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## **Voluntary Standards and Coordination in Public Goods Games**

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# Voluntary Standards and Coordination in Public Goods Games \*

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*Abstract:* Contributions to public goods are often unobservable. In order to make contributions visible, voluntary standards are used, which make a particular contribution level publicly observable. This paper investigates the effect of such partial information on the contributions to public goods. First, we observe that the implementation of a too low standard level leads to the lowest efficiency. Second, we find that standards function as a coordination device. Higher standards give rise to higher modal contribution but the likelihood that the standard level is reached gets lower. Third, conditional cooperation is observed in the sense that subjects are more likely to comply with the standard as the number of group members who previously complied with it is higher.

*Key-Words:* Public goods, Information, Standards, Coordination.

*JEL codes:* C92, D83, H41

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## 1. Introduction

Public goods such as a clean environment are vital to be sustained. Many studies in the experimental economic literature have been devoted to understand behavior in public goods games (see Anderson, 2001, and Ledyard, 1995, for reviews). In most of these studies participants learn their own payoff from which they can infer other participants' average behavior. In reality, in only very rare situations this information is available. Most of the time, people only observe partial information regarding others' behavior toward a common pool such as a public goods. Voluntary standards are one way how partial information is transmitted. They convey the information whether a specific threshold, for example with respect to environmental friendliness is reached. Such voluntary standards have recently been extensively used to certify the environmental quality of products.<sup>2</sup>

The aim of this study is to get insights into the effect of a specific type of partial information, the information whether an agent contributes more or less than a predefined voluntary standard amount to the public goods. Our study evaluates how such partial information affects contribution. We run a laboratory experiment, in which we vary the information subjects receive as feedback. We analyze the contribution behavior for four different levels of the voluntary standard. We compare these contribution patterns with two benchmarks, a situation without any information and a situation with full information. Moreover, we analyze the effect of voluntary standards on conditional cooperation, i.e., we investigate whether subjects condition their decision to comply with the standard on the number of other group members' who complied with the standard in the previous period.

This study is related to the literature on categorization of donations. If donations are published in categories then category borders serve as standards. Different to our setting there

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<sup>2</sup> Some firms affix a label on their product in order to signal whether their product is environmentally-friendly, such as "Blue Angel" in Germany, "NF Environnement" in France, "Environmental Choice" in Canada, Australia and New-Zealand or "Blue Energy Star" in the United States.

are several “standards”. In this literature, it has been shown that when donations are categorized and made public in classes, they concentrate on the lower bound of each class (Glazer and Konrad, 1996, Harbaugh, 1998a, Harbaugh, 1998b). Laboratory experiments without anonymity confirm this finding in dictator games (Li and Riyanto, 2009) as well as in public goods games (Andreoni and Petrie, 2004, and Rege and Telle, 2004). We are interested in how the level of the standard affects efficiency, what these studies do not address. Furthermore, we are interested in the coordination function of the standard. Therefore, we try to avoid that people are motivated by the prestige motive and propose an experiment with anonymity about participants’ contributions to the public goods.

Our study also adds to the literature on mechanisms that favor public goods provision. The introduction of a punishment option is one of the most powerful mechanisms to induce higher contributions to public goods (Andreoni, Harbaugh and Vesterlund, 2003, Fehr and Gächter, 2000, Masclet, Noussair, Tucker and Villeval, 2003, Sefton, Shupp and Walker, 2007). However, punishment is not always possible and punishment can be counter-productive when subjects punish contributors to the public goods (Cinyabuguma, Page and Putterman, 2006, Denant-Boemont, Masclet and Noussair, 2007, Hermann, Thöni and Gächter, 2008, Nikiforakis, 2008). Communication also fosters contributions (Bochet, Page and Putterman, 2006, Cason and Khan, 1999, Charness and Dufwenberg, 2006, Ellingsen and Johannesson’s, 2004, Isaac and Walker, 1988), but communication is difficult when the market is large or when agents do not meet. As a high percentage of individuals are conditional cooperators (Fischbacher, Gächter and Fehr, 2001, Fischbacher and Gächter, 2010, Levati, 2002), the implementation of partial information in the form of voluntary standards might be another way to foster cooperation. The underlying mechanism is that the standard level can serve as a coordination device for the conditional cooperators. They

provide little but salient information, which can explain why voluntary standards are present in many markets.

We show that the implementation of a too low standard level leads to lower efficiency than higher standards and providing no information. We also find that standards function as a coordination device, but the higher the standard level, the fewer people coordinate on this level. Furthermore, conditional cooperation is observed with respect to complying with the standard level, i.e., more people comply with the standard as the number of other group members who complied with it at the previous period increases. We detect stronger conditional cooperation when higher standard levels are implemented.

In section 2 we present the experimental design and procedures. We analyze the results in section 3. Finally, we conclude in section 4.

## 2. Experimental Design and Procedures

### 2.1. Design

We use standard four person linear public goods games. Each agent is endowed with 20 tokens and decides how much to invest into the public goods and which amount she wants to keep for herself. The individual marginal return of an investment  $g_i$  into the public goods equals 0.4. Since group size is 4, the social marginal return is then 1.6. Thus, the payoff function of agent  $i$  is the following:

$$\pi_i = 20 - g_i + 0.4 \sum_{j=1}^4 g_j \quad (1)$$

The game is repeated for 10 periods. The composition of groups remains the same for the 10 periods. Our treatments differ in the feedback that is provided after every period. In the four interest treatments, a voluntary standard is implemented. Each agent complies with the standard if she contributes the level of the standard or a higher amount to the public goods.

Four levels of standards are tested and thus four treatments are organized: Level 4 treatment, S4, Level 8 treatment, S8, Level 12 treatment, S12 and Level 16 treatment, S16. At the end of each period, all group members learn how many agents complied with the standard in this period: they are informed about how many of the other group members contributed between 0 and the standard level minus one, and how many contributed between the standard level and 20. The subjects did not receive any information apart from this standard level information and the information was presented in this neutral form. This means that the standard level was not explicitly introduced. For instance, in the treatment in which the voluntary standard was 4, 3 as well as 4 are at the limit of the ranges. Anchoring could in principle activate people to report 3 or 4. So we can exclude anchoring if we do not observe clustering also at the standard minus 1 level. This is actually the fact..

