The use of peer sanctioning mechanisms in an asymmetric commons dilemma: An experimental study[1]

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Abstract:
In symmetric commons dilemmas, peer sanctioning – i.e. the possibility to gather information about the resource use of others and to sanction overuse – can be an effective structural solution in terms of resource conservation. However, most real-world commons are characterized by structural asymmetries, with some users having the facilities to harvest more and therefore being more powerful than others. This structure is e.g. found in fisheries where large commercial fishers with sizable harvesting capacities compete with smaller subsistence fishers.

Will peer sanctioning be effective in asymmetric commons dilemmas as well? And what are the effects of structural asymmetry on the users' information gathering behavior? Do individual users request more information about the resource use of powerful agents because they expect powerful agents to misuse their power? And do powerful agents themselves request more or less information about the resource use of others than powerless agents?

To answer these questions, an experimental study was conducted. The research tool was a computer simulated fishing commons, having one human player compete with four computer simulated others playing a range of fixed strategies in an iterated game. On the one hand, the players' task was to decide about their harvests and to inform the other players about their decisions. However, the players were told that this information was not necessarily true and that they therefore could not rely on the indicated harvest sizes of the others. On the other hand, by giving the players the possibility to gather information about the resource use of the others, a peer sanctioning system was introduced. If overuse was detected, the overusing player was sanctioned. As the costs of information gathering had to be born individually while sanctioning resulted in collective gains (distribution of an additional bonus in the short run, resource conservation in the long run), the peer sanctioning system constituted a second-order social dilemma.

In the experimental setting, both the most overusing computer simulated player's power and the human player's power were manipulated. In general, the participants' information gathering behavior turned out to be quite adaptive, making use of the sanctioning system whenever they suspected overuse. Results indicated also that the application of the sanctioning system depended on the other players' observed harvests and on expectations concerning their future harvests, but not on the other players' power. Furthermore, powerful participants tended to gather more information about the resource use of others than powerless participants. Further analyses of the experimental situation allow for the conclusion that the participants' information gathering behavior was presumably mediated by their knowledge about the other players' harvesting strategies. Implications for the management of real-world commons are discussed.

Keywords: commons dilemma, asymmetric agents, structural solutions, sanctions, individual decision making, experimental study

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1 Introduction

As examples of common pool depletion abound, the question of how to limit overuse becomes more and more crucial. Frequently suggested solutions are e.g. to enable users to communicate with each other or to introduce punishment systems in order to enhance cooperation among users (e.g., Axelrod, 1984). With respect to symmetric agents, a number of experimental and field studies indicate that institutional regulations like peer sanctioning – i.e. the possibility to gather information about the resource use of others and to sanction overuse – can be an effective structural solution in terms of resource conservation (e.g., Ernst, Eisentraut, Bender, Kägi, Mohr & Seitz, 1998; Fehr & Gächter, 1999; Ostrom, 1992).

Looking at real-world social dilemmas, however, it turns out that they are often characterized by structural asymmetries (e.g., Wit, Wilke & Oppewal, 1992): Agents either differ with respect to their individual resources or with respect to their payoff matrices (e.g., Biel & Gärling, 1995; Rapoport, Bornstein & Erev, 1989; Van Lange, Liebrand, Messick & Wilke, 1992). This structure is e.g. found in fisheries all over the world where large commercial fishers with sizable harvesting capacities compete with smaller subsistence fishers. In this case, the commercial fishers' advantages are twofold: They do not only have the facilities to harvest more than subsistence fishers and to benefit more from harvesting beyond a sustainable level, but also have greater abilities to switch their harvests to different species in case of a collapsed stock (Wade-Benzoni, Tenbrunsel & Bazerman, 1996). As an agent's power in a commons dilemma results from his or her harvesting facilities (Eisentraut, 1999), commercial and subsistence fishers do also differ with respect to their power, with commercial fishers being more powerful than their subsistence counterparts.

And it is still an open question whether peer sanctioning will be effective in asymmetric commons dilemmas as well. We addressed this question in an experimental study, with the research tool being a computer simulated fishing commons with asymmetric agents. In the following, design and results of the study will be presented after briefly summarizing results on the effects of sanctioning mechanisms and on asymmetric social dilemmas. Finally, implications for the management of real-world commons will be discussed.

