A possible explanation of the unexpected direction of the effect of information about others’ is that participants did not want to request more than the other group members even though they perhaps were convinced that they could do that without running the risk of losing their request. Participants might have felt that if so they would violate an equal-share rule. Another possibility is of course that they believed that the resource was smaller than they estimated. Against this may speak
that no influence was observed of others’ estimate on the estimates by participants in the estimate groups. On the other hand, it may be the case that it is crucial that something is at stake. In the request groups, participants might thus, because money was at stake, have become more cautious and reduced their requests accordingly.

Another question concerns why the effect of uncertainty still remained when subjects received information about the others’ estimates. A possibility is that participants initially anchored on their own biased estimates, then they adjusted their initial estimates downward to take into account the others’ estimates. In this adjustment participants may in both groups have been influenced by the average estimates, ignoring the explicit dispersion of the estimates in individual-estimate group. If the adjustments were insufficient as has frequently been found (e.g., Northcraft & Neale, 1987; Wright & Anderson, 1989), then the initial bias would remain.

Experiment 2

The question addressed in Experiment 2 is whether uncertainty about the amount of the required contribution (provision threshold) leads to less contribution in a step-level PG dilemma where participants are asked to contribute an amount to a resource. This is what Wit and Wilke (1995) found, although only when there was high social uncertainty. It is therefore possible that the effect they observed is due to an egoism bias. If so, the effect would be eliminated if the outcome only depend on the size of the provision threshold but not on others’ contributions. This was the case in one group of participants, whereas in another group the outcome depended both on the provision threshold and others’ contributions. If less contribution is only observed under high resource uncertainty when the outcome is dependent on both the provision threshold and others’ contributions, this would speak in favor of an egoism bias. However, if less contribution is observed regardless of whether or not the outcome depends on others’ contributions, this would instead suggest an optimism bias.

A second question asked was whether the results of Experiment 1 would generalize to a step-level PG dilemma, that is, would information about others’ estimates have the same effect in a step-level PG dilemma as it was found to have in a CPR dilemma? If participants are informed that others overestimate the uncertain provision threshold, would this
thus lead to more contribution? On the other hand, if an egoism bias is stronger in a PG dilemma, the effect may instead be observed that participants contribute less when they know that others underestimate the provision threshold relative to their own estimates. In a third group participants were presented information about other group members’ average estimates of the provision threshold. These estimates were pessimistically biased (i.e., higher than the mean provision threshold).

Method

Participants

Thirty-two male and 32 female undergraduate students at Göteborg University participated in return of the equivalent of US$7. An equal number of men and women were randomly assigned to each of three groups.

Procedure

Participants serving individually or in small groups were seated separately in private booths in the laboratory. In each booth a PC controlled presentation of the material. After having read the instructions on the PC screen, participants were presented 16 self-paced trials consisting of eight target trials and an equal number of similar, interspersed filler trials. On each target trial participants had to infer the provision threshold from a sequence of 15 numbers symbolizing previous sizes of the provision threshold. The numbers in the sequence were presented one by one. The target trials were made up of two number sequences which were each repeated four times. The two number sequences were sampled from uniform probability distributions with means of 5,000. Their variances were either large or small (SD = 1068.9 or 625.2) corresponding to low and high uncertainty, respectively. Four different random orders were used equally often.

Participants in the individual condition were informed that they on each trial could contribute any amount of a sum of money (10,000) they possessed. If their contribution exceeded the provision threshold on that trial, they would receive twice the amount they contributed. However, if the contribution did not exceed the provision threshold, they would receive nothing and also loose the money they had contributed.
In the group condition participants were informed that they were part of a group consisting of five students, themselves and four others of whom they had no prior knowledge. On each trial they could each contribute any amount of a sum of money (2,000) they possessed. Each participant would receive twice the sum they contributed if the total contribution exceeded the provision threshold on that trial. None of them would however receive anything if the group contributed less than the provision threshold and all would lose their contributions.

In the group condition with information about others’ estimates, after having seen the number sequence participants were informed about the average of the other four group members’ estimates of the provision threshold. This average estimate was on average 1,000 (980, 990, 1010, 1020) larger than the actual provision threshold (the mean of the distribution). In all other respects the procedure was the same as in the group condition without information about others’ estimates.