To understand whether the implementation of a voluntary standard is beneficial at all, in the first control treatment agents receive no information at the end of each period. This treatment is called the “No information treatment”, NI. In the other control treatment, the “Full information treatment”, FI, full information is provided to agents where people learn at the end of every period the exact contribution of other members in the group.<sup>3</sup>

Once all agents have played the first 10 periods, in all six treatments, they received complete information about all contributions and payments, i.e., on their own contributions and payments as well as those of every person in the group. Then, a second part started. The second part is identical to the first part except with respect to the composition of groups. The existence and the rules of this second part are common knowledge at the very beginning of

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<sup>3</sup> Most experimental studies on the analysis of behaviors in public goods games can be assimilated to our Full information treatment. In most studies, either agents learn the exact contribution of other members in the group or they learn their own payoff and then can deduce the sum of contributions of other members (see Anderson, 2001, or Ledyard, 1995, for a survey of behaviors in public goods games with this type of information). Cason and Khan (1999) show that average contributions to the public goods are not significantly different when agents receive information on other group members' contributions or only on their own payoff.

the experimental sessions, i.e., before agents play the first part. This second part is necessary to let agents learn the effect of the voluntary standard on behaviors and payments.

## **2.2. Predictions**

According to standard economic theory, each agent maximizes her own profit. In this game there is a dominant strategy to contribute zero. This prediction is independent of the feedback and, therefore, full information, partial information or no information about group members' contributions to the public goods should not alter agents' behaviors in the public goods game. However, if subjects are conditionally cooperative, then they will provide higher contribution if they believe that the others do contribute as well. This means that sufficiently conditional cooperators actually play a coordination game. Thus, the standard can have two effects. First, it can serve as a coordination device for the conditional cooperators. Second, in the repeated game, selfish subjects mimic conditional cooperators in order to keep cooperation high (Kreps et al. 1982). Of course, they will never contribute more than the standard. If conditional cooperators are aware of this fact, they will also not be willing to contribute more than the standard.

The implementation of a voluntary standard induces some people to contribute exactly the amount of the voluntary standard as higher contribution levels are not observable by other group members. Thus, two focal points exist: zero and the standard level. The effect of the level of the standard on average contribution is nevertheless ambiguous. The higher the standard, the more risky is cooperation – also for conditional cooperators. Therefore, we expect that the probability that the standard is provided decreases with the level of the standard. Thus, on the one hand, a high standard level yields to higher contributions by those who comply with the standard. On the other hand, fewer people might be willing to achieve high rather than low standards.



### 2.3. Procedures

The experiment has been conducted at the University of Konstanz, Germany. Participants have been recruited via the ORSEE software (Greiner, 2004) and the experiment has been programmed with z-Tree (Fischbacher, 2007). In total, 12 experimental sessions have been conducted, which represent a total of 252 participants. Subjects participated in only one treatment. Table 1 summarizes the number of subjects participating in every treatment as well as the number of groups in each part of the experiment and the number of matching groups. Subjects were in different groups in the two parts of the experiment but subjects were always matched within the matching group. Thus, subjects in different matching groups are unrelated in the first part and in the second part of the experiment and the observations are independent between different matching groups.

<b>Treatments</b>	<b>Abbreviation</b>	<b>Number of subjects</b>	<b>Number of groups</b>	<b>Number of matching groups</b>
No Information	NI	44	11	5
Standard at 4	S4	40	10	4
Standard at 8	S8	36	9	4
Standard at 12	S12	48	12	6
Standard at 16	S16	40	10	4
Full Information	FI	36	9	4
<b>Total</b>		<b>244</b>	<b>61</b>	<b>27</b>

*Table 1. Description of treatments*

Each participant was randomly assigned to a cubicle guaranteeing the anonymity of the experiment. After having read the instructions, each participant had to answer a questionnaire on the instructions (instructions and questionnaire can be found in appendix C). The experiment started only once all participants had correctly answered every question in the questionnaire. The conversion rate was 1 token equals 0.015€ On average, they earned,

10.43€ (about 14.30\$ at the time of the experiment), including a showup fee of 3€. The experiment lasted about 90 minutes.

### **3. Results**

We address the following questions: *(i)* Does the implementation of a voluntary standard increase or decrease contributions to the public goods? and *(ii)* How are coordination and conditional cooperation affected by the implementation of a voluntary standard? To answer these questions, we first present descriptive statistics about average contributions to the public goods and their evolution in each of the treatments we run. Because agents must learn the effect of the implementation of standard to make conscious decisions, we focus our analysis on agents' behavior in the second part of the experiment when answering question *(ii)*.<sup>4</sup>

#### **3.1. Main treatment effects**

We first analyze the effect of the implementation of a voluntary standard on the average contribution of agents. Table 2 describes the average contributions separating the two parts of the experiment, i.e., before and after the feedback about payments on the 10 first periods. Moreover, we differentiate periods 1, periods 1 to 8 and periods 9 and 10. We are interested in the first period of each part because it is uninfluenced from experience in the group and we separate the last two periods because there is a strong endgame effect in partner matching public goods games.

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<sup>4</sup> Results about the first part can be found in Appendix A.

	Part 1				Part 2			
	Period 1	Periods 1-8	Periods 9 and 10	Total	Period 11	Periods 11-18	Periods 19 and 20	Total
NI	8.95	8.60	8.66	8.61	7.14	7.17	7.10	7.15
S4	8.43	6.72	5.31	6.44	5.98	4.82	3.43	4.54
S8	9.81	9.51	5.44	8.69	10.08	8.57	5.63	7.98
S12	9.60	8.65	6.97	8.31	8.35	7.46	4.38	6.84
S16	9.25	8.49	6.68	8.13	11.05	9.80	6.41	9.12
FI	11.81	11.22	5.78	10.13	12.36	11.47	5.22	10.22

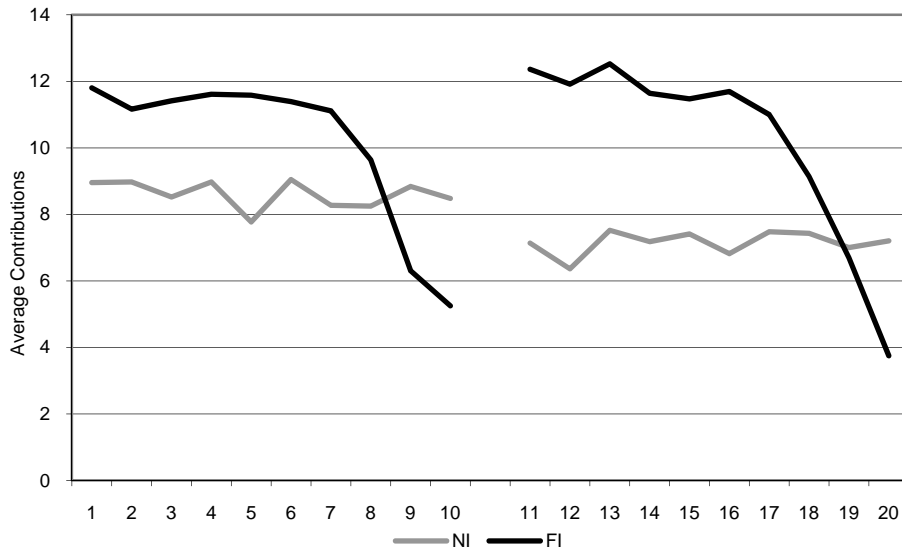
*Table 2. Average contributions by treatment*

