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Heterogeneous productivity in voluntary public good provision – an experimental analysis*

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Abstract — *This article experimentally examines voluntary contributions when group members' marginal returns to the public good vary. The experiment implements two marginal return types, low and high, and uses the information that members have about the heterogeneity to identify the applied contribution norm. We find that norms vary with the information environment. If agents are aware of the heterogeneity, contributions increase in general. However, high types contribute more than low types when contributions can be linked to the type of the donor but contribute less otherwise. Low types, on the other hand, contribute more than high types when group members are aware of the heterogeneity but contributions cannot be linked to types. Our results underline the importance of the information structure when persons with different abilities contribute to a joint project, as in the context of teamwork or charitable giving.*

Keywords: Public goods; Voluntary contribution mechanism; Heterogeneity; Information; Norms
JEL-Classification: C09; H41

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1 Introduction

People who contribute to public goods or to common projects are, generally speaking, not alike. They differ, for instance, in their talents, skills, and qualifications. In some cases, heterogeneous abilities are even necessary to achieve a common goal. Naturally, the question arises of how group heterogeneity affects contributions to joint projects. This article examines the voluntary contribution behaviors of individuals with heterogeneous abilities using laboratory experiments.

Differences in individual capacities within a group, e.g., between citizens in a society or team members, might stimulate voluntary contributions from those whose special abilities are desperately needed. For instance, after the devastating Kobe earthquake in Japan in 1995, local transportation systems in the town of Kobe were paralyzed. Bicycling became a vital means of transportation. The serious problem then became that many bicycles broke and were left unrepaired due to a lack of the necessary equipment and expertise to fix the damage. To help the people in Kobe, a number of bicycle enthusiasts from all over Japan came to Kobe voluntarily and offered much-needed assistance with repairing the broken bicycles.

On the other hand, heterogeneous abilities can become an obstacle when soliciting effort to accomplish common projects, as exemplified by the legal dispute among musicians in the Beethoven Orchestra in Bonn. The musicians cooperating to perform a common musical program are heterogeneous with respect to many factors, including the instruments they play, the (number of) notes they play during a given piece of music, and the amount of time they must spend practicing in joint rehearsals before a performance. However, under the unionized contracts of orchestra musicians in Germany, all orchestra members are guaranteed equal payment regardless of the particular instrument they play. In March 2004, the violinists of the Beethoven Orchestra demanded higher pay on the grounds that they have to rehearse more than musicians playing other instruments.[1] The other musicians, particularly soloists, argued that they were subject to more pressure than the violinists, so receiving the same pay for less rehearsal time seemed to be

[1]The request was mainly based on the opportunity cost argument, namely that the additional free time that other musicians enjoy can be used to augment their monthly wages by teaching or performing elsewhere.

justified.[2]

The above examples capture two general considerations relevant to the voluntary contribution behavior of individuals with heterogeneous abilities. On one hand, heterogeneity between group members might evoke different contribution norms. On the other hand, the appropriate contribution norm may depend on the context in which the heterogeneity is perceived. In the case of the Kobe earthquake, the norm called for help from persons who were knowledgable about bicycle repair. The conflicting views between soloists and violinists in the Bonn orchestra suggest that violinists consider equal remuneration of nominal work hours to be an appropriate norm, while soloists seem to favor remuneration according to effective contribution, which takes into account other factors (responsibility, stress, etc.). What kind of norm is considered appropriate thus depends on the circumstances and is an empirical question.

The experimental literature has studied contribution norms and behavior in the context of voluntary contribution mechanisms for homogeneous groups extensively (see Ledyard (1995) for a survey). In a classical linear voluntary contribution mechanism, group members receive an endowment from which they can invest in a group project with an outcome that is shared equally amongst all members at the end of the project. The marginal return for each member of one unit contributed to the group project by any member is what the literature has termed the marginal per capita return. To assess the effect of this marginal return on contributions, some studies compare homogeneous groups that differ in their marginal returns (e.g., Isaac and Walker (1998)). One main result of these studies is that groups with higher marginal returns have an increased propensity to contribute. This finding seems to be robust across studies and for different marginal returns and numbers of group members.

Only a few studies have examined heterogeneous groups in which members vary in their marginal returns.[3] Fisher et al. (1995) and Tan (2008) compare the type specific behavior of heterogeneous groups consisting of

[2] The case was eventually settled with a compromise in which part-time student violinists were hired for some rehearsals to fill in for the overworked violinists (see Klassik News, March 29, 2004 on klassik.com).

