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# Information Feedback in Public-Bad Games: A Cross-Country Experiment

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## Abstract

In this paper, we examine the impact of information on individual contributions in a public-bad experiment. We compare two experimental treatments. In the partial information treatment, subjects are only informed about the total contributions by their group, whereas in the full information treatment they get also feedback on the individual decisions of their group members. Both treatments have been performed in two countries: Norway and the Netherlands. The main results are that the average contributions are not significantly different between the information conditions in the two countries. Furthermore, a restart effect, which is often observed in public-good experiments, is also found here.

**Keywords:** public bad, experiments, information feedback, cross-culture

**JEL-Classification codes:** C92, D63, H41

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# 1 Introduction

In the last few decades, there has been a growing interest in the quality of the environment. For instance, many environmental policies have been advanced to prevent (dramatic) reductions of the environmental quality. The quality of the environment is a typical example of a public good, and, conversely, pollution can be seen as a public bad. For example, when countries are asked to cut down their CO<sub>2</sub>-emissions they find themselves in a public-bad situation: for each country separately, it is better not to reduce the emissions, but in total it would be better if all countries cooperated and polluted less. A natural question that arises in this respect is what instruments could increase cooperation. One instrument one can possibly think of is information.<sup>1</sup> It may be the case that by giving explicit feedback on the actions of each country, countries react differently and perhaps increase the degree of cooperation. As in many areas of economics, it is hard to derive from real-life situations what the exact impact is of a possible determining factor, like in this case information. However, it is possible to investigate the question whether information feedback leads to different outcomes in a controlled laboratory experiment. This paper presents the results of an experimental study that addresses exactly this question. To that end, we compare contributions that people make to a public bad when they have feedback on individual decisions and when they do not have this information.

The possible impact of information feedback on individual decisions has been studied before in other experimental situations. In particular, there is some literature on this effect in the context of public-good experiments (e.g. Sell and Wilson (1991), Weimann (1994), and Croson (1997)). However, although the provision of a public good and the prevention of a public bad are identical situations from a theoretical point of view, it turns out that people behave differently in both situations (see e.g. Andreoni (1995) and Sonnemans et al. (1998)).<sup>2</sup> Therefore, the impact of information feedback in public-good experiments cannot be translated directly to results for public-bad experiments. A distinction between the present experiment and other studies is, moreover, that we use a within-subject design. That is, subjects are involved in two information treatments. In

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<sup>1</sup>Another situation that could be beneficial for cooperation is the presence of a ‘leader’, who could take unilateral measures (Hoel (1991)). Actually, studying the possible impact of a leader in a public-bad situation was the main goal of our research project. In a public-bad game with a leader, one subject (the leader) first decides on his or her contribution. The other group members (the ‘followers’) are informed about this contribution, after which they make their contribution decisions simultaneously. To exclude the possibility that differences in contribution levels between the public-bad game with a leader and a standard public-bad game are merely caused by the fact that in the leader situation subjects receive information about individual decisions whereas in the standard game they only know the aggregate group contribution, we decided to study the impact of information feedback on itself. The results of this first experiment are presented in this paper; the results on the leader experiment are reported in Moxnes and Van der Heijden (1998).

<sup>2</sup>See Ledyard (1995) for an overview of public-good experiments.

the partial information treatment (the standard treatment) subjects are only informed about the total group level of contributions to the public bad. In the full information treatment, on the other hand, subjects also know the individual decisions. Finally, the present study concerns a cross-cultural experiment: the experiments have been conducted in Norway and the Netherlands and we compare the results for the two countries.

Our main result is that providing information is not very conducive to prevent the public bad from happening: only in Norway the average contribution to the public bad turns out to be somewhat lower when individuals receive feedback on individual decisions. Furthermore, the level of contributions to the public bad is significantly higher in the Netherlands than in Norway, but this result might be provoked by some other factors. Finally, we find clear evidence that a restart effect as has been found in public-good experiments (Andreoni (1988) and Croson (1996)) is also present in our public-bad situation.

The remaining part of this paper is organized as follows. The next section reviews some literature on related experiments. In section 3 we describe the details of the public-bad game and the experimental procedure. Section 4 presents the main results and the last section contains a concluding discussion.

## 2 Previous experiments

Our study examines whether subjects contribute more or less to a public bad when they are informed about individual decisions compared with a situation in which they only know the aggregate contributions. Our paper is related to previous experimental studies. In this section we briefly review some literature on information feedback in public-good experiments, some results from public-bad experiments and some cross-cultural experimental studies.