No feedback was at any time given about what the actual provision threshold was or how much other group members contributed. A session lasted for about 30 minutes. All participants were told that for one randomly chosen trial they would actually receive a bonus proportional to their contributions if they or the group had contributed a larger amount than the provision threshold. The maximum bonus was US$28. After having debriefed the participants, they were all paid an additional US$7 in bonus.

Results and Discussion

Tables 3 displays subjects’ mean contributions. It may be seen that the contributions are lower when resource uncertainty was high than when it was low. However, overall the contributions exceed the mean of the provision threshold. Furthermore, the individual condition does not differ from the group condition. A 2 (outcome dependence: individual vs. group) by 2 (resource uncertainty: low vs. high) ANOVA only yielded a significant main effect of resource uncertainty, $F(1, 30) = 24.14, p<.001$, $MSe = 15543.9$. Since no differences were found between the group and individual conditions, the results speak in favor of a optimism rather than an egoism bias. This conclusion is inconsistent with Wit and Wilke (1995) who found that the effect of resource uncertainty interacted with social uncertainty. It is, however, consistent with the results of several previous experiments with a CPR dilemma (Gustafsson et al., 1997a, 1997b) in which no differences were found between group and individual conditions.
Table 3

Mean Contributions in a PG Dilemma where the Outcome only Depended on Size of Threshold (Individual) or both Threshold and Others’ Contributions (Group) as Related to Information about Others’ Estimates and Resource Uncertainty

<table>
<thead>
<tr>
<th>Resource uncertainty</th>
<th>Low</th>
<th>High</th>
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<tbody>
<tr>
<td>Individual(^a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No information</td>
<td>1155.9</td>
<td>1012.1</td>
</tr>
<tr>
<td>Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No information</td>
<td>1146.7</td>
<td>1013.6</td>
</tr>
<tr>
<td>Average-estimate information</td>
<td>1213.7</td>
<td>1143.8</td>
</tr>
</tbody>
</table>

\(^a\)The means are divided by 5.

In part consistent with the results of Experiment 1, Table 3 also shows that the contributions were larger in the group who received information about others’ estimates than in the group who received no information. In the former group the effect of resource uncertainty was not eliminated but weaker than in the latter group. Another 2 (information: no vs. average-estimate) by 2 (resource uncertainty: low vs. high) mixed ANOVA with repeated measures on the last factor yielded a main effect of resource uncertainty, \(F(1, 30) = 18.17, p<.001, MSE = 35175.1\), and of information, \(F(1, 29) = 3.19, p<.05, MSE = 50671.2\). The interaction between resource uncertainty information and information was only marginally significant, \(F(1, 29) = 1.75, p<.19, MSE = 35175.1\).

In summary, the results clearly showed that participants did not contribute less but more when they were informed about others’ estimates of the uncertain provision threshold. However, the effect of information was weaker than in the CPR dilemma investigated in Experiment 1. In fact, compared to the average-estimates in the group with information, subjects tended to contribute less than an equal-share of the average estimates. This may be interpreted as a sign of an egoism bias. Another possible interpretation is however that participants’ weighed the risk of
loosing in the PG dilemma (contributing more but still not meeting the provision threshold) more than the risk of not winning in the CPR dilemma (the risk of requesting more than the resource size). This interpretation is in line with prospect theory (Kahneman & Tversky, 1979) implying that people are risk seeking in the domain of losses but risk aversive when it comes to gains.

Experiment 3

In Experiments 1 and 2 the effect of resource uncertainty was reduced but not eliminated when participants were informed about other group members’ estimates of the resource size (in the CPR dilemma) or provision threshold (in the PG dilemma). The reason may be that participants anchored their requests or contributions on their own biased estimates of the uncertain information about resource size or provision threshold which was presented first, then made insufficient adjustments to take into account the information about the others’ estimates which was presented thereafter. This is in line with research showing that people use an anchoring-and-adjustment judgment heuristic (Slovic & Lichtenstein, 1971; Tversky & Kahneman, 1974) implying that they judge the value of an unknown object by initially anchoring on a value which then is adjusted to reach a final judgment. It is also consistent with some other research on anchoring effects (e.g., Chapman & Johnson, 1994) showing that the order of presentation of information may be an important determinant of the selection of an anchor.