[3] Other experimental studies have focused on alternative sources of heterogeneity, for example, wealth (e.g., Buckley and Croson (2006) and Chan et al. (1996)) or marginal benefits (e.g., Palfrey and Prisbrey (1997) and Bagnoli and Mckee (1991)).

members with high and low marginal returns to that of homogeneous groups. Within heterogeneous groups, both studies find that individuals whose contributions have higher marginal returns to the public good tend to have a higher propensity to contribute than do members of the same group with lower marginal returns. These results seem to suggest that efficiency concerns prevail in controlled laboratory studies. However, in these studies, the contributor benefits from his or her own contribution; hence, contributions of high types are not only more efficient but also less costly for the donor. High types might therefore contribute more either because they can better advance the joint project or because their costs of contribution are low.

The present study investigates the effect of the first of these two factors on contributions, which we will refer to as "productivity." The literature on distributive justice has suggested different fair contribution and sharing rules (Konow (2003)). Based on this literature, we motivate three plausible social norms, namely *an equal nominal contribution, an equal effective contribution,* and *an efficient contribution norm*, that we examine experimentally. To do so, first we introduce heterogeneity by allowing the marginal returns of individual contributions to vary between two types, a low and a high productivity type, in a standard linear voluntary contribution mechanism while maintaining symmetry of costs among group members. Second, we vary the level of information about heterogeneity in three different treatments. In the baseline treatment, group members are informed about their own marginal returns as well as about individual nominal contributions of others. In the other two treatments, participants are additionally informed about the marginal returns of the other productivity type. Additionally, in the third treatment, participants also know which productivity type made a particular contribution. This design allows us to control the extent to which individuals know about heterogeneity, and hence, it provides restrictions on the contribution norms that can be applied. In this way we aim to discriminate between different contribution norms and to examine the joint effect of a heterogeneous environment and information on voluntary contributions.

Our findings can be summarized as follows: When individuals are made aware of the heterogeneity in productivity, the average propensity to contribute increases. However, the information structure evokes different relative contribution patterns between types, resulting in no conclusive support for any one particular contribution norm. The less information that is available, the more equal contribution norms prevail; the more information that is available, the more efficient contribution norms take over. The information about heterogeneity affects contribution behavior differently depending on productivity type. Public information about heterogeneity in productivity within a group increases individual contributions almost exclusively for low types, who contribute more than high types, whereas the latter do not change their contribution behavior compared to the no information benchmark. More detailed feedback information on the contributor's type induces high types to contribute more and, at the same time, low types to lower their contributions compared to the situation with partial information.

The remainder of the article is organized as follows. Section 2 introduces the model of our voluntary contribution mechanism and presents behavioral motives to contribute. Section 3 describes the experimental design, explains how information about heterogeneity is varied across treatments and presents the behavioral predictions. Section 4 gives an overview of the stated contribution norms and aggregated contribution behavior. Section 5 presents a dynamic analysis of individual contribution behavior. Section 6 discusses our results in the light of the literature and section 7 concludes.

2 The model

2.1 The linear voluntary contribution mechanism

In order to introduce heterogeneity in the economic environment, we augment the standard linear model of the voluntary contribution mechanism (VCM). First, we introduce a productivity factor for each group member to reflect heterogeneity in individuals' ability to produce the public good. The joint project in a group with n members can be written as:

$$G = \sum_{j=1}^{n}(p_j y_j)$$

where y_j is an individual's nominal contribution to the group project and p_j denotes the individual's productivity. Each group member has either high or low productivity, i.e., $p_j \in \left\{p^H, p^L\right\}$ for all $j \in \{1, \ldots, n\}$. We will refer to individuals with high productivity as H-types, and those with low productivity as L-types. Any unit contributed to the joint project is efficient but units of H-types progress the group project further, i.e., $1 < p^L < p^H$. The effective contribution of each group member to the joint project therefore depends on two factors: the individual nominal contribution (y_j) and the individual productivity (p_j). We consider a group that is composed of an equal number of H-types and L-types.