### 2.1 Information feedback

A number of papers consider the effect of information in public-good experiments. Sell and Wilson (1991), for instance, have compared three experimental treatments in a public-good setting: (1) no information about other member's contributions, (2) aggregated information about other members' contributions (which is comparable to our treatment with partial information), and (3) individualised information about each member's contribution (which is comparable to our treatment with full information). They find that contributions to the public good are greater in treatment (3) over the last five rounds than in the other two treatments. Over all rounds, this difference is not significant, however.

Among other things, Weimann (1994) also compares two experimental public-good

treatments with different amounts of information. He obtains a small, but insignificant, difference between the average contribution under partial information (55.5%) and under full information (61.5 %). Similarly, Croson (1997) concludes that average group contributions are the same when comparing treatments with partial and with full information. However, she also finds that group contributions under full information have a significantly higher variance than those under partial information.

## 2.2 Public-bad experiments

In one of the few papers on public-bad experiments, Andreoni (1995) has analysed the effects of positive and negative framing on cooperation. He finds that subjects display a higher degree of cooperation in a public-good experiment than in a public-bad experiment: the average level of cooperation was 34% in the public-good frame against 16% in the public-bad frame. Similarly, Sonnemans et al. (1998) compare the results of a public-good and a public-bad experiment with thresholds. They report significantly higher levels of cooperation in the public-good frame (51% versus 40%).<sup>3</sup>

## 2.3 Cross-cultural experiments

Some years after one of the first cross-cultural experimental studies by Roth et al. (1991), there seems to be a growing interest in experiments that examine behaviour across countries.<sup>4</sup> Particularly relevant for the present study are some recent experimental studies that compare subjects' behaviour in public-good games in several countries (Weimann (1994), Burlando and Hey (1997), Ockenfels and Weimann (1999), Cason et al. (1997), and Brandts et al. (1997)). Weimann (1994), for instance, finds that American subjects are less cooperative than German subjects. Similarly, Burlando and Hey (1997) conclude that British subjects are significantly less cooperative than Italians. In an interesting paper, in which they compare behaviour in eastern and western Germany, Ockenfels and Weimann (1999) find that eastern subjects behave in a significantly more selfish manner than do western subjects. Also relevant in this respect is a study by Lensberg and Van der Heijden (1998), which compares subjects' behaviour in Norway and the Netherlands in a gift exchange experiment. They find that Norwegian participants display more trust and cooperation than Dutch subjects.

Apparently, whether or not subjects in different countries behave differently depends on the specific characteristics of the experimental situation at hand. We are not aware of

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<sup>3</sup>In these public-bad studies, subjects were only informed about the aggregate contribution such that the impact of information cannot be derived.

<sup>4</sup>Roth et al. (1991) mention three possible problems concerning cross-cultural experimental studies: the experimenter effect, the language effect, and the currency effect. We have tried to avoid this kind of framing problems as much as possible, mainly by having one of the experimenters present in all sessions.

any other cross-cultural public-bad experiment, so the question whether people behave differently in public-bad situations in different countries is still open, as well as the issue whether subjects in different countries react similarly or not to information feedback.

### 3 The public-bad frame and the experimental procedure

The experimental design of the present study is almost similar to the public-bad framework used by Andreoni (1995), the only difference being that we have modified some of the parameters. The features of our game are as follows. Subjects play in groups of five. In each round, subjects are endowed with 20 tokens, which they can allocate between two projects: project A (the public bad) and project B. Investing in project A gives a direct private return of 0.7 per token invested. Investing in project B gives a private return of 0.4 per token invested. However, investing in project A has also a negative external effect: each token invested in project A yields a negative return of 0.1 to all group members. So, payoff  $\Pi_i$  to individual  $i$  when s/he invests  $x_i^A$  in project A (and thus  $20 - x_i^A$  in project B) reads

$$\Pi_i = 0.7x_i^A + 0.4(20 - x_i^A) - 0.1 \sum_{j=1}^5 x_j^A \quad (1)$$

where  $x_j^A$  denotes the investment in project A by subject  $j$ . Note that the payoff to individual  $i$  is not only determined by his or her own decision; each token invested in the public bad by him- or herself or by one of the group members reduces  $\Pi_i$ .

From (1) it follows that purely selfish, money-maximising subjects have a dominant strategy to invest their total endowment in the public bad. That is, the unique Nash equilibrium is  $x_j^A = 20, \forall j$ , which gives a total investment of 100 tokens in project A and a payoff  $\Pi_j = 4, \forall j$ . However, higher payoffs can be obtained if subjects invest in project B: If all members of a group decide to invest the total endowment in project B, i.e.  $x_j^A = 0, \forall j$ , the payoff to each individual would be twice as much, namely 8, which is the Pareto efficient outcome.