2 Solving social dilemmas via sanctioning mechanisms

With respect to social dilemmas, it is first of all necessary to make the distinction between commons dilemmas and public good dilemmas. A commons dilemma can be described as a situation in which agents harvest from an already existing resource pool, e.g. a fishery, with the "conflict between short-term self-interest and long-term collective interest" (Samuelson & Messick, 1986a, p. 139) being its essential feature. In a public good dilemma, however, agents have to contribute individually in order to create the public good, e.g. a sum of money which may be distributed among them. An essential feature is the non-exclusivity of the public good (e.g., Connolly, Thorn & Heminger, 1992; Olson, 1965; Rapoport, 1987): If it is created, each agent will be free to benefit from the public good, irrespective of his or her individual contributions.

The evolution of cooperation between symmetric agents as a consequence of sanctioning mechanisms has been demonstrated in computer simulated tournaments (e.g., Yamagishi & Takahashi, 1994) as well as in experimental games (e.g., Ernst et al., 1998; Fehr & Gächter, 1999). A number of studies focus on peer sanctioning systems, i.e. institutional arrangements in which the agents are able to monitor and to sanction each other, without the existence of a central authority. From a theoretical point of view, a peer sanctioning system can be described as a second-order social dilemma if agents who do not engage in monitoring activities, do nevertheless benefit from the cooperation of others (e.g. Yamagishi & Takahashi, 1994; Ernst et al., 1998). And it can also be characterized as a public good dilemma.

Yamagishi and Takahashi (1994) investigated the evolution of cooperation in a second-order social dilemma in a series of computer simulations. Their starting-point is the notion that, based on assumptions of rationality, non-cooperation – i.e. not making any efforts to monitor and sanction other agents – has to be considered as the dominant strategy in this situation. That is, while the first-order social dilemma can be resolved by the implementation of mutual sanctioning, the question of how to enhance cooperation in the second-order social dilemma arises nevertheless. Opposed to Axelrod (1984) who concluded that this second-order social dilemma can only be resolved by metanorms (i.e. sanctioning the non-sanctioners), Yamagishi and Takahashi were able to demonstrate that consistent mutual cooperation in both dilemmas emerges through evolutionary processes, even without requiring metanorms.

Fehr and Gächter (1999) investigated a public good dilemma with punishment opportunities. In the punishment conditions, the participants were given the additional possibility to punish each other after having made their contribution decision. Although punishment was costly and did not provide any material benefit to the punisher, the results indicate that participants made use of the punishment system whenever they observed free riding by others. As a consequence, the existence of the punishment system led to almost complete cooperation because participants were facing a credible threat, although cooperation is contrary to the standard assumptions of rationality.

In the experimental study described by Ernst et al. (1998), participants were playing an iterated commons dilemma game in groups of five players each. Besides making decisions about their harvests, half of the groups were also given the possibility to gather information about the resource use of others and to sanction overuse. As the costs of sanctioning had to be born individually while resulting in collective gains – distribution of an additional bonus in the short and resource conservation in the long run – the peer sanctioning system constituted a second-order social dilemma. The results confirmed the hypothesis that peer sanctioning can be an effective structural solution in terms of resource conservation: If the participants were able to gather information about the resource use of others, there was significantly less overuse than if information gathering was not possible. As a consequence, the experimental conditions also differed in the remaining pool size.

In the experiment reported by Beckenkamp and Ostmann (1999), however, the sanctioning system turned out to be effective only for mean levels of sanctions, but not for extremely high or extremely low levels. Opposed to the scenarios described above, the non-cooperator in the Beckenkamp and Ostman scenario had not only to pay a fine, but also to bear the costs of monitoring. If the fine was either too high or too low, the existence of the sanctioning system even lead to a decrease in cooperation.

Summing up these results, they indicate that peer sanctioning mechanisms may enhance cooperation in social dilemmas, although the calibration of the sanctioning level may be crucial. But will peer sanctioning be effective in asymmetric commons dilemmas as well? And what are the effects of structural asymmetry on the users' information gathering behavior? Do individual users request more information about the resource use of powerful agents because they expect powerful agents to misuse their power? And do powerful agents themselves request more or less information about the resource use of others than powerless agents? Some preliminary answers to these questions may derive from research on asymmetric social dilemmas.