Second, we ensure identical pecuniary incentives to contribute across all group members as follows: the payoff of individual i from the public good is independent of i's contribution. In other words, each individual does not benefit from his or her own contribution but receives a share of the output generated by the contributions of only the other group members. Additionally, the contribution of one other member with different productivity is excluded from the public good pool, so that each subject benefits from a public good pool provided by a balanced number of individuals of both productivity types. The payoff of an individual i with an endowment w resulting from the interaction in a group with n members can be written as

$$\pi_i = w - y_i + G_i. \tag{1}$$

Each group member benefits from the amount allocated to the own account ($w - y_i$) and the returns G_i from the joint project, where

$$G_i = \frac{1}{n-2} \sum_{j \neq \{i,k\}} (p_j y_j), \; p_i \neq p_k, \text{ and } i, j, k \in \{1, \ \dots \ , n\}$$

$$\text{and } G = \sum_{j=1}^{n} (p_j y_j) = \sum_{i=1}^{n} G_i.$$

The following are the novel features of our model. First, unlike in the standard VCM, group members are excluded from the returns generated by their own contributions. This is necessary because, otherwise, H-types not only advance the joint project more but also benefit from their own contributions more than L-types do, resulting in two motivations to give: higher efficiency and lower costs of contributing. Excluding members from benefiting from their own contribution keeps contribution costs constant across types and prevents the described confound. Second, group members nevertheless face a symmetrical payoff structure: every individual benefits only from contributions of an equal number of both productivity types. Hence, both productivity types are equally accounted for in everyone's payoff function. For example, consider a group composed of six members; three H-types and three L-types. An L-type individual i's payoff from the public good is derived as 1/4 of the sum of the contributions by the two other L-types and two randomly selected H-types. Consequently, by excluding the contributions of the individual him- or herself and of one member of the opposite type, we maintain the symmetry of individual payoff functions.

2.2 Contribution motives

Efficiency requires that total surplus be maximized when each group member invests his or her whole endowment in the group project because $\partial \sum \pi_k / \partial y_i = -1 + p_i > 0$. However, from an individual point of view, there is a strong incentive not to contribute to the joint project because the marginal benefit of contributing one point is -1, i.e., $\partial \pi_i / \partial y_i = -1$. A number of empirical and experimental studies on social dilemma problems suggest different individual motivations that can help to overcome such an incentive to free-ride and to arrive at equilibria that lie in between those two extreme cases.

First, suppose individuals are concerned not only with advancing their own income but also with increasing others' payoff. Those persons might be motivated by either altruism or concerns for social efficiency. We approximate the utility function of such a person by

$$U_i = \pi_i + R_i(\pi_{-i})$$

where $R_i(\pi_{-i})$ is a linear, continuous, increasing and twice differentiable function that captures an individual's concern for others' payoff.

One unit contributed by group member i increases the public good, hence, the total payoff of the other group members by p_i, because

$$\frac{\partial G}{\partial y_i} = \frac{\partial G_{-i}}{\partial y_i} = \frac{\partial \pi_{-i}}{\partial y_i} = p_i.$$

From this it follows that group member i will contribute to the public good as long as his marginal utility gain is sufficiently high so that it satisfies the following first-order condition,

$$\frac{\partial U_i}{\partial y_i} = -1 + \frac{\partial R_i(\pi_{-i})}{\partial \pi_{-i}} p_i \geq 0,$$

implying

$$\frac{\partial R_i(\pi_{-i})}{\partial \pi_{-i}} \geq \frac{1}{p_i}. \tag{2}$$

Therefore, when individuals are altruistic or concerned about social efficiency and their marginal utility in others' payoff is either constant or decreasing, H-types will, on average, contribute more than L-types. Because $1 < p^L < p^H$, it is easier for H-types than for L-types to satisfy condition (2). Being concerned about what is socially optimal can be a norm based on the understanding that "people often seek to maximize surplus, sometimes at a personal cost, and that this goal is regarded as 'fair'." (Konow (2003), p.1205). We will refer to this norm hereafter as the *efficient contribution norm*.

Second, when group members observe nominal contributions of others (y_j), norms concerning equity may play a role in determining individual levels of contribution to a public good. The proportionality principle is often used as a measure of equity (see Konow (2003) for a more general discussion of justice theories). This principle suggests that an individual's benefit from a joint project should be in proportion to the degree to which a person contributed to the project. Because in VCMs, benefits from public goods are shared equally among group members, according to the proportionality principle, all individuals are expected to contribute equally. When group members differ in their productivity, equity depends on the way individual contributions are evaluated. Thereby, contributions might be evaluated with reference either to nominal units of endowment contributed (y_i) or to their 'effective' impact on the joint project ($p_i y_i$). Hereafter we will refer to these norms as the *equal nominal contribution norm* and the *equal effective contribution norm*, respectively.