To understand implications of the implementation of partial information such as voluntary standards, we compare average contributions to the public goods in the treatments S4 to S16 with benchmark treatments NI and FI. All results of the Wilcoxon rank-sum tests with various specifications of independent observations are provided in appendix A.<sup>5</sup> We find that contributions in the S4 treatment are significantly lower compared to contributions in treatments with higher standard levels, i.e., in S8, S12 and S16. Efficiency is also lower if standard level 4 is implemented than if no information is provided. Contributions induced by the implementation of higher standards are not significantly increased, neither compared to the situation without any information nor compared to the situation with full information.<sup>6</sup> Thus, a high standard do not help or at least not much, but the implementation of a low standard leads to efficiency losses compared to higher standards.<sup>7</sup>

<sup>5</sup> We use as independent observations average contributions per group as well as per matching group in part 2 from periods 1 to 8 as contributions undergo a end-game effect. Moreover, we use average contributions in the first period of part 2 per group in part 1 as in the first period of part 2, observations are independent regarding the group subjects belong to in part 1.

<sup>6</sup> We observe higher average contributions in the S16 treatment compared to in the NI treatments but the difference is not significant.

<sup>7</sup> Efficiency is defined as the amount of the public goods financed.



*Figure 1. Evolution of contributions in the NI and FI treatments*

Figures 1 and 2 show the evolution of contributions over periods. Figure 1 confirms previous results in the literature on public goods games. When agents perfectly observe the contributions of other group members at the end of each period, at least some agents try to cooperate and manage to reach a positive average contribution. Nevertheless, end-game effects are observed: Contributions strongly decrease as periods approach the end (see Anderson, 2001, and Ledyard, 1995, for a review of similar results in the literature). As people do not receive any information at the end of each period in the NI treatment, average contributions are stable across periods. A decrease in contributions occurs between the first and the second part.<sup>8</sup>

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<sup>8</sup> This phenomenon could be explained by the fact that one part can be assimilated to one period in the NI treatment. Therefore, we would expect a decrease of average contributions for subsequent parts if there were more than two parts organized.

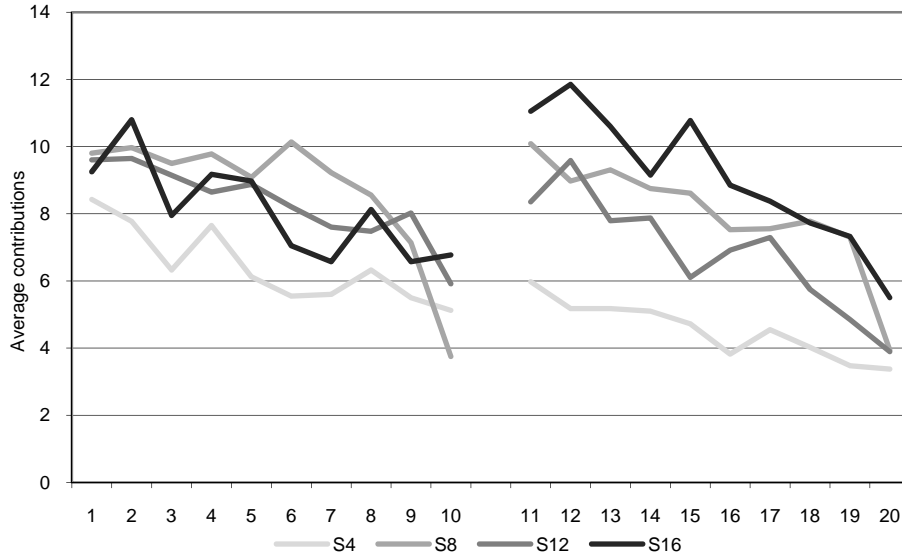


Figure 2. Evolution of contributions in the treatments with voluntary standards

If a standard is implemented, the decrease of contributions is also observed. However, the endgame effect is less pronounced than in the FI treatment.<sup>9</sup> Because of these strong endgame effects, we restrict our analysis to periods 1 to 8 in the following section of the paper.<sup>10</sup>

### 3.2. Voluntary standards as a coordination device

The standard levels are reasonable focal points for contributions. We expect them to be chosen with high frequency. We investigate this conjecture using a detailed study of the distribution of contributions. In this section we clarify whether the two focal points previously suggested, i.e., zero and the standard level, are observed in the data in the treatments with voluntary standards. After the description of the distribution of contributions in all six treatments, we explain what changes occurred when a voluntary standard is implemented compared to a situation with no information or full information.

<sup>9</sup> We run linear regressions explaining contributions with a time trend, dummies for treatments and crossed variables as explicative variables. We find that the negative effect of the time trend on contributions is significantly stronger in the FI treatment than in any treatment with voluntary standard (except for treatment S8 in part 1) if we include only final periods, i.e., periods 6 or 7 to 10 for part 1 and periods 16 or 17 to 20 for part 2.

<sup>10</sup> As we concentrate on part 2 of the experiment and there is a rematching of agents at the beginning of part 2, we rename periods 11 to 20 into periods 1 to 10.

Figure 3 and Figure 4 present the frequency of contributions in each treatment.