3 Asymmetric social dilemmas

Reviewing the literature on asymmetric social dilemmas, it is first of all evident that structural asymmetry may affect individual decision making in commons and public good dilemmas in different ways.

Having a look at studies on commons dilemmas, results are somewhat contradictory. Some studies report higher overall harvests under asymmetric conditions (e.g., Wade-Benzoni et al., 1996) and a proportional distribution of individual harvests, with larger proportions for powerful than for regular agents (e.g., Wilke, de Boer & Liebrand, 1986), while others do not. Samuelson and Messick (1986b) report the results of a study in which powerful agents harvested more than regular agents only if the overall resource use of the group was optimal. If the overall use of the group was sub-optimal and the resource was therefore in danger of being destroyed, however, powerful agents reduced their individual harvests, resulting in less variance among the harvests of powerful and regular agents. That is, the effects of structural asymmetry on individual resource use seem to be moderated by additional situational variables like the size of and the threat on the resource pool.

Results on public good dilemmas, however, seem to be clearer. A number of studies indicate that if individuals have to decide about the proportion of their endowments they are willing to contribute to a public good, these decisions are based on a rule prescribing contributions in proportion to endowments, with powerful agents giving more than regular agents (e.g., Joireman, Kuhlman & Okuda, 1994; Marwell & Ames, 1979; Van Dijk & Wilke, 1995, 2000; Wit et al., 1992).

With respect to the situation described above, results on asymmetric public good dilemmas may be of greater relevance than results on asymmetric commons dilemmas because peer sanctioning systems were characterized as second-order, public good dilemmas. However, it is worth noting that the results reported here are all based on studies with one-shot-games, while a commons dilemma with an additional sanctioning system is an iterated game per definition – maybe a crucial difference which may limit the generalizability of the public good dilemma results.

Based on the experimental research briefly summarized above, we nevertheless expected individual agents to be more suspicious about the resource use of powerful agents in the case of overuse and therefore to request more information about the resource use of a powerful agent than about the resource use of a regular agent. And we expected powerful agents to request more information about the resource use of others than regular agents because of their privileged position.

4 An experimental study

Participants of the experimental study were 48 volunteers (24 female and 24 male), with a mean age of 27.9 years. Twenty-eight of them were students at the University of Freiburg, sixteen were working people, and four did not report their professional status. The amount of payment for participation depended on the economic success during the simulated dilemma game, with a mean of 20 German Marks (approximately 10 $) for about 1.5 hours of participation.

The dilemma game was an iterated commons dilemma in which the participants competed with four computer simulated players (for a more detailed description of the game, see Eisentraut, 1999). However, participants were told that they had been matched with four other participants, with each of them sitting in a separate room in front of a computer. They were also told that, during the game, each of them would be responsible for the fishing of an hypothetical country bordering the North Sea.

At the beginning of each round, participants were informed about the size of the simulated fish stock and were asked to decide about the amount of their harvests and to inform the other players about their decisions. However, this information did not need to be true. Individual resource use was limited by a sanctioning threshold that depended on the pool size at the beginning of each round. The threshold was calculated in a way that if all players respected it, the resource pool regenerated to its initial size after each round of fishing. Nevertheless, overuse was possible up to a maximum, but was sanctioned if detected by another player.

Without the sanctioning of overuse, these harvesting options presented the participants with a commons dilemma. In the short run, individual outcomes could be maximized by harvesting amounts that exceeded the sanctioning threshold, regardless of the harvests of the simulated players. However, if all players overused the resource, the resource pool was depleted, resulting in smaller individual and collective gains in the long run. Thus, all players would be better off if they all kept to the sanctioning threshold.

After having made their harvest decisions, the participants were given the possibility to gather information about the others' harvests. The cover story of this information gathering was to send inspectors to one or more of the other countries. Information gathering had to be initiated individually, with its cost depending on the size of the resource pool. If overuse was detected by another player, the wrongdoer had to pay a fine which was distributed to the other players as an additional gain. The possibility to gather information about the resource use of the other players therefore presented the participants with a second-order public good dilemma.

The players were labeled *Player A*, *Player B*, *Player C*, *Player D*, and *Player E*, with *Player A* being the human participant and *Players B* to *E* being the computer simulated players. During the game, the simulated players played according to fixed harvesting strategies, ranging from sustainable resource use to extreme overuse. As the information gathering behavior of the human participant was one of the dependent variables of interest, the strategies of the simulated players did not include any information gathering. Nevertheless, every second overuse of the human participant was sanctioned.