To investigate the impact of giving information feedback, two treatments have been developed and conducted. In treatment PI (Partial Information), subjects are only informed about the total investments in project A by all members of their group. In treatment FI (Full Information), subjects also get to know how much each individual in their group contributed to the public bad.

Finally, we are also interested in the issue whether particular (experimental) findings carry over to other countries. To investigate these cross-cultural aspects, we have run the experiment in two countries, Norway and the Netherlands. By comparing the results

we can find out whether people from different countries react similarly or not to identical situations.

### 3.1 The experimental procedure

In both countries we have employed a within-subject design by conducting the two experimental treatments within one session (first treatment PI, then treatment FI).<sup>5</sup> In Norway, the experiment was run by hand while in the Netherlands the experiment was computerised. Expected earnings in both countries were the same in relative terms. In the following, we describe the experimental procedure. First, the general procedure is presented for the case of Norway, next the particulars of the Dutch sessions are commented.

#### *Norway*

In Norway, we ran one session of the public-bad experiment in April 1997. In this session, three groups of five subjects participated, henceforth labelled groups A1, A2, and A3. The subjects were students from the Norwegian School of Economics and Business Administration who were recruited from classes. Subjects were told that they could earn between NOK 100 and 180 (\$ 12.50 - \$ 22.50) in somewhat more than one hour by participating in an experiment. They knew that rewards were contingent on performance.

Upon arrival subjects were randomly seated behind numbered desks. Instructions (in Norwegian) were divided and read aloud by one of the experimenters (an English translation of the instructions is included in the appendix). Subjects were encouraged to ask questions. Few questions were asked. After that the experiment started. Groups were formed in a random way and people could not identify the other members in their group. Groups remained the same during the session (Andreoni's (1988) partner design). In both treatments, all parameters of the experiment were common knowledge to all subjects. In particular, subjects knew that 10 rounds would be played and then, after a slight modification of the design, another 10 rounds.

In the first round of treatment PI each group member filled out on a decision form how much of the endowment of 20 tokens he or she wanted to invest in project A (the public bad). The remaining amount was allocated to project B. Forms were collected by the experimenters and the decisions were typed into computers. Total group investments

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<sup>5</sup>We have chosen not to change the order of the treatments because if treatment FI came first, in treatment PI subjects would be aware of the individual contributions, which could affect the decisions to be made in treatment PI. One might argue that the fact that FI comes second (after a restart) could affect the results, for instance because subjects are more experienced. However, several experimental studies (e.g., Andreoni (1988) and Croson (1996)) have established that decisions in the rounds after a restart are virtually identical to the behavioural pattern in the rounds before the restart, in particular among partners.

and payoffs were calculated by the computer and written down on the next (round 2) decision form. Then subjects were given these forms and were asked to write down an investment decision for round 2. After that the forms were collected, decisions typed, payoffs calculated etc. A total of 10 rounds was conducted in treatment PI.

The procedure in treatment FI was almost the same. The only difference was that when subjects made their investment decision, they also got to know the individual decisions of their group members of the previous round. Due to time constraints only 8 rounds were played in treatment FI.

At the end of the session, subjects were privately paid their earnings from all rounds. The tokens were transformed into money earnings at a rate of 1 token = 1 NOK. The session lasted somewhat longer than expected, namely almost two hours. Average earnings were NOK 121, including NOK 20 for showing up in time.

### *The Netherlands*

In the Netherlands we ran two sessions with three groups of five subjects each in November 1998. The groups are labelled groups C1, C2, C3, E1, E2 and E3. The Dutch subjects were students from Tilburg University, who were told that they could earn between Dfl 10 and 50 (\$ 4.5 - \$ 22.50) in about 1.5 hour, which turned out to be the actual duration. At the end of the session, the tokens earned in all rounds were transformed into money earnings at a rate of 1 token = Dfl 0.25. Average earnings were Dfl 27.10, including Dfl 5 for showing up.

## 4 Results

Table 1 presents the average contribution to the public bad (i.e. averaged over all rounds and groups) for the partial information treatment and the full information treatment for Norway and the Netherlands. Table 2 gives the average contribution to the public bad by treatment and by group. From the two tables we can derive the following observations:

**Observation 1:** On average, subjects behave as week free riders. Contribution levels are closer to the Nash prediction of 20 than to the Pareto efficient level (investing 0).