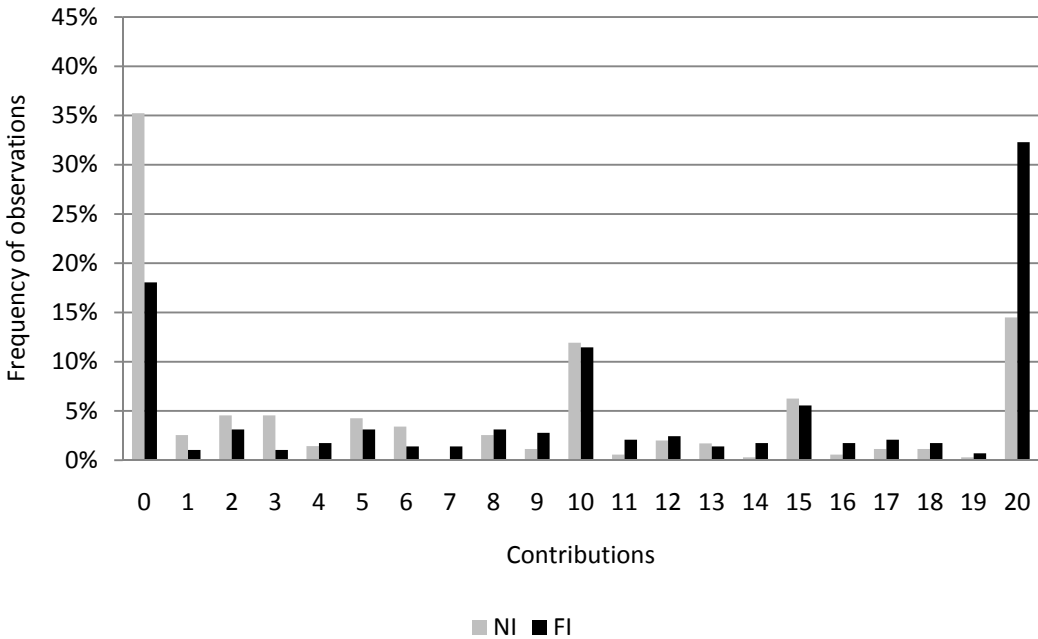


Figure 3. Distribution of contributions in the NI and FI treatments

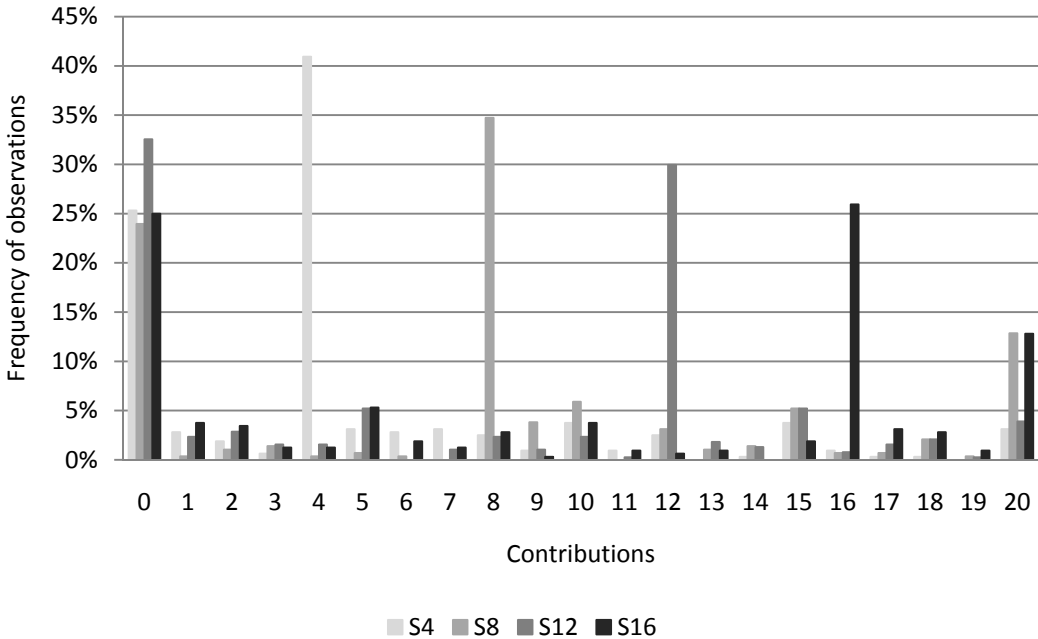


Figure 4. Distribution of contributions in the treatments with voluntary standards

Figure 3 shows that in the control treatments, many subjects contribute zero: 35.2% and 18.1% of agents' contributions are equal to zero respectively in the NI and the FI treatments. No other contribution amount can be seen as a focal point except 20: 14.5% and 32.3% of agents' contributions are equal to 20 respectively in the NI and the FI treatments. Figure 4, which represents the distribution of contributions in the treatments with voluntary standards, gives a very different picture (the Kolmogorov-Smirnov test rejects at 1% the hypothesis of equal distributions of the average contribution by group between the treatments with voluntary standards and the control treatments).

Table 3 synthesizes distributions of contributions for treatments with voluntary standards. We classify contributions into four categories: contributions equal to zero, contributions between zero and the standard level, contributions equal to the standard level and contributions between the standard level and 20.

Contributions	0	]0;Standard[	Standard	]Standard;20]
S4	25.31%	5.31%	40.94%	28.44%
S8	23.96%	4.17%	34.72%	37.15%
S12	32.55%	20.57%	29.95%	16.93%
S16	25.00%	29.38%	25.94%	19.69%

*Table 3. Frequencies of contributions in the treatments with voluntary standards*

It is clear that two focal points exist in every treatment with voluntary standard: contributing zero and contributing the standard level. While between 25% and 41% of people coordinate on the standard level in the treatments with voluntary standards, in the control treatments, the highest share of people playing one standard level is only 5%. In all treatments with voluntary standards, subjects are significantly more likely to contribute the standard level to the public goods than in the NI and FI treatments but not more likely to contribute zero (see appendix B for results of the Wilcoxon rank-sum tests). Hence, the implementation

of a voluntary standard can be seen as a coordination device.<sup>11</sup> From these results, we deduce that differences in average contributions in the treatments with voluntary standards and the control treatments do not come from a general increase or decrease of all agents' contributions but from coordination on a new focal value that is exogenously determined and that corresponds to the standard level.

Further, comparing coordination in the various treatments with voluntary standards, the data show that the higher the standard level, the lower the share of people choosing to contribute exactly the standard level. The Spearman's rank correlation coefficient between the level of the standard and the share of people choosing to contribute exactly the standard level is equal to -0.336 (-0.412) and is significant at the 5% (10%) level if we use groups as independent observations (if we use matching groups as independent observations).

To precise our analysis of the role of voluntary standards as coordination devices, we now focus on the direction of coordination. Four different scenarii are hypothesized. The convergence toward the standard level may be due to *(i)* a higher contribution of all people who contribute less than the standard level, *(ii)* a lower contribution of all people who contribute more than the standard level, or local changes, *(iii)* a higher contribution of people who contribute slightly less than the standard level and *(iv)* a lower contribution of people who contribute slightly more than the standard level.

Figures 5a to 5d illustrate the corresponding expected results in each of the four hypothetical cases for the uniform distribution as a reference. The vertical line represents a general standard level.

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<sup>11</sup> The coordination on these two focal points is stronger in the second part of the experiment. It means that, as expected, people need to observe the effect of a standard to really appreciate its value. The mechanism is fully understood only once participants have been able to observe and evaluate the impact of the standard.