The strategy of *Player B* used the resource sustainably by always keeping to the sanctioning threshold. The strategy of *Player C* moderately overused the resource because it calculated its harvest on the basis of the other players' harvests in the preceeding round of the game. The strategy of *Player D* clearly overused the resource pool by constantly harvesting the maximum of a regular player. Only after being sanctioned in two successive rounds, the sanctioning threshold was respected once. The strategy of *Player E*, finally, compensated for part of the overuse of the other players by harvesting even less than the sanctioning threshold in case that the resource was being depleted.

Power was manipulated by assigning different harvest maximums to the players. The cover story was that the maximum of a player depended on his or her fleet size, with the fleet sizes not being equal among participants. For a regular player, the maximum was calculated in a way that the resource pool would have been depleted if all players harvested that amount of fish (i.e., 1/5 of the pool size). A powerful player, however, was assigned 1.5 times the maximum of a regular player, with the sum of possible harvests exceeding the pool size under asymmetric conditions. Nevertheless, the strategies of the computer simulated players were chosen in a way that the overall harvest never exceeded the pool size.

Player D's power and the participant's own power were manipulated in a 2 (high vs. regular) x 2 (high vs. regular) factorial design. Because of this, the game which lasted 11 rounds in total was divided into two sections: In two of four experimental conditions, the most overusing simulated *Player D* was described to be powerful in the first section and lost its power after round six. Nevertheless, the harvest sizes of *Player D* were the same in all experimental conditions. Opposed to *Player D*, the human participant always was a regular player in the first section of the game. In two experimental conditions, however, he or she gained more power after round six. The participants were only informed about the changes concerning the fleet sizes, but were not provided with any information about the bases of power or the reasons why the distribution of power changed. Then, the game started again with the initial values of the pool size and other parameters in order to make the two sections comparable to each other.

After each round, the participants were asked to fill out a questionnaire on their own strategies and on their attributions towards the other players. The questions included (a) the attributed harvesting strategies of the other players, (b) the attributed trustworthiness of the other players, (c) the attributed predictability of the other players, (d) the participants' satisfaction with the actions of the other players, and (e) the expected harvesting strategies of the other players. After the game was finished, a post-experimental interview was conducted before the participants were thanked and paid for their participation. They were debriefed via mail after the experimental series was finished.

5 Results

The goal of the study was twofold: to investigate the effects of another agent's power on the participants' information gathering behavior towards this agent, and to investigate the effects of the participants' own power on their information gathering behavior. In the following, the question whether powerful and regular agents are monitored differently will be addressed first. Afterwards, results on the participants' own power will be presented.

5.1 The participants' information gathering towards a powerful agent

To answer the question whether the frequency of individual information gathering depends on the perceived power of an agent, we analyzed the participants' information gathering behavior towards the most overusing *Player D* in rounds 1 to 6. In this part of the game, *Player D* was a powerful player in two of the four experimental conditions, while being a regular player in the two others. Opposed to the assumptions stated above, a repeated measures analysis of variance did not reveal any differences in the frequency of information gathering per round (F [1, 44] = 1.16; p = .29, $M_{powerful}$ = 0.47, $SE_{powerful}$ = 0.05, $M_{regular}$ = 0.39, $SE_{regular}$ = 0.05).

Further analyses, however, revealed that the two overusing agents *Player C* and *Player D* were monitored significantly more often than the two sustainably harvesting agents *Player B* and *Player E* (see figure 1).