It is important to note that if the reference point of the proportionality principle is nominal contributions, then group members' knowledge about heterogeneity in the group will have no influence on contribution behavior. On the other hand, effective contributions can only be used as a reference point when there is sufficient information about heterogeneity in a population. Therefore, the intensity with which different reference points of the proportionality principle can come into play depends on the level of information that group members have about the productivity of others.

We vary the information groups have about the productivity of their members to investigate if behavior is shaped by efficiency concerns or proportional fairness and, for the latter case, which reference point is used. For instance, if persons act according to a contribution norm that has nominal contribution levels as a reference point, H-types and L-types would make the same nominal contributions regardless of whether members are aware of differences in productivity within their group. Similarly, behavior should not change with the level of information when group members are only concerned about altruism or efficiency. In this case, H-types would contribute more on average than L-types regardless of the information they possess about the difference in productivity.

If individuals make their contribution decisions according to a contribution norm with reference to effective contributions, however, such norms cannot come into play without sufficient information about the heterogeneity within the group. In this case, contribution behavior will differ depending on whether the information about heterogeneity in productivity is public. More precisely, without information, the reference point remains that of equal nominal contributions, whereas when information about heterogeneity is public, L-types will contribute (nominally) more than H-types, resulting in equal effective contributions of both types.

3 The experiment

3.1 Design and procedure

In light of the different contribution motives, what norm is adopted in heterogeneous environments is -a priori- not clear. Therefore, we need to rely on empirical evidence to study the norms that are prevalent in heterogeneous environments. To provide such empirical evidence, we conducted a public good experiment. In the experiment, members of a group had to decide how to divide their private endowment between a private account and a group project. The nominal contributions of each member to the group project were public information. The treatment variable in our experiment, the level of information, varies in two ways: first, subjects either do or do not receive precise information on the distribution of productivity types within the group, and second, the feedback information about the contributions of all group members does or does not reveal each contributor's type. In particular, we study three treatments with the following information scenarios. In the *No-info* treatment, group members know their own productivity, but not the distribution of types within their group. In the *Part-info* and *Full-info* treatments, the distribution of types is explicitly stated in the instructions. Additionally, the feedback information in the *Full-info* treatment allows members to link an individual contribution to the contributor's type. In sum, the three treatments gradually change the level of information about the heterogeneity in the population and contributions by different types.

Each information treatment comprised nine groups. Each group consisted of six members, three H-types with $p^H = 3.99$ and three L-types with $p^L = 1.33$, who interacted with each other over 15 periods.[4] A group member remained either a H-type or a L-type throughout the whole experiment. At the beginning of every period, each group member was endowed with w =17 points and had to decide how many of them (y_i) to invest in a joint project and how many to keep ($w - y_i$).[5] After all group members had made their decisions, individual payoffs were computed according to the VCM (as presented in equation 1), and group members were informed about their payoffs. Additionally, a table was displayed containing the history of contributions by each group member in all previous periods. In the *Full-info* treatment, this table also displayed the type of each contributor. The order of individual contributions in the history table was randomized so that contributions could not be attributed to a specific group member.

Prior to the beginning of the first period and after the exposition of the instructions, subjects were asked once to state a contribution norm, i.e., what they think is appropriate to contribute, and to predict the average contribution of others.[6] After the experiment, participants completed a standard personality test.[7] A sample copy of the instructions is included in

[4]The two productivity values were chosen with respect to the parameters used in previous research on heterogenous marginal per capita returns (MPCR). For instance, the two MPCRs used in Fisher et al. (1995) were 0.3 and 0.75, implying that a one-unit contribution by a low (high) MPCR type generates 1.2 (3) units of public goods in groups with four members. Therefore, the MPCR values used in Fisher et al. (1995) are comparable to the productivity factors of 1.33 and 3.99 used in our design.

[5]Experimental earnings were counted in points and exchanged at the end of the experiment for Euros, where 80 points corresponded to 1 Euro.

[6]We were only interested in the answers to the question about the normative behavior and asked the two questions so that participants could distinguish between normative and anticipated behavior. This is important because contribution norms and the anticipated behavior of others might not necessarily coincide. As contribution norms cannot be incentivized, participants were not paid for these answers. We also refrained from providing incentives for predictions.

[7]We used the official German translation of the revised version of the Sixteen Per-

Appendix A.