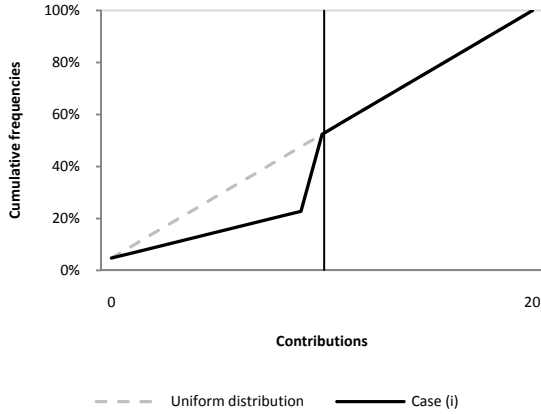


Figure 5a. Case (i)

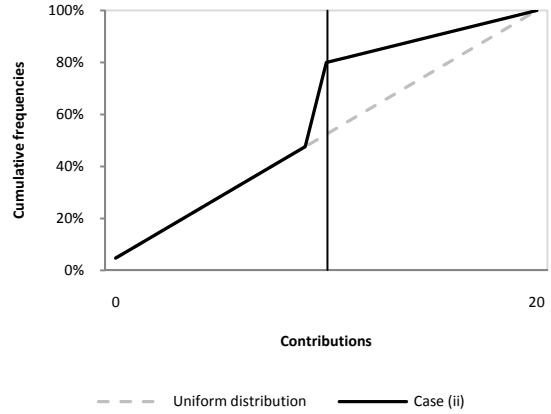


Figure 5b. Case (ii)

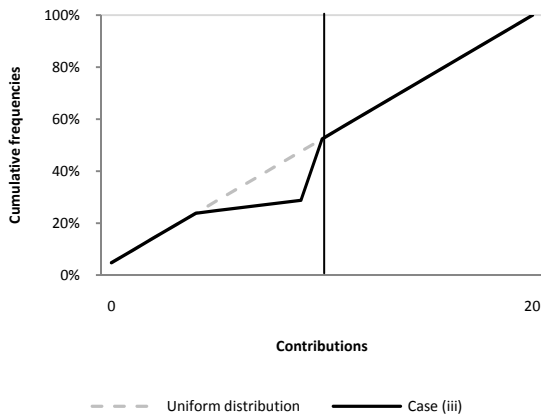


Figure 5c. Case (iii)

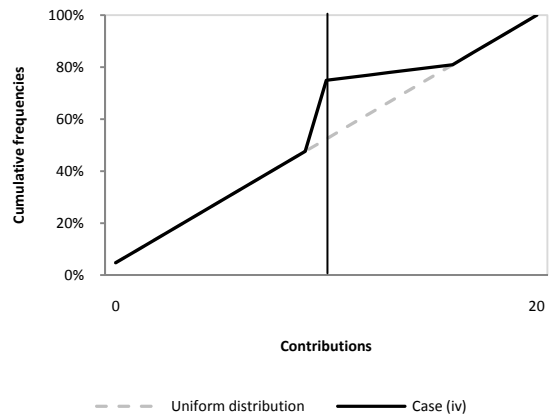


Figure 5d. Case (iv)

We represent observed distributions in the data in the same way as the theoretical distributions just presented. Figures 6a to 6d present the cumulative distributions of contributions in each treatment with voluntary standards as well as distributions in both NI and FI treatments. For results of the Wilcoxon rank-sum tests showing significance of differences between the numbers of observations for specific ranges of contributions between treatments with voluntary standard treatments and control treatments, report to appendix B.

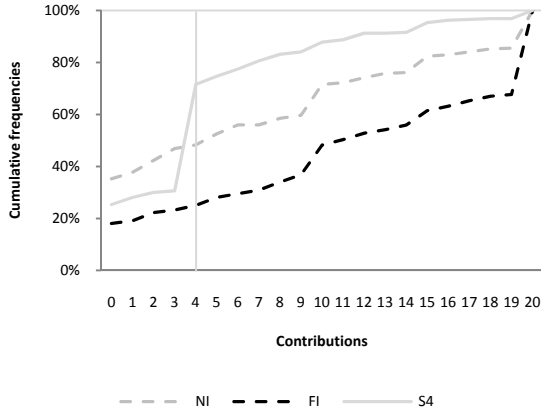


Figure 6a. Treatment S4

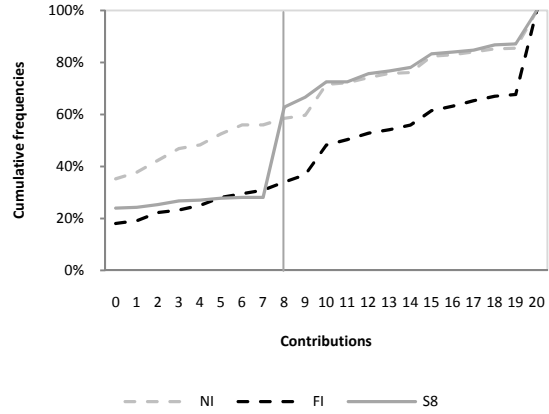


Figure 6b. Treatment S8

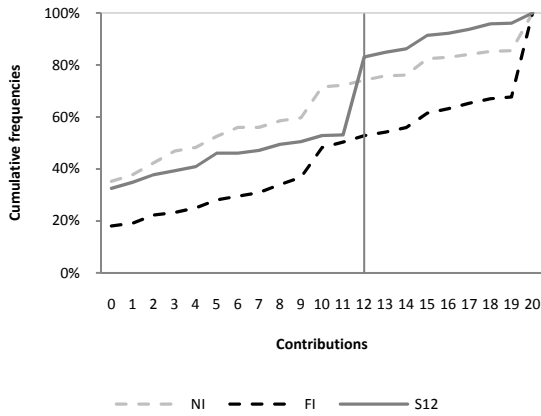


Figure 6c. Treatment S12

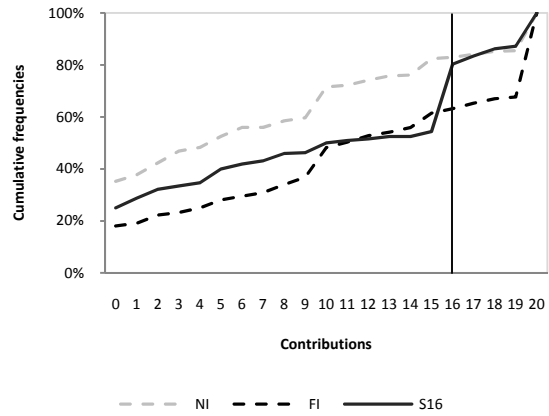


Figure 6d. Treatment S16

We observe first that the number of contributions below the standard level is significantly lower in the treatments with voluntary standards than in the NI treatment for any level of the standard. Second, the number of contributions above the standard level is significantly lower only in the S4 treatment compared to the NI treatment. Therefore, we can conclude that relatively to the NI treatment, coordination on the standard level is due to an increase of contributions below the standard when the standard is sufficiently high, i.e., in S8, S12 and S16, but to both an increase of contributions below the standard and a decrease of contributions above the standard when the standard is low, i.e., in S4. More precisely, when the standard is high, i.e., in S12 or S16, only local contributions are increased. Compared to the FI treatment, coordination on the standard level comes from a strong decrease of the

number of contributions higher than the standard level. This strong effect is mainly due to a decrease of very high contributions, i.e., contributions higher than 16.