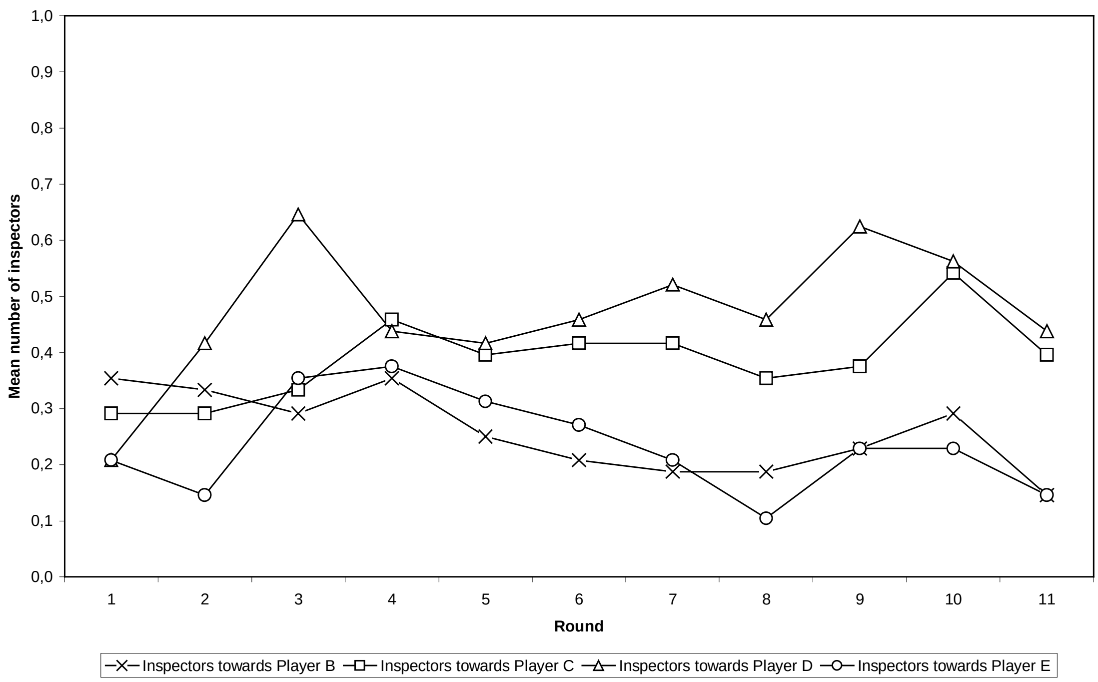

Figure 1 Means of the participants' information gathering activities (N = 48).

In a repeated measures analysis of variance with the mean number of inspectors per round being the dependent variable, the main effect of the factor "player" turned out to be significant (*F* [2, 123] = 21.37, *p* = .00; degrees of freedom adjusted by ε, see Huynh & Feldt, 1976).

Table 1 Post-hoc comparisons of the mean numbers of information gathering towards the simulated players (Tukey test).

Comparison	Absolute difference of means
Player B – Player C	0.13**
Player B – Player D	0.21**
Player B – Player E	0.02
Player C – Player D	0.08
Player C – Player E	0.15**
Player D – Player E	0.24**

Annotations. For p ≤ .05, the critical difference is 0.09; for p ≤ .01, the critical difference is 0.11.
**p ≤ .01.

Pairwise post-hoc comparisons using the Tukey test (e.g., Stevens, 1992) revealed significant differences whenever an overusing agent was compared to a non-overusing agent (see table 1). That is, when deciding about their information gathering, participants made a clear distinction between overusing and non-overusing agents. If an overuser was identified, however, the degree of his overuse was only of minor importance. Therefore, the difference between the mean number of information gathering towards *Player C* and *Player D* was not significant.

Inspections into the data also revealed that the participants' attributions towards the most overusing simulated *Player D* were by far more negative than the participants' attributions towards the other simulated players, regardless of *D's* actual power. Figure 2, for example, shows the participants' attributions of trustworthiness towards the four simulated players.