One aim of Experiment 3 was thus to investigate whether information about others’ estimates eliminate the effect of resource uncertainty if the information is presented before information about the resource size (provision threshold). From the interpretation of the previous results that participants anchor on their own biased estimates of the size of the resource or provision threshold when it is presented first, the effect of resource uncertainty was expected to be eliminated when the order of presenting the information is reversed. In Experiment 3 information about others’ estimates was presented either before or after information about the resource or provision threshold.

In Experiment 1 the issue was raised whether a reduced outcome-desirability bias explained the weaker overharvesting effect due to information about others’ estimates of resource size. The alternative is that participants wanted to comply with an equal-share rule. Thus, they did not request more than they expected others would do on the basis of
their estimates of resource size. If a reduced outcome-desirability bias is the primary explanation, an effect of information about others’ estimates should be expected even if the outcome is only dependent on resource size and not on others’ requests. Experiment 3 employed such an individual condition with information about others’ estimates. If the effect of information of others’ estimates reduces the outcome-desirability bias, an effect of the order of information was expected in the individual condition.

A comparison between the results of Experiments 1 and 2 suggested that the effect of information about others’ estimates of the resource size in a CPR dilemma is stronger than the effect of information about others’ estimates of the provision threshold in a PG dilemma. A third aim of Experiment 3, which employed both a CPR and a PG dilemma, was to make a direct comparison of the effects of information about others’ estimates on cooperation in these two types of dilemmas. Furthermore, it was also of interest to investigate the effect of information about others’ estimates on contributions in a PG dilemma when the outcome only depends on the provision threshold. If the results are similar to those in a CPR dilemma, a reduced outcome-desirability bias is a likely explanation in both cases.

Method

Participants

Sixteen male and 16 female undergraduates at Göteborg University participated in return for the equivalent of US$7. An equal number of men and women were randomly assigned to two groups.

Procedure

The same number sequences were used as in Experiment 2. In the PG dilemma they represented previous sizes of the provision threshold, in the CPR dilemma previous sizes of the resource. In the PG dilemma participants could on each trial contribute any amount. If the contributed amount exceeded the provision threshold, they would receive twice that amount but would otherwise receive nothing and lose their contribution. On all trials participants were given information about the average estimate of four others who had performed the task before them. The average estimate was 1,000 (980, 990, 1,010, 1,020) larger than the mean provision threshold (5,000). In half the trials with low and high resource
uncertainty respectively, the information about the others’ estimates were presented before and in the other half of the trials after the information about the provision threshold.

In the CPR dilemma participants could on each trial request any amount and would receive that amount if it did not exceed the size of the resource but would otherwise receive nothing. Others’ average-estimates were 1,000 (980, 990, 1,010, 1,020) less than the mean resource (5,000). In other respects the procedure did not differ from that in the PG dilemma.

Except for the differences described, the procedure was the same as in Experiment 2. A session lasted for about 30 minutes after which participants were debriefed and paid.
Results and Discussion

Mean requests and contributions are given in Table 4. As may be seen, there was both in the CPR and PG dilemmas an effect of resource uncertainty when information about the others' average estimate was given before but not when it was given after information about the resource size or provision threshold. Furthermore, whereas requests in the CPR dilemma were close to the others' average estimates, contributions were further off the estimates in the PG dilemma. In support of these observations a 2 (type of dilemma: CPR vs. PG dilemma) by 2 (order of information: before vs. after) by 2 (resource uncertainty: low vs. high) mixed ANOVA with repeated measures on the last two factors showed an expected significant effect of type of dilemma, $F(1, 30) = 154.46, p < .001$, $MS_e = 139523.6$. Furthermore, the three-way interaction between type of dilemma, order of information, and resource uncertainty was highly significant, $F(1.40, 42.13) = 15.90, p < .001$, $MS_e = 312292.6$, after Greenhouse-Geisser correction of the dfs. Bonferroni corrected separate $t$ tests showed at $p = .05$ that in both the CPR and PG dilemma, the effect of resource uncertainty was significant only when information about others' estimates was given first. The mean difference between requests and contributions were also significant in all comparisons.