### 3.3. Conditional cooperation

In this section, we focus on individual contributions and we explain these contributions by conditional cooperation, i.e. we analyze how contributions depend on the behavior of other group members. Trivially, people who comply with the standard contribute more if the standard level is high. For this reason, we examine conditional cooperation based on the visible contributions. This means that we analyze how the number of other agents complying with the standard affects the own propensity to contribute at least the standard level. Table 6 shows the probability to comply with the standard, i.e., to contribute at least the standard level, conditional on how many other subjects complied with the standard in the previous period for the four treatments with voluntary standards. The slope of the equation of the linear curve approximating the share of contributions that reach the standard in function of the number of other group members complying with the standard in the previous period, i.e., the slope of conditional cooperation, is presented in the last column of table 4. The slope in function of the treatment, i.e., in function of the standard level, is presented in the last line of table 4.

# others complying with the standard in the previous period	0	1	2	3	Slope CC
S4	0.40	0.61	0.57	0.85	0.133
S8	0.67	0.55	0.73	0.77	0.048
S12	0.19	0.37	0.57	0.68	0.165
S16	0.12	0.23	0.53	0.93	0.272
Slope S	-0.132	-0.131	-0.031	0.013	

*Table 4. Share of contributions that reach the standard*

We observe conditional cooperation in all four treatments as the probability to contribute at least the standard level is higher if many other subjects contribute at least the standard level as well. This effect is significant at the 5% level, tested using probit regression with groups as clusters. The pattern is similar across the treatments with the exception when the standard level is 16. In S16, the conditional cooperation is much stronger. In particular, if few other comply with the standard, subjects are unlikely to comply with the standard. Actually, if the number of other subjects complying with the standard at the previous period is 0 or 1, the probability to contribute at least the standard level is lower for high standards. This effect is significant at the 1% level, tested using probit regression with groups as clusters. If 2 or 3 comply with the standard, the compliance rate does not depend on the level of the standard. This suggests that people manage to comply with high voluntary standards only in case of a strong coordination.

To precise how contributions depend on the behavior of other group members, Table 5 presents the coefficients of a linear regression explaining contributions in function of the number of other group members complying with the standard at the previous period and on the standard level. We control for a time trend and we cluster on groups (41 clusters). We multiply the number of other group members complying with the standard at the previous period by the level of the standard to neutralize the pure effect of the standard value on contributions.<sup>12</sup> This number can be interpreted as the visible contribution of the other subjects. Given the observation, it is the minimum level of contribution that is possible.

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<sup>12</sup> Indeed, people who comply with the standard contribute more if the standard level is high and we know that the number of contributions at least equal to the standard increases with the number of group members complying with the standard at the previous period.

Dependant variable: Contribution in periods 1 to 8	
Period	-0.158** (0.070)
Number of others complying with the standard $_{t-1} \times$ standard level	0.354*** (0.115)
S4	Ref.
S8	4.431 (2.736)
S12	1.992* (1.172)
S16	1.822 (1.140)
S4 $\times$ Number of others complying with the standard $_{t-1} \times$ 4	Ref.
S8 $\times$ Number of others complying with the standard $_{t-1} \times$ 8	-0.225 (0.204)
S12 $\times$ Number of others complying with the standard $_{t-1} \times$ 12	-0.146 (0.121)
S16 $\times$ Number of others complying with the standard $_{t-1} \times$ 16	-0.086 (0.119)
Constant	2.467** (0.913)
Observations	1148
Prob > F	0.000
Pseudo R <sup>2</sup>	0.272

Robust standard errors in parentheses.

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

*Table 5. Contributions across treatments with voluntary standards*

The results of the regression show that agents' contributions increase in the number of other group members complying with the standard in the previous period. This effect is however not significantly different between the treatments with voluntary standards. Hence, conditional cooperation with respect to complying with the standard level is clearly observed but the effect of the number other group members complying with the standard at the previous period on contributions is not different between treatments.

#### **4. Conclusion**

The effect of partial information on contributions has been mainly ignored in the literature on public goods even though it is relevant in many situations. For instance, consumers cannot perfectly quantify and show their investment in environmentally-friendly actions. Our study aimed to fill this gap. We investigated the effect of the implementation of partial information on contributions to public goods. The partial information we considered is

the implementation of voluntary standards that are nowadays widespread.

We show first that the implementation of a too low standard level leads to the lowest efficiency. Second, we find that standards function as a coordination device. Besides, we observe that as standards increase, the coordination becomes less strong. Third, conditional cooperation is observed with respect to complying with the standard level, i.e., more people comply with the standard as the number of other group members who complied with it at the previous period increases. We detect stronger conditional cooperation when higher standard levels are implemented.

Our data have important policy implications. For example, environmentally-friendly goods that verify only a low standard should be avoided. High standards should be favored. Even with anonymity, people coordinate on standard levels. Additionally, our results provide first insights in a controlled environment on the effects of the implementation of voluntary standards on strategic behavior of agents that is coordination and conditional cooperation.

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## 6. Appendix

### *Appendix A– Direction and significance of differences between average contributions*

In the following table, we present the sign of the difference between average contributions in different treatments and its degree of significance. Degrees of significance correspond to results of a Wilcoxon rank-sum test. In the first line of each comparison, we use as independent observations average contributions by group in periods 1 to 8 in the second part of the experiment while we use average contributions by matching group in the second line. In the third line, we use average contributions by group in the first period of the second part where groups are those of the first part.



	Difference between rank sums on the average contributions				
	NI - s	S4 - s	S8 - s	S12 - s	S16 - s
<i>Treatment s</i>					
S4	+ *				
	+ *				
	+ n.s.				
S8	- n.s.	- ***			
	- *	- **			
	- **	- ***			
S12	- n.s.	- **	+ n.s.		
	- n.s.	- n.s.	+ n.s.		
	- n.s.	- **	+ n.s.		
S16	- n.s.	- **	- n.s.	- n.s.	
	- n.s.	- *	- n.s.	- *	
	- **	- ***	- n.s.	- **	
FI	- *	- ***	- n.s.	- *	- n.s.
	- **	- **	- n.s.	- *	- n.s.
	- **	- ***	- *	- ***	- n.s.