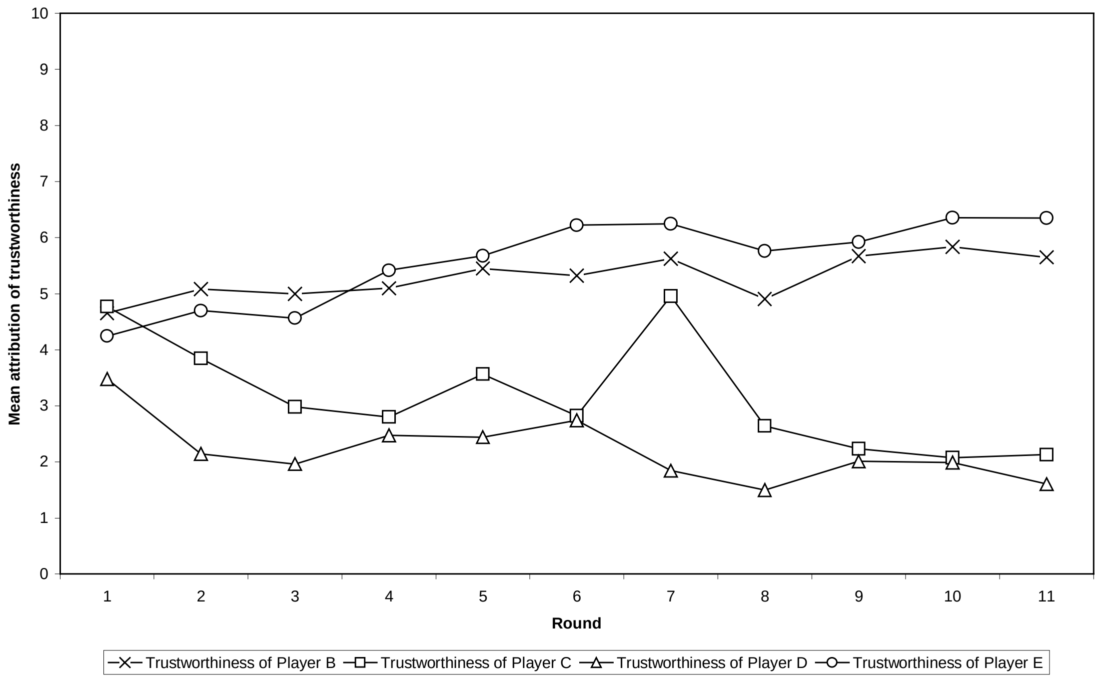

Figure 2 Means of the participants' attributions of trustworthiness towards the simulated players (N = 48).
Participants rated their attributions of trustworthiness on analogue scales with a length of 10 cm each. A value of 0 indicates that a simulated player was judged not to be trustworthy at all, while a value of 10 indicates that a simulated player was judged to be absolutely trustworthy.

It is evident that the sustainably harvesting *Players B* and *E* were judged to be more trustworthy than the overusing *Players C* and *D*, with the attributions towards *Player D* being the most negative ones. Statistical testing confirmed this observation: In a repeated measures analysis of variance with the mean attributions of trustworthiness per round being the dependent variable, the main effect of the factor "player" turned out to be significant (F [1, 93] = 72.29, p = .00; degrees of freedom adjusted by ε, Huynh & Feldt, 1976). Pairwise post-hoc comparisons using the Tukey test (e.g., Stevens, 1992) revealed significant differences for all comparisons except for the comparison between *Player B* and *Player E* (see table 2).

Table 2 Post-hoc comparisons of the mean attributions of trustworthiness towards the simulated players (Tukey test).

Comparison	Absolute difference of means
Player B – Player C	2.13**
Player B – Player D	3.10**
Player B – Player E	0.29
Player C – Player D	0.97**
Player C – Player E	2.42**
Player D – Player E	3.39**

Annotations. For p ≤ .05, the critical difference is 0.70; for p ≤ .01, the critical difference is 0.85.
**p ≤ .01.

The same turned out to be true for the attributed and expected harvesting strategies of the simulated players and for the participant's satisfaction with the simulated players. That is, while the decision about the gathering of information seemed to be a binary decision based on overuse versus sustainable use of another player, the attributions towards the other players clearly seemed to be affected by the amount of overuse, with the attributions getting more negative if the amount of overuse increased.

5.2 The information gathering behavior of powerful and regular participants

Opposed to the simulated *Player D's* power, the participants' own power was manipulated in the second half of the game. Consequently, analyses of the effects of the participants' power have to be based on the data of rounds 7 to 11. And it has to be taken into consideration that participants differed insofar as half of them were confronted with a powerful *Player D* in rounds 1 to 6, while half of them were not. Therefore, it seemed reasonable not only to analyze the data of the entire sample, but also to analyze the data of the conditions with a powerful *Player D* and the conditions without a powerful *Player D* separately. As the possibility of interfering effects of *Player D's* power and the participants' power could not be ruled out for the conditions with a powerful *Player D*, data of the conditions without a powerful *Player D* seemed to be more reliable.

Table 3 Main effects of the participants' own power on their information gathering towards the simulated players in the second half of the game.