The experiment was computerized and conducted in eight sessions with a total of 162 undergraduate students from Jena University at the laboratory of the Max Planck Institute of Economics in Jena, Germany.[8] Participants were between 19 and 36 years old and approximately half of them were female (57%). At the end of each session, subjects received their payoff from the experiment and a show-up fee of 2.5 Euros in cash. Subjects earned on average 5.7 Euros for the 15 rounds, which lasted on average 30 minutes.[9]

3.2 Behavioral predictions

In light of the norms discussed in section 2.2 and our experimental design, we expected the following behavior in our experiment.

(i) *Efficient contributions norm*:

If individuals are concerned about others' payoff and social efficiency, both types will contribute to the joint project, with H-types contributing on average more than L-types. The level of information that group members have about the heterogeneity in productivity within the group, will have no influence on contribution levels ($0 < y^L < y^H$ in all treatments).

(ii) *Equal nominal contributions norm*:

If individuals follow the proportionality principle with nominal contributions as a reference point, group members will contribute the same amounts regardless of their type and whether they are aware of the heterogeneity in productivity within the group ($y_i = y_k, \forall i \neq k$ in all treatments).

(iii) *Equal effective contributions norm*:

(iii.1) If individuals follow the proportionality principle with effective contributions as a reference point, both types will make the same nominal contributions when there is no information about heterogeneity ($y_i = y_k, \forall i \neq k$ in the *No-info* treatment). However, when individuals are informed about the heterogeneity in productivity in the group, L-types will contribute more than H-types resulting in equal effective contributions to the joint project

sonality Factor Questionnaire (Cattell et al. (1993)) translated by Schneewind and Graf (1998).

[8]Recruitment was performed with the help of an online system (ORSEE Greiner (2004)), and the experiment was executed using the software zTree (Fischbacher (2007)).

[9]Each session comprised two phases of group interactions lasting 15 periods each. In this article we consider only the first phase. Average earnings for the whole experiment (including both phases) were about 11 Euros.

by H-types and L-types (if i is a L-type and k is a H-type, $p^L y_i = p^H y_k$ implies $y_i > y_k$ in the *Part-info* and *Full-info* treatments).
(iii.2) In order to conform to a norm, group members need to compare themselves to their peers, and especially to peers of their own and the other type, with efficient or effective contributions as possible reference points. Detailed information on contributors' types supports coordination of type specific contribution norms. It might not be possible to establish and maintain type specific contribution norms when types cannot be identified. Whereas the *Part-info* treatment only informs group members about the presence of heterogeneity, the *Full-info* treatment allows group members to link others' contribution behaviors to their types. Therefore, even though different contribution norms might come into play with public knowledge about heterogeneity, coordination on these norms might be more easily established in the *Full-info* treatment and we expect behavior in the *Part-info* treatment to be amplified in the *Full-info* treatment.

4 Data: Stated Norms and Contributions

In this section, we report stated norms and contributions aggregated over the 15 periods of the experiment. We first evaluate the contribution norms and actual contributions in light of our behavioral predictions. Second, we examine social welfare as observed in the experiment.

Stated private contribution norms and contributions by type

Contribution norms can be classified into two types, social and private contribution norms. Social contribution norms are constructed and fortified by social interaction. In contrast, private norms may be held by individuals prior to any social interaction. It is therefore natural to think that participants may have entered this experiment with their own private norms. In order to study these norms, we elicited participants' private norms for nominal contributions after introducing them to the details of the experiment, but before they started interacting with each other.[10]

[10]We elicited private norms in the *No-info* treatment using the question "What transfer to the project do you think is appropriate?" In the other two treatments the following two questions were asked: "What transfer to the project do you think is appropriate for a person whose productivity factor is 1.33?" and "What transfer to the project do you think is appropriate for a person whose productivity factor is 3.99?" These questions allowed

Panel A of Table 1 reports median (nominal) contribution norms for each treatment separately by productivity type.[11,12] The stated contribution norms are fairly identical across treatments and types.[13] Neither in the *No-info* nor in the *Part-info* treatment could we detect statistically significant differences between the medians of the stated contribution norms for each type.[14] This is equally true for H-types in the *Full-info* treatment.[15] In this respect, the stated private norms reflect an *equal nominal contribution norm* as implied by prediction (ii). The only exception are L-types in the *Full-info* treatment, who report significantly higher contribution norms for H-types (10.00) than for L-types (9.00), supporting the idea of an *efficient contribution norm*.[16]

Social norms that evolve via interaction within a group are, on the other hand, reflected in actual contribution behavior. Panel B of Table 1 displays median (nominal) contributions observed in each group by treatment and by productivity type. Both types in the *No-info* treatment make the same contributions to the joint project (7.00). In the treatments in which information is provided, both types contribute at least as much as in the *No-info* treatment. Additionally, in the *Part-info* treatment, the median L-type contributes more (10.00) than the median H-type (9.00). Furthermore, although the median contribution of both types is the same in the *Full-info* treatment (8.00), the interquartile range is much larger for H-types (10.00 vs. 5.00 for L-types), indicating a wider dispersion of their contributions.