**Observation 2:** Contributions do not differ significantly between the two information conditions.

Observation 1 is roughly in line with the results of other studies. The level of cooperative behaviour is somewhat less than usually observed in public-good experiments. This may be explained by Andreoni's (1995) finding that subjects are more willing to cooperate when there is a positive externality (public good) than when there is a negative



Table 1: Average contribution to the public bad (project A) by country and treatment

country	PI	FI
Norway	14.79 (7.51)	12.81 (8.75)
Netherlands	17.63 (4.59)	18.18 (3.98)

Note: standard deviations between parentheses

Table 2: Average contribution to the public bad (project A) by treatment and group

	group	PI	FI
Norway	A1	10.10 (9.31)	11.93 (8.99)
	A2	16.98 (5.04)	12.38 (9.27)
	A3	17.28 (5.07)	14.13 (8.00)
Netherlands	C1	19.10 (2.23)	17.92 (2.75)
	C2	17.32 (4.72)	18.30 (4.39)
	C3	18.04 (4.28)	18.42 (3.33)
	E1	17.30 (4.55)	17.76 (5.60)
	E2	17.00 (5.70)	19.10 (2.56)
	E3	17.04 (5.15)	17.56 (4.42)

Note: standard deviations between parentheses

externality (public bad). Observation 2 confirms the public-good findings by Sell and Wilson (1991), Weimann (1994) and Croson (1997) that feedback on individual decisions has no significant effect on the average contributions: A non-parametric Wilcoxon test using session averages as units of observation results in  $p=0.25$  for the Netherlands ( $n_1=n_2=6$ ) and  $p=0.29$  for Norway ( $n_1=n_2=3$ ).

A cross-cultural comparison between Norway and the Netherlands suggests that the Norwegians are more cooperative than the Dutch: a Mann-Whitney test with session averages as units of observation shows that contributions to the public bad are significantly higher in the Netherlands in treatment PI ( $p=0.07$ ,  $n_1=3$ ,  $n_2=6$ ) and in treatment FI ( $p=0.02$ ,  $n_1=3$ ,  $n_2=6$ ). Although this finding is in line with experimental results by Lensberg and Van der Heijden (1998) who find that Norwegian subjects behave more cooperatively and display more reciprocity and trust than Dutch ones in a gift exchange experiment, and with field data on trust and cooperation for both countries (Knack and Keefer (1997)), one has to be careful here. In general, it might be that observed differences between countries are (partly) caused by uncontrolled differences in the experimental set-up. Although we have tried to minimise all possible framing effects (see footnote 4), there is one obvious discrepancy between the Norwegian and the Dutch

sessions, namely that the latter ones were computerised while the former one was run by hand (suggesting less anonymity).<sup>6</sup> This difference may explain the higher degree of cooperation among Norwegians. Actually, we can test this argument by comparing the results of the Norwegian session run by hand with the results of an additional, computerised session, which was run in Norway in April 1999 (as part of the ‘leader’ experiment). In this session, 3 groups of 5 subjects were involved in 10 rounds of treatment FI (and after that in another 10 rounds of a treatment with a leader). Analysing these new data, it turns out that Norwegian subjects are significantly more cooperative in the session run by hand than in the computerised session. Furthermore, there is no significant difference in behaviour between Norwegian and Dutch subjects in the computerised treatment FI. So, it seems that the fact that the experiment was run by hand is responsible for the higher level of cooperation in Norway. For our purposes, the fact that differences in the experimental set-up may lead to different outcomes is not a very serious problem, as we are mainly interested in the impact of information feedback. Although the set-up is different in the two countries, a comparison between treatments PI and FI within one country is still valid.

Further results on this comparison can be obtained if we look at the development over rounds. For both countries, Figure 1 depicts the average contribution to the public bad in each round for the partial and the full information treatment for the two countries. The dashed line is Norway, the solid line is the Netherlands. First of all, for both countries we observe a clear restart effect, like Andreoni (1988), Croson (1996 and 1997) find in a public-good experiment: the average contribution to the public bad in the first round of treatment FI (after the restart) is significantly lower than the average contribution in the last round of treatment PI. Furthermore, Dutch subjects behave very similarly in treatments PI and FI: In both treatments the average contribution starts at about 15 and then increases to almost 20 in the final rounds. In Norway, the distinction between the two information conditions is larger. In treatment PI contributions are rather constant at a level of about 15. After the restart, the average contribution is much lower and it even declines in the first rounds of treatment FI. In later rounds it increases again and it becomes almost 20 in the very last round. In later rounds of treatment FI in Norway, the average contribution approaches that in treatment PI.<sup>7</sup>

We can summarise these results as

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<sup>6</sup>In the experimental literature, the question whether anonymity of the subjects has any effect on subjects’ behaviour is not completely answered. Some authors (e.g. Hoffman et al. (1995)) suggest that subjects tend to behave more cooperatively if they think that their actions can be observed (by the experimenter), whereas for instance Bolton and Zwick (1995) find that anonymity does not matter in ultimatum games. Laury et al. (1995) show that in public-good experiments procedures taken to guarantee anonymity of the subjects do not lead to different results.