				Powerful participant		Regular participant	
Dependent variable	**df**	**F**	**p**	**M**	**SE**	**M**	**SE**
Total number of information gathering	1 (42)	1.52	.22	1.47	0.16	1.19	0.16
Information gathering towards *Player B*	1 (42)	3.88	.06	0.27	0.05	0.15	0.05
Information gathering towards *Player C*	1 (42)	1.90	.18	0.48	0.06	0.36	0.06
Information gathering towards *Player D*	1 (42)	0.50	.48	0.49	0.06	0.55	0.06
Information gathering towards *Player E*	1 (42)	1.93	.17	0.23	0.05	0.14	0.05

Annotations. Numbers in brackets indicate the degrees of freedom for error.
Means are adjusted for the effects of the covariates capital and gender.
SE = standard error of the mean.

For the entire sample, there was a tendency of powerful participants to gather more information about the resource use of the sustainably harvesting *Player B* than regular participants (F [1, 42] = 3.88, p = .06). For the other simulated players, the differences of means between groups were also in the expected direction, with powerful subjects initiating slightly more information gathering activities than regular subjects, but failed to reach the level of statistical significance (see table 3).

For the conditions without a powerful *Player D* in the first half of the game, however, the level of statistical significance was reached: In this case, powerful participants gathered more significantly more information about the resource use of the sustainably harvesting *Player B* than regular participants (F [1, 20] = 6.37, p = .02, $M_{powerful}$ = 0.22, $SE_{powerful}$ = 0.05, $M_{regular}$ = 0.05, $SE_{regular}$ = 0.05; see also figure 3). That is, our assumptions concerning the effects of the participants' own power on their information gathering decisions were at least partially confirmed.

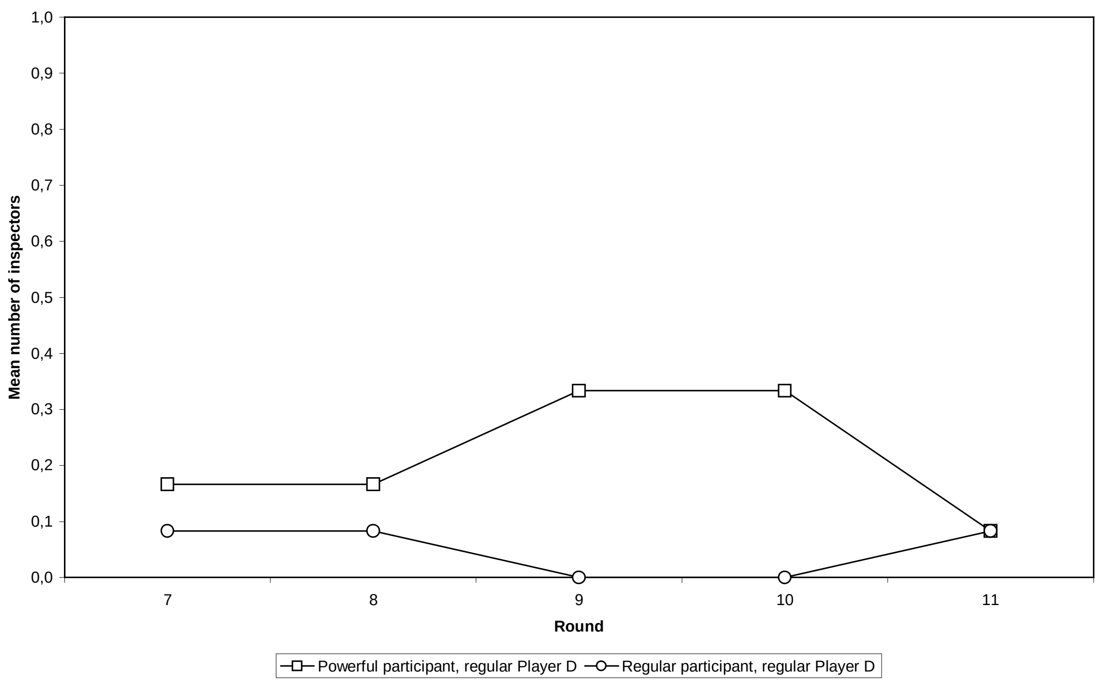

Figure 3 Means of the participants' information gathering towards *Player B* in the second half of the game; conditions with a regular *Player D* in the first half of the game (N = 24).

6 Discussion

In general, the participants' information gathering behavior turned out to be quite adaptive, making use of the sanctioning system whenever they suspected overuse.