Note: \* Significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

*Table A. Direction and significance of differences between average contributions*

*Appendix B– Direction and significance of differences between the number of observations*

Degrees of significance correspond to results of a Wilcoxon rank-sum test. In the first line of each comparison, we use as independent observations average contributions by group in periods 1 to 8 in the second part of the experiment while we use average contributions by matching group in the second line. In the third line, we use average contributions by group in the first period of the second part where groups are those of the first part. We mainly present significance of differences between numbers of observations when contributions equal zero, are between 0 and the standard level, are equal to the standard level and are higher than the standard level (columns 2 to 5). For more details, we present in columns 6 to 10 significance of differences between numbers of observations for small intervals of contributions: ]0;4[, ]4;8[, ]8;12[, ]12;16[ and ]16;20].

		Difference between rank sums on the number of observations								
	0	]0;Standard[	Standard	]Standard;20]	]0;4[	]4;8[	]8;12[	]12;16[	]16;20]	
S4 – NI	–	n.s.	– *	+ ***	– ***	– *	+ n.s.	– **	– n.s.	– **
	–	n.s.	– n.s.	+ ***	– *	– n.s.	+ n.s.	– *	– n.s.	– *
	–	n.s.	– **	+ ***	– n.s.	– **	– n.s.	+ n.s.	– n.s.	– n.s.
S4 – FI	+	n.s.	+ n.s.	+ ***	– ***	+ n.s.	+ n.s.	– **	– n.s.	– ***
	+	n.s.	+ n.s.	+ **	– **	+ n.s.	+ n.s.	– n.s.	– n.s.	– **
	+	n.s.	– n.s.	+ ***	– ***	– n.s.	+ n.s.	– **	– ***	– ***
S8 – NI	–	n.s.	– ***	+ ***	– n.s.	– **	– ***	– n.s.	– n.s.	– n.s.
	–	n.s.	– **	+ ***	+ n.s.	– **	– *	– n.s.	=	+ n.s.
	– *	– n.s.	+ ***	+ n.s.	– n.s.	+ n.s.	– n.s.	– n.s.	– n.s.	+ n.s.
S8 – FI	+	n.s.	– *	+ ***	– **	– n.s.	– ***	– n.s.	– n.s.	– *
	+	n.s.	– *	+ **	– **	– n.s.	– **	– n.s.	= n.s.	– *
	+	n.s.	– **	+ ***	– **	– n.s.	– ***	– n.s.	– n.s.	– *
S12 – NI	+	n.s.	– **	+ ***	– n.s.	– n.s.	– n.s.	– ***	+ n.s.	– n.s.
	–	n.s.	– *	+ ***	– n.s.	– *	– n.s.	– **	– n.s.	– n.s.
	–	n.s.	– *	+ ***	+ n.s.	– n.s.	– n.s.	– n.s.	+ n.s.	=
S12 – FI	+	**	– n.s.	+ ***	– **	+ n.s.	– n.s.	– ***	+ n.s.	– **
	+	n.s.	– n.s.	+ ***	– ***	+ n.s.	– n.s.	– **	+ n.s.	– **
	+	**	– **	+ ***	– ***	+ *	– n.s.	– ***	– +	– **
S16 – NI	–	n.s.	– **	+ ***	+ n.s.	– n.s.	– n.s.	– **	– **	+ n.s.
	–	n.s.	– n.s.	+ ***	+ n.s.	– n.s.	+ n.s.	– *	– n.s.	+ n.s.
	–	n.s.	– *	+ ***	+ n.s.	– n.s.	+ n.s.	– n.s.	– n.s.	+ n.s.
S16 – FI	+	n.s.	– n.s.	+ ***	– n.s.	+ n.s.	+ n.s.	– ***	– **	– n.s.
	+	n.s.	– n.s.	+ **	– n.s.	+ n.s.	+ n.s.	– *	– *	– n.s.
	+	n.s.	– n.s.	+ ***	– n.s.	+ *	+ n.s.	– ***	– ***	– n.s.

Note: \* Significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

Table B. Direction and significance of differences between numbers of observations

### Appendix C – Instructions

Welcome to this economics experiment at the University of Konstanz. Please read the following instructions carefully. Depending on your decisions in this experiment, you will have the possibility to earn more money **additional to the show-up fee of 3 Euros**. Therefore, it is important that you read the instructions carefully.

During the experiment talking to the other participants is not allowed. A violation of this rule will lead to immediate exclusion from the experiment and confiscation of any payments.

In this experiment we will not speak of euros but of points. Your income will always be calculated in points. At the end of the experiment your points will be summed up and converted with the following exchange rate:

1 point = 0.015 euro

At the end of the experiment you will receive your earnings plus the show-up fee of 3 Euros **in cash**.

On the next pages you will find precise explanations for the execution of this experiment. If you have any questions raise your hand and we will come and answer them.

## The decision situation

First we want to make you familiar with the basic decision. At the end of the instructions you will find some questions. Answering them will help you to understand the decisions. The experiment will not start until all participants are familiar with the procedures of this experiment.

Participants are randomly matched in groups of 4. The experiment will consist of 2 sets of 10 periods.

During the first 10 periods you are in a group of the same 4 persons. The group composition does not change during the first 10 periods. After this participants will be randomly assigned to new groups of 4 which will remain unchanged for the following 10 periods. Again the group composition will not change during these 10 periods.

You will never be informed about the identity of the other participants.

### Course of a period

At the beginning of each period each group member receives an endowment of 20 points. Each group member has to decide how to spend these 20 points. You can either put points on your private account or invest all or part of your points in a joint project. You are free to invest any part of your endowment into the project; every point that is not invested in the project will automatically be credited to your private account.

### Your private account

For each point put on your private account you will earn one point. For example, if you put 20 points on your private account your earnings from your private account will be exactly 20 points. If you put 6 points on your private account you will earn 6 points from your private account. Nobody else but you earns anything from your private account.

### Points from the joint project

**Points that have been invested in the joint project affect the earnings of all group members.** All points that were invested into the joint project in your group will be summed up and multiplied by a factor of 1.6. After the multiplication the points will be equally given back to the members of the group, giving each a quarter of the total.

This means that every group member receives 0.4 times (factor  $1.6/4$  group members) the sum of all points that were invested in the joint project. Your earnings from the joint project are calculated as follows:

*Points from the joint project = Sum of all points invested in the joint project  $\times$  0.4*

For example, if the sum of all invested points turns out to be 60, every group member receives  $60 \times 0.4 = 24$  points from the joint project. If the total of invested points by the four group members sums up to 10 then each one earns  $10 \times 0.4 = 4$  points.