<sup>7</sup>This result is in line with Sell and Wilson’s (1991) and Weimann’s (1994) finding that the fall in contributions to the public good is more pronounced under full information.

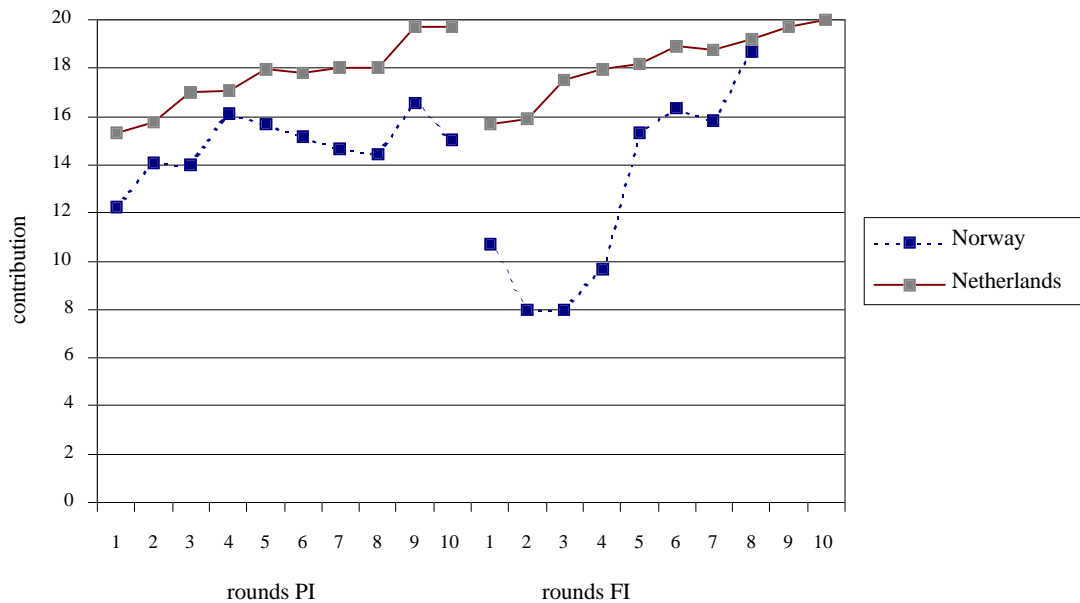


Figure 1: Development of the average contribution to the public bad for both countries and both information conditions

**Observation 3:** Behaviour across time in the two information conditions is very similar.

The only exception is the first rounds of treatment FI in Norway in which people seem to have a more cooperative attitude.

**Observation 4:** In both countries there is a restart effect.

The lower average contribution by Norwegians in treatment FI may be caused by lower contributions by all individuals or by some individuals contributing less. A closer look at the data at the individual player level suggests that the latter explanation is the correct one, i.e. it seems that in the early rounds of treatment FI a substantial number of Norwegian subjects want to signal a willingness to reduce contributions to the public bad, whereas Dutch do not try to do this.<sup>8</sup>

Related to this is the question about the distribution of the contributions under the two information conditions. A wide distribution may signal that there are clear free-

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<sup>8</sup>Put differently, in the Netherlands, the individual data of both information conditions show a very similar pattern. In Norway, however, several subjects show more cooperative behaviour in the first rounds of treatment FI. For instance, the modal contribution in the first two rounds of treatments PI is 20, whereas it is 0 in treatment FI. Interestingly, besides some people who contribute 20 in all rounds of both treatments, some of the Norwegian subjects who contribute 20 in all rounds of treatment PI turn out to contribute 0 in the first four rounds of treatment FI. Consequently, payoffs are distributed relatively uneven in these rounds. It might be that this perceived unfairness and feelings of disappointment induced these people with a cooperative attitude to contribute 20 in later rounds of treatment FI.