Table 4
Mean Requests and Contributions in CPR and PG Dilemmas Related to Order of Information about Others’ Estimates and Resource Uncertainty

<table>
<thead>
<tr>
<th>Order of information about others’ estimates and resource uncertainty</th>
<th>First</th>
<th>Second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>CPR dilemma</td>
<td>4017.9</td>
<td>4102.6</td>
</tr>
<tr>
<td>PG dilemma</td>
<td>5448.8</td>
<td>5439.8</td>
</tr>
</tbody>
</table>
As in Experiments 1 and 2, subjects adjusted their requests or contributions towards the estimates by other subjects. Since the outcome only depended on the size of the resource or the provision threshold and not on others’ requests or contributions, the results speak against that participants reduce their requests in order to comply with an equal-share rule. A stronger case is made for that in both types of dilemmas an individual outcome-desirability bias is operating and this bias is influenced by information about others’ estimates by way of an anchoring and adjustment process.

Furthermore, when information about resource size or provision threshold is given before information about others’ estimates, in line with findings about the anchoring-and-adjustment heuristic (Tversky & Kahneman, 1974) participants anchor on their biased estimates of the information presented first and adjust insufficiently. Thus, when optimistically biased information precedes pessimistically biased information, the optimism bias will prevail in the final judgment about how much to request or contribute. However, when given the possibility to anchor on pessimistically biased information, the optimism bias disappears.

The results also replicated the difference in the strength of the effect of information about others’ estimates in the CPR and PG dilemma. Since this difference seem to be unrelated to the fact that the outcome depended on the requests/contributions by others, an explanation in terms of loss aversion (Kahneman & Tversky, 1979) seems most likely.

General Discussion

The consistent finding in previous research (e.g., Rappoport et al., 1992; Gustafsson et al., 1997a) that overharvesting is observed when uncertainty exists about resource size was once again replicated in a CPR dilemma where participants request from a common resource. The results of Experiment 2 which in part replicated the results of Wit and Wilke (1995) furthermore extended this finding to a step-level PG dilemma where participants were asked to contribute an amount to a common resource. Although the sequences of numbers representing resource size or provision threshold were exactly the same, in the CPR dilemma the requests were on average larger than the mean resource size whereas the contributions in the PG dilemma were on average less than the mean provision threshold. Thus, if participants had misperceived the size of the
resource (which the results of Experiment 1 indicated that they did not), this asymmetry should not have been observed. In Experiment 3 consistent results were furthermore obtained in both the CPR and PG dilemma when the outcomes did not depend on others’ requests or contributions (social uncertainty). In this respect the results reported by Wit and Wilke (1995) were not replicated. However, the results supported the conclusion that the effect of resource uncertainty is an individual outcome-desirability bias as Gustafsson et al. (1997a) proposed.

Informing participants in the CPR and PG dilemmas about the estimates of the resource size or provision threshold made by other group members (Experiments 1 and 2) did not result in an increase in overharvesting or free riding. An egoism-bias explanation such as that proposed by De Vries and Wilke (1992) would predict this. However, the results were in fact contrary to this prediction in that participants in the CPR dilemma adjusted their requests downward to be largely consistent with the others’ estimates of the uncertain resource size. The tendency was the same in the PG dilemma although the adjustments were less. The possibility that participants did not want to violate an equal-share fairness principle, based on the others’ average estimates did not appear to be a likely explanation since the results of Experiment 3 indicated that the results were the same even though the outcome did not depend on other requests or contributions.

The effect of resource uncertainty on overharvesting and free riding was in Experiment 3 eliminated when information about other group members’ estimates was presented first. Thus, it appeared as if others’ estimates were trusted by the participants unless they first were biased by their own estimates based on information about resource size. In addition the results seem to warrant the conclusion that the bias is an individual outcome-desirability bias. In the present research it was found that the outcome-desirability bias disappears if the debiasing information receives priority. Debiasing was weaker in the PG dilemma. Perhaps loss aversion is a stronger motivation underlying the outcome-desirability bias, thus participants showed more resistance to debiasing information.
References


Gustafsson, M., Biel, A., & Gärling, T. (1997b). *Overharvesting of resources of unknown size* (Göteborg Psychological Reports, 27, No. 9). Göteborg, Sweden: Göteborg University, Department of Psychology.