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us to identify normative expectations separately for contributions of L-types and H-types and to evaluate how those norms vary by type.

[11]Unless indicated otherwise, we refer to nominal contributions.

[12]Note that participants in the *No-info* treatment were not aware of the heterogeneity in the group. Therefore, the contribution norms stated by H-types are taken as reflecting norms for H-types. The same holds for L-types.

[13]We compared norms stated by different persons using a two-sided non-parametric Wilcoxon-Mann-Whitney test (hereafter referred to as "WMW-test") for two independent samples.
WMW tests: *No-info* vs. *Part-info*: H-types: $p = 0.75$ and L-types: $p = 0.77$. We find the same results when conditioning on the respondent's own type.

[14]For the comparison of contribution norms for different types within the *Part-info* and *Full-info* treatments, we used a two-sided non-parametric Wilcoxon signed rank test (hereafter referred to as "W-test") for matched pairs. Thereby, one person's contribution norm for H-types and L-types constitutes one pair.
WMW-test: $p = 0.70$ (*No-info*). W-tests: $p = 0.50$ (*Part-info*); $p = 0.60$ (*Part-info*; H-types) and $p = 0.53$ (*Part-info*; L-types).

[15]No difference from the contribution norms for both types stated by H-types, W-test: $p = 0.43$

[16]W-test: $p = 0.04$

We cannot reject the null hypothesis that types within treatments make the same contributions at conventional levels of significance.[17]

Hence, with the exception of L-types in the *Full-info* treatment, private and social norms seem to endorse equal nominal contributions.

Social welfare

In this VCM, contributions of either productivity type enhance social welfare. However, effective contributions of H-types are greater than those of L-types. Hence, the extent to which information about heterogeneity affects social welfare depends on whether and how types react to the information when making their contribution decisions. Panel C of Table 1 presents the median of individual payoffs within a group as an indicator of group welfare. Social welfare increases progressively from the *No-info* treatment (27.97) to the *Part-info* treatment (32.08) and the *Full-info* treatment (34.09), but the differences between group medians are not statistically significant.

The preceding analysis aggregated contributions over time into a single median observation per group. Though necessary for appropriate non-parametric testing, it thereby neglects information contained in the data. The lack of significant variation in the analysis of aggregated data is therefore not surprising. It is, however, natural to think that information exerts its effect in the dynamics of the interaction throughout the course of the experiment. To develop a more detailed account of the effect of heterogeneity, or more precisely, of the extent to which heterogeneity in productivity is common information in a group, we examine the dynamics of contribution behavior over time in the following section.

[17]WMW-tests: *No-info*: $p = 0.96$, *Part-info*: $p = 0.35$, and *Full-info*: $p = 0.59$.
W-tests: H-types: *No-info* vs. *Part-info* (p=0.76), *Part-info* vs. *Full-info* (p=0.48), *No-info* vs. *Full-info* (p=0.26).
L-types: *No-info* vs. *Part-info* (p=0.17), *Part-info* vs. *Full-info* (p=0.41), *No-info* vs. *Full-info* (p=0.72).

	Treatments					
	No-Info		Part-Info		Full-Info	
Panel A	Private Norms on nominal contributions (unit of observation: individual participant)					
	H-type	*L*-type	*H*-type	*L*-type	*H*-type	*L*-type
Median	10.00	8.00	9.00	8.00	10.00	9.50
IQR	12.00	10.00	8.00	5.00	10.00	10.00
Nobs	27	27	54	54	54	54
	reported by *H*-types					
	H-type	*L*-type	*H*-type	*L*-type	*H*-type	*L*-type
Median	10.00	-	9.00	8.00	10.00	10.00
IQR	12.00	-	8.00	5.00	11.00	10.00
Nobs	27	-	27	27	27	27
	reported by *L*-types					
	H-type	*L*-type	*H*-type	*L*-type	*H*-type	*L*-type
Median	-	8.00	9.00	9.00	10.00	9.00
IQR	-	10.00	10.00	10.00	9.00	6.00
Nobs	-	27	27	27	27	27
Panel B	Nominal contributions by type (unit of observation: group median over 15 periods)					
	H-type	*L*-type	*H*-type	*L*-type	*H*-type	*L*-type
Median	7.00	7.00	9.00	10.00	8.00	8.00
IQR	7.00	7.00	7.00	7.00	10.00	5.00
Nobs	9	9	9	9	9	9
Panel C	Social Welfare (unit of observation: group median over 15 periods)					
Median	27.97		32.08		34.09	
IQR	10.45		10.81		16.64	
Nobs	9		9		9	