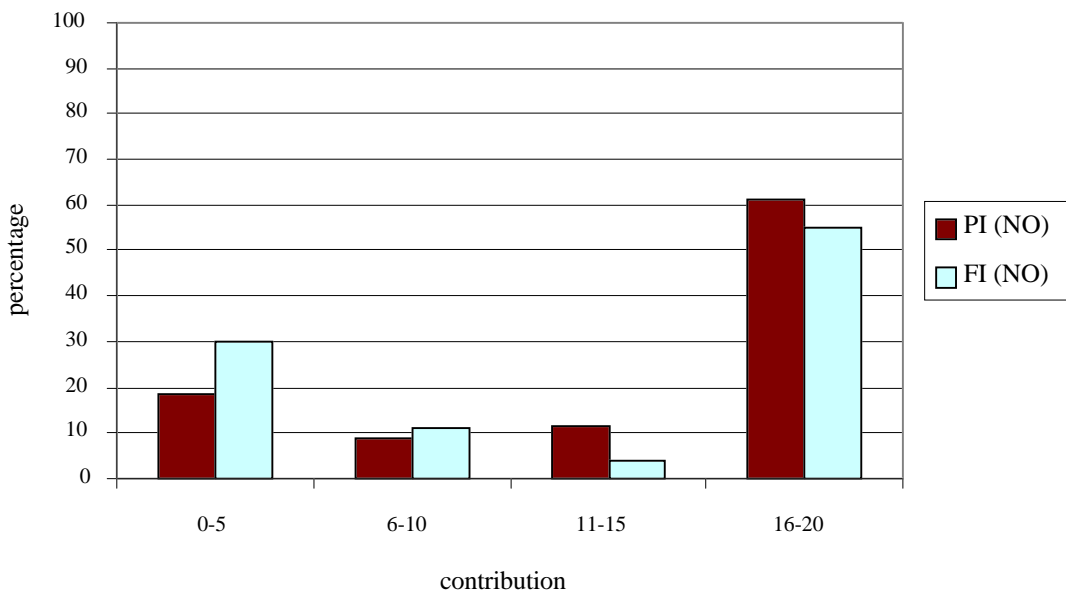


Figure 2: Frequency distribution of contributions to the public bad in treatments PI and FI in Norway

riders and clear cooperators, whereas a narrow one suggests an equal division of the pay-offs among the subjects. The mere fact that the distribution is observable in treatment FI could lead to differences, also between the countries. Therefore, we want to investigate the variation of the contributions. Croson (1997) finds that contributions under full information have a significantly higher variance than those under partial information. To see if we can replicate this finding we consider the standard deviations of the contributions by group, averaged over all rounds. Averaged over all groups, the mean standard deviations are 4.88 (3.64) and 7.83 (2.81) for treatments PI and FI in Norway (the Netherlands), respectively. It turns out that in Norway, there is (marginally) significantly more variation in the contributions under full information than under partial information ( $p=0.10$ ,  $n_1=n_2=3$ ), whereas there is no significant difference in the Netherlands ( $p=0.17$ ,  $n_1=n_2=6$ ). A comparison of the variation across countries shows that there is no difference for treatment PI ( $p=0.20$ ,  $n_1=3$ ,  $n_2=6$ ), but that for treatment FI the contributions by the Norwegian subjects have significantly higher variances ( $p=0.02$ ,  $n_1=3$ ,  $n_2=6$ ).

This is also illustrated by Figures 2 and 3, which depict the frequency distributions of the contributions to the public bad for both information condition for Norway and the Netherlands, respectively. In the Netherlands, the distributions are very similar. Almost 80% of the contributions are lying between 16 and 20 (more than 70% is equal to 20). In Norway, on the other hand, contributions in the interval 0-5 are relatively frequent.

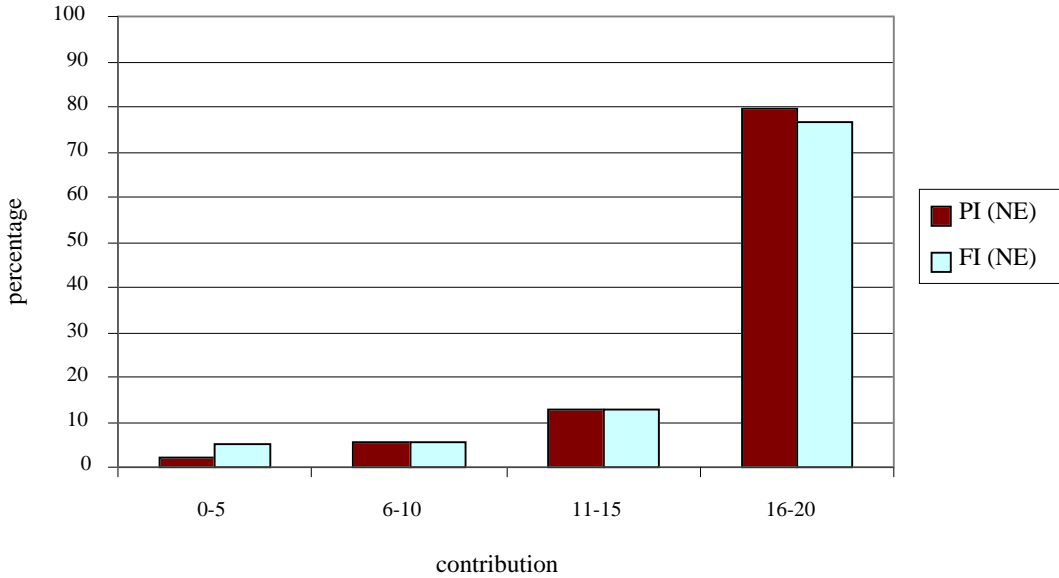


Figure 3: Frequency distribution of contributions to the public bad in treatments PI and FI in the Netherlands

Furthermore, under full information Norwegian subjects contribute relatively often zero (28%) and less often 20 (54%) to the public bad compared with the situation under partial information (16% and 59%, respectively). This explains the higher variance for treatment FI in Norway. We can summarise these findings as

**Observation 5:** In the Netherlands, the information condition has no impact on the distribution of the contributions. In Norway, contributions to the public bad in treatment FI are somewhat more spread than in treatment PI.