### Your income in one period

Your income in each period is the sum of the points you earned from your private account and the points you earned from the joint project:

$$\begin{aligned} & \text{Points from your private account } (= 20 - \text{your contribution to the joint project}) \\ & + \text{Points from the joint project } (= 0,4 \times \text{sum of all points contributed in the group}) \\ & = \text{total points} \end{aligned}$$

#### **Information at the end of a period**

At the end of a period you will be informed about the contributions of the other group members. You will not receive the exact amount contributed. Instead you will be informed about how many members contributed an amount in a certain interval. The intervals are as follows:

“Amount of contributions *between 0 - 3 points*”

and

“Amount of contributions *between 4 - 20 points*”

You will see how many group members contributed an amount of 0 to 3 points to the joint project and you will see how many group members contributed between 4 and 20 points to the joint project.

After this the next period follows.

#### **New group formation after 10 periods**

During the first 10 periods you will remain in the same group. At the end of these 10 periods you will be informed in detail how the members of your group had decided in these 10 periods. After that, new groups will be formed randomly and you will have to go through another 10 periods making the same types of decisions as before about how to spend your 20 points of endowment. Overall, you will have to decide 20 times how many points you want to put on your private account and how many points you want to invest in a joint project.

#### **On screen**

The following pages contain a detailed description of what you will see on screen.

Here, you are facing the decision described above. The experiment will consist of 2 sets of 10 periods. Each period is structured exactly the same way.

On the first screen you will have to decide how many points of your endowment (20 points per period) you want to invest in the joint project. The points you choose not to invest in the project are automatically assigned to your private account.

In every period you will first see the following screen:

Periode 2 von 2

Verbleibende Zeit [sec]: 0

Bitte entscheiden Sie sich jetzt!

Ihre Ausstattung beträgt: 20

Wie viele Punkte tragen Sie zu dem Projekt bei?

OK

Hilfe  
Bitte geben Sie Ihren Beitrag (zw. 0 - 20 Punkten in ganzzahligen Werten) ein.  
Nachdem Sie Ihre Eingabe getätigt haben, drücken Sie bitte die "OK" Taste.

On this screen you can see which period you are in and the amount of your endowment. You have to enter the amount of points you want to invest in the joint project into the blank field. Any integer from 0 to 20 is a possible input.

After you have entered your decision, please press the OK button. As soon as you have done this your decision is confirmed and you will not be able change it anymore.

As soon as all group members have made their decisions the following screen will be shown:

Periode 1 von 1

Verbleibende Zeit [sec]: 19

Ihr Beitrag zum Projekt: 12

Damit liegen Sie im Punktebereich: 4 - 20

Anzahl der anderen Mitglieder Ihrer Gruppe im Punktebereich von 0 - 3: 1

Anzahl der anderen Mitglieder Ihrer Gruppe im Punktebereich von 4 - 20: 2

Weiter

Hilfe  
Nachdem Sie alle Informationen durchgelesen haben, drücken Sie bitte die "Weiter" Taste.

This information screen shows you which period you are in. Additionally, you see the amount of points you invested in the project and which interval you are in. Below you see **how many** other group members chose an investment between the given intervals. It is impossible to tell which person has contributed how much. The intervals are:

“How many other group members contributing *between 0 - 3 points*” and  
 “How many other group members contributing *between 4 - 20 points*”

For example, you invested 12 points, the first other member in your group invested 2 points, the second 20 points and the third 4 points. This results in what is shown on the screen above. You are in the interval “4-20” points. One group member is in the interval “0-3” and 2 group members are in the interval “4-20”.

You have 30 seconds to look at this screen. After that the period ends and you enter the next period.

After 10 periods you will see the following screen:

Periode						
10 von 10						
Periode	Ihr Beitrag zum Projekt	Kleinster Beitrag der anderen Mitglieder Ihrer Gruppe	Mittlerer Beitrag der anderen Mitglieder Ihrer Gruppe	Großter Beitrag der anderen Mitglieder Ihrer Gruppe	Summe der Beiträge Ihrer Gruppe zum Projekt	Ihre Gesamtpunktzahl
1	7	0	18	20	45	31
2	20	0	0	2	22	9
3	11	1	12	17	41	25
4	0	14	14	20	48	39
5	6	3	15	19	43	31
6	0	7	16	17	40	36
7	1	0	11	20	32	32
8	0	0	10	10	20	28
9	14	0	0	9	23	15
10	18	11	16	17	62	27

Hilfe  
 Nachdem Sie alle Informationen durchgelesen haben, drücken Sie bitte die "Weiter" Taste.

This screen shows a detailed list of your and your other 3 group members’ contributions in every period.

The list is organized so that you find your own contribution in the first column followed by the contribution of the group member that contributed least in this period. It ends with the contribution of the group member that contributed most. Additionally you see the sum of all contributions in this period and in the last column you find your total points of the relevant period.

Please press “continue” as soon as you have read all the information.

After this new groups are formed and you are assigned to a new group of 4 randomly chosen participants.

In this new group you now enter the next 10 periods, where you again have to decide in 10 periods how many points you want to invest into a joint project and how many points you want to keep in your private account.

## Practice questions

Please answer the following questions. This will help you to better understand how your total points are calculated. Your income depends on your decisions.

*Please answer each question and write down your calculations. When you have finished the questions please raise your hand. A member of the experimental team will come to correct them. Wrong answers do not have any consequences. The experiment starts as soon as everybody has answered all questions correctly.*

1. Each group member has 20 points. Assume that nobody invests any points in the joint project.  
*What are your total points?* \_\_\_\_\_  
*What are the total points of the other group members?* \_\_\_\_\_
  
2. Each group member has 20 points. You invest 20 points. Every other group member also invests 20 points.  
*What are your total points?* \_\_\_\_\_  
*What are the total points of the other group members?* \_\_\_\_\_
  
3. Each group member has 20 points. Assume that the sum of the other group members' investments is 30 points.
  - a) *What are your total points if you- additional to the 30 points- invest 0 points in the joint project?*  
*Your total points:* \_\_\_\_\_
  - b) *What are your total points if you- additional to the 30 points- invest 8 points in the joint project?*  
*Your total points:* \_\_\_\_\_
  - c) *What are your total points if you- additional to the 30 points- invest 15 points in the joint project?*  
*Your total points:* \_\_\_\_\_
  
4. Each group member has 20 points. Assume that you invest exactly 8 points in the joint project.
  - a) *What are your total points if the others – additional to your 8 points – invest a sum of 7 points in the joint project?*  
*Your total points:* \_\_\_\_\_
  - b) *What are your total points if the others – additional to your 8 points – invest a sum of 17 points in the joint project?*  
*Your total points:* \_\_\_\_\_
  - c) *What are your total points if the others – additional to your 8 points – invest a sum of 22 points in the joint project?*  
*Your total points:* \_\_\_\_\_

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