Table 1: Descriptive statistics of the experimental data: medians and 27-75% interquantile ranges

5 Dynamic analysis of contribution behavior

This section explicitly considers the dynamic nature of the data and analyzes contribution behavior over time. By doing so, we aim to provide statistical evidence of how individual contribution behavior evolves in line with plausible contribution norms and how information about heterogeneity affects individual contribution behavior over time.

Figure 1 plots the average nominal contribution in each period for the three treatments. Contribution behavior evolves quite differently over time according to treatment. Generally, the average contribution is about one half of the endowment and decreases over time, with a quicker decay at the end of the experiment. In the *No-info* treatment, contributions continuously decrease over time following a general trend observed in other public good experiments, while in the two treatments with information about heterogeneity, average contributions seem to increase initially before following the general trend of decay.

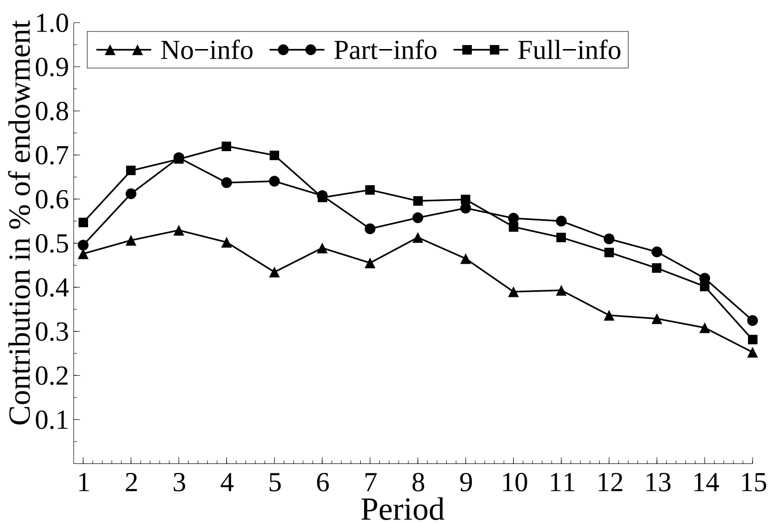

Figure 1: Average nominal contributions as a proportion of the endowment for the three treatments (*No-info*, *Part-info* and *Full-info*)

5.1 Empirical model specification

We describe the proportion that individual i contributes from his or her own endowment in period t, $y^{\star}_{it}$, as the function:

$$y^{\star}_{it} = \gamma + \omega High + f(t) + x_i\beta + \epsilon_{it} \tag{3}$$

Where γ indicates the basic contribution level, ω captures the effect of productivity (with the dummy variable $High$ being equal to one if i is a H-type and zero otherwise). We control for time trends by including $f(t)$, a function of time. The vector x_i represents the individual observable characteristics of age, gender, and measures of self-control obtained from the personality questionnaire. Their influence on contributions is captured by the parameter β. Idiosyncratic errors, ϵ_{it}, are assumed to be independent of productivity and other individual characteristics in x_i.

The influence of information is captured by treatment dummies. The complete model, including treatment dummies, with the *No-info* treatment as a baseline is given by:

$$\begin{aligned} y^{\star}_{it} &= \gamma_0 + \gamma_1 \textit{Part-info} + \gamma_2 \textit{Full-info} \\ &+ \omega_0 High + \omega_1 High \cdot \textit{Part-info} + \omega_2 High \cdot \textit{Full-info} \\ &+ f(t) + x_i\beta + \epsilon_{it} \end{aligned} \tag{4}$$

Given the design of the experiment, individual contributions to the joint project are doubly censored, first at the lowest contribution level of 0 units and second at the highest contribution level of 17 units, the period endowment.[18] We therefore use a standard regression doubly censored Tobit model to estimate the relation for the latent contribution proportions $y^{\star}_{it}$ described in model (4) with

$$y_{it} \begin{cases} = 0 & \text{if } y^{\star}_{it} \leq 0, \\ = y^{\star}_{it} & \text{if } 0 < y^{\star}_{it} < 1, \\ = 1 & \text{if } y^{\star}_{it} \geq 1. \end{cases} \tag{5}$$

[18] In fact, 23% and 21% of all contribution decisions were at the upper and lower limits, respectively.

5.2 Results

Baseline: specification 1

We estimate two specifications of the model in equation (4). Both specifications include the same set of background characteristics, but vary in the way time effects are modeled. In specification 1, the time trend is modeled non-parametrically by including dummy variables for each period ($f(t) = \delta_t 1_t$ with 1_t being an indicator function for period t for $t > 1$ and $f(1) = 0$). Estimation results are reported in Table 2.

The first thing to note from the results of specification 1 is that group members invest a positive amount of their endowment ($\gamma_0 > 0$ with $p = 0.000$) in the group project. Further, information about heterogeneity has a positive impact on contributions (γ_1, γ_2 and $\omega_2 > 0$ with $p = 0.000$). In the *Full-info* treatment, this increase is almost exclusively driven by the more productive type ($\gamma_2 = 0.076 < \omega_2 = 0.326$). In the other two treatments (*No-info* and *Part-info*), H-types contribute significantly less compared to their L-type colleagues, but this effect is relatively small ($\omega_0 = -0.069, p = 0.000$ and $\omega_1 = 0.011, p = 0.420$). The period dummy coefficients reveal a non-linear time trend, indicating an increase in contribution levels until period 6 and a strong decrease over the last third of the experiment (after period 12). Finally, we find that women tend to make significantly smaller contributions ($\beta_2 = -0.235$ with $p = 0.000$) and that age and norm obedience have significant but relatively small negative influences on contributions.

		Specification 1		Specification 2	
Variable	Parameter	Coefficient	T-value	Coefficient	T-value
Constant	γ_0	0.950	10.123	1.041	6.693
Part-info	γ_1	0.199	11.547	0.075	0.373
Full-info	γ_2	0.076	4.563	-0.000	-0.002
H-type	ω_0	-0.069	-3.807	-0.052	-0.242
H-type *Part-info*	ω_1	0.011	0.420	0.059	0.201
H-type *Full-info*	ω_2	0.326	14.403	0.364	1.323
linear Time trend	τ_{10}			0.013	0.277
Part-info	τ_{11}			0.062	1.015
Full-info	τ_{12}			0.054	0.896
H-type	τ_{13}			0.010	0.145
H-type *Part-info*	τ_{14}			-0.070	-0.760
H-type *Full-info*	τ_{15}			-0.033	-0.393
quadratic Time trend	τ_{20}			-0.002	-0.871
Part-info	τ_{21}			-0.004	-1.235
Full-info	τ_{22}			-0.004	-1.168
H-type	τ_{23}			-0.001	-0.290
H-type *Part-info*	τ_{24}			0.006	1.110
H-type *Full-info*	τ_{25}			0.003	0.546
Background characteristics		Yes		Yes	
Time dummies		Yes		No	
Number of Observations		2430		2430	
Number of Parameters		23		21	
	σ_ϵ	0.582	62.963	0.582	47.116
Log-Likelihood value		-33067		-33050.4	

Table 2: Estimation results for nominal contribution behavior (dependent variable: proportion that an individual contributes from his or her initial endowment).
Other parameter estimates are presented in Table 3 in Appendix C.

Time and treatment interaction effects: specification 2

In a second specification, we model the time trend as a quadratic function including interaction effects with productivity and information:[19]

$$f(t) = \tau_{10} \cdot t + \tau_{20} \cdot t^2 + Interaction(t, High, Part\text{-}info, Full\text{-}info). \tag{6}$$

This allows us to account for both non-linear effects of periods and interactions with the different treatments while minimizing the loss of degrees of freedom. Estimation results are presented in Table 2.

Specification 2 reveals that the effect of treatment variables materializes largely through dynamic interactions over the periods. More precisely, information about heterogeneity has a non-linear effect on individual contributions of both productivity types. Instead of the standard monotonic decay, they increase before they diminish (as captured by the positive coefficients τ_{11} and τ_{12} and the negative coefficients τ_{21} and τ