Additional insights may be obtained by using data by round. A simple regression analysis can give an overall picture of the relative effects of the various factors mentioned above.<sup>9</sup> To detect any difference in contributions between the partial and the full information treatment and between Norway and the Netherlands we have run an OLS regression for each country separately with fixed effects for the information condition and the groups. The dependent variable is a vector consisting of the the average contributions to the public bad by a group in a particular round (*contr*) for all groups in a particular country. The model we estimate reads

$$contr = \beta_0 + \beta_1 lag(contr) + \beta_2 sdFI + \beta_3 roundPI + \beta_4 roundFI + \beta_5 dumPI + \varepsilon \quad (2)$$

<sup>9</sup>Implicitly, it is assumed here that the observations are independent, which is not the case, strictly speaking. Regressions using individual observations are rather common in experimental research, though, particularly for illustrative purposes.

where  $lag(contr)$  is the average group contribution to the public bad in the previous round,  $roundPI = round \times dumPI$  and  $roundFI = round \times dumFI$  represent the round number in treatments PI and FI respectively,  $sdFI = sd \times dumFI$  is the standard deviation of the average group contribution in the previous round in treatment FI (and 0 in treatment PI as there the individual contributions are not observed). The variable  $dumPI$  (which equals 1 in treatment PI) is included to allow for differences across treatments (including the restart effect). To this model we add the fixed effects for the groups (constants). Regression results for each country separately are depicted in Table 3.<sup>10</sup>

Table 3: Estimation results for the average group contribution to the public bad

	Norway		Netherlands	
	coefficient	p-value	coefficient	p-value
$lag(contr)$	0.50	0.00	0.41	0.00
$sdFI$	0.47	0.17	0.12	0.28
$roundPI$	-0.04	0.83	0.27	0.00
$roundFI$	1.50	0.00	0.25	0.01
$dumPI$	12.27	0.00	-0.16	0.88
constant	-6.07	0.15	8.80	0.00
Adjusted $R^2$		0.73		0.47
observations		48		108

Basically, the estimation results confirm the previous findings. In particular, the estimates for  $dumPI$  suggest that in Norway the average group contribution to the public bad is significantly higher in treatment PI than in treatment FI, whereas there is no significant difference in the Netherlands. In both countries, more free-riding in the previous round results in even more free-riding in this round. As suggested by the positive estimates for the variables indicating the round, the average group contributions increase across rounds except for treatment PI in Norway where the average contribution remains more or less constant. The insignificance of the estimates for  $sdFI$  suggests that the spread of the group contributions in the previous rounds has little impact on the average group contribution in this round. The regression results seem not sensitive to

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<sup>10</sup>The estimates for the group effects are not reported as they are not so important on themselves. The estimation results are very similar if we include the group effects or not. Concerning the group effects it turns out that in the Netherlands there does not seem to be any effect at all, i.e. all groups behave similarly, while in Norway one group (A1) seems to behave differently. It is also this group that prevents us to find statistically significant differences between the contribution levels in treatments PI and FI. The reason is that in group A1 contributions are higher in treatment FI compared with PI, whereas the reverse holds for the other two groups in Norway (see Table 2).

the chosen specifications. For instance, if we run a regression without *sdFI*, or if we use pooled data for Norway and the Netherlands we find similar results.

## 5 Concluding discussion

This paper has presented the results of a public-bad experiment in which the amount of information has been varied. In treatment FI subjects know the individual contributions while in treatment PI they do not know this. We performed both information treatments in Norway and the Netherlands. In line with the literature on the impact of information feedback in public-good experiments, we find that in general providing additional information is not very conducive to prevent the occurrence of a public bad. But the results depend on the country. In the Netherlands, we observe no difference between both information treatments, while in Norway average contributions are somewhat lower in case of full information. Actually, if we impose less severe requirements on the independence of the observations and run a regression analysis, we find that Norwegian subjects behave significantly more cooperatively in treatment FI compared with treatment PI. Comparing the contributions in the two countries we find that in both information treatments Norwegian subjects display a larger degree of cooperation. Although this finding seems to be in line with Lensberg and Van der Heijden (1998), who find that Norwegian subjects display more trust and cooperation than the Dutch participants, in particular in situations in which the actions of others can be observed and possibly be reciprocated, it cannot be excluded that the observed differences are due to differences in the experimental set-up.