With respect to the power manipulation, it is first of all worth noting that opposed to our assumptions, the power of the most overusing agent – the computer simulated *Player D* – did not affect the frequency of the participants' information gathering towards this agents. Rather, overusing agents were monitored more frequently than sustainably using agents in all experimental conditions, regardless of the agents' power. Further inspections into the data also revealed that the participants' attributions towards overusing agents were by far more negative than their attributions towards sustainably using agents: Participants rated the most overusing *Player D* to be the least trustworthy of all players and to play the most damaging harvesting strategy. Furthermore, they expected the strategy of *Player D* to continue its exploitation of the resource pool, and they were by far less satisfied with *Player D* than with other agents. In sum, these results clearly show that the participants based their information gathering decisions as well as their attributions towards another agent on the agent's observed behavior and were not blinded by the power of the respective agent.

Effects of the observed behavior of a powerful agent are also reported by Wilke et al. (1986) who confronted participants either with an overusing or a sustainably using powerful agent. Similar to the study reported here, the effects in the Wilke et al. (1986) study were twofold: Participants reduced their own harvests as a reaction to the powerful agent's overuse while, at the same time, they voted more frequently for punishing the overuser and agreed less frequently to the question whether the powerholder should keep his advantaged position.

With respect to the participants' own power, we expected powerful participants to contribute more to the information gathering activities in the group than regular participants. The results, however, confirmed this assumption only partially: Although the expected tendency was observed in all cases, the mean differences of the information gathering activities of powerful and regular participants turned out to be significant only with respect to the information gathering activities towards one of the four computer simulated players and only in the conditions in which the simulated *Player D* was a regular player in all rounds of the game. So what may be the reasons why participants did not base their decisions about the gathering of information on a proportionality rule as reported by other authors (e.g., Joireman et al., 1994; Marwell & Ames, 1979; Van Dijk & Wilke, 1995, 2000)?

The first reason may be the fact that while in all studies in which the proportionality rule was observed, only one-shot games were investigated, while the research tool in the study reported here was an iterated dilemma game. Opposed to one-shot games, successful information gathering in an iterated commons dilemma does not only result in immediate gains, but also in long-term consequences in terms of resource conservation. As a result, the incentive structures of both scenarios may be quite different. Second, presenting the study as an experiment on resource management may have encouraged participants to interpret the situation in terms of morality and therefore to strive for resource conservation instead of gain maximization. This would be in accordance to the results of two unpublished studies reported by Dawes (1980) in which the participants' cooperation rates were enhanced by moralizing notions of the experimenter. A third reason may be the fact that, in the study reported here, the participants' own power was manipulated in the second half of the game when the participants were already familiarized with the harvesting strategies of the simulated players. That is, the situation in which some of the participants became more powerful than others was characterized by a high degree of social certainty and, as a consequence, rather foreseeable effects of information gathering. Maybe the effects of the participants' own power would have been more pronounced in a situation of high social uncertainty in which the situational demands are not only to sanction overuse but also to acquire knowledge about the others on which subsequent information gathering and harvesting decisions can be based.

7 Conclusions: Peer sanctioning and the management of asymmetric real-world commons

Nevertheless, the results presented here allow for the conclusion that peer sanctioning has proven to be an effective structural solution to asymmetric commons as well as to symmetric ones. So if we turn to the question of how to resolve asymmetric real-world commons, the prior conclusion is to suggest the implementation of the same structural arrangements as they are suggested for symmetric commons because it seems reasonable to assume that the effects of these arrangements may not be weakened by the existence of structural asymmetry between the users. Moreover, if it turns out to be true that powerful agents might enhance their monitoring efforts under the circumstances of social uncertainty, the probability of successful resource conservation may be even higher under asymmetric than under symmetric conditions.

However, some limitation are worth mentioning. The major one concerns the bases of power: It has to be taken into consideration that in the study presented here, the participants were not provided with any information about the bases of power and that the agents' power therefore was a pure label without any deeper meaning. This may be a crucial difference to real-world commons in which power may e.g. be based on traditional hierarchies of a culture. As the social structure and the cultural background may clearly differ from one commons to another, institutional arrangements always have to be seen in close interaction with their social and cultural framework (e.g., Bender, 2000). Therefore, the need for designing specific suggestions for the solution of specific real-world commons instead of designing the "one best way" is evident.

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