Our experimental results suggest that providing information about individual contributions is not sufficient to reduce free-riding behaviour. That is, to increase cooperation, to reduce pollution and to improve the quality of the environment it seems that we need more than mere information feedback. Our findings do not rule out the possibility that knowledge about individual contributions could have significant effects in other settings, for instance when performing negotiations. Face-to-face communication has been found to contribute towards Pareto efficient solutions (e.g. Ostrom et al. (1994), Dawes et al. (1977) and Isaac and Walker (1988)), even in the case of imperfect monitoring (Cason and Khan (1999)). Based on the positive effect of full information for Norwegian subjects, who were found to free-ride less in treatment FI, one might speculate that the effect of knowledge about individual contributions depends on the general willingness to contribute. However, this is a question for further research, as well as the question about how efficient other forms of communication could be.

## Appendix: Instructions for the experiment

This appendix contains an English translation of the instructions for the experiment as conducted in Norway.

### Welcome

This is an experiment to investigate investing behaviour. The instructions are simple. If you follow them carefully, you can earn a considerable amount of money. Earnings will be paid in cash immediately after the experiment. In addition, you receive NOK 20 for showing up. The money is supplied by the Norwegian Research Council.

In the experiment you first have to make 10 investment decisions, one in each round. After that we will change the design slightly and there will be 10 additional decision rounds. The payoffs of all 20 rounds determine your total earnings.

During the experiment you belong to a group together with four other subjects, which are the same persons all the time. Your payoffs will depend on your own decisions and on what the other four members of your group decide. The design is such that nobody is able to find out which persons belong to a group and what decisions persons have made. In other words, you are anonymous.

### Investments and payoffs

In each round, you (and all others in your group) can invest an endowment of NOK 20. So, in total, NOK 100 per round is invested. You can invest in two different projects: project A and project B. You write down how much you want to invest in project A, the rest of your endowment is then automatically invested in project B. Project A yields a direct payoff of NOK 0.70 per crown invested. Note, however, that in addition to the payoff for yourself, investing in project A yields an additional cost of NOK 0.10 per crown invested for you and the other four members in your group. Similarly, investments in project A by the other members gives a cost for you and the other subjects. Project B yields a direct payoff of NOK 0.40 per crown invested. Investments in project B have no (indirect) impact on the payoffs for others. All persons in a group are in the same position.

To make it easier to see the consequences for your payoffs of the investment decisions made by you and the others, we have computed the payoffs for several combinations. To limit the size of the table we only mention investments in steps of 5. However, you can use all integers from 0 up to and including 20 when you choose your investment in project A.

An example shows how the numbers in the table are computed. Assume that you invest NOK 10 in project A. Then you receive a direct payoff of NOK 7 from project



Table 4: Table for your own payoff per round

average investment in project A by the others	Your own investment in project A				
	0	5	10	15	20
0	8	9	10	11	12
5	6	7	8	9	10
10	4	5	6	7	8
15	2	3	4	5	6
20	0	1	2	3	4

A. The rest of your endowment, NOK 10, is automatically invested in project B, and yields a payoff of NOK 4. Together this generates a direct payoff of NOK 11. Assume furthermore that the other four persons in your group invest on average NOK 5 in project A. That gives a total investment of NOK 20 in project A for these four persons. Together with your own investment of NOK 10 this gives a total investment in project A of NOK 30. This yields a cost of NOK 3 for you (and for the others). A direct payoff of NOK minus a cost of NOK 3 gives your own payoff of NOK 8.

## Practical design

Every round you receive a form on which you write down how much you want to invest in project A (integers from 0 up to and including 20). The forms are collected by the experimenters. For each round after the first one, on this form you get also information about the previous round: your own payoff and the total investment in project A by all persons in the group (at most NOK 100 per round). You are not informed about the payoffs of your group members. You can show that you have made your decision by putting your form upside down on your desk. After 10 rounds we inform you about the changes in the rules for the last 10 rounds.

**Do not communicate with the other participants and try to avoid the possibility that others see your form!**

You can now ask questions for clarification.

Good luck.

After the first 10 rounds, the following procedure for the last 10 rounds was announced.

We will now make investment decisions for another 10 rounds. You stay in the same group with the same 4 participants. The only difference is that now in each round after the first one, you are informed about your own payoff, the investment in project A by all other members of your group, and the total investment in project A by all persons in the group (at most NOK 100 per round). Everything else stays the same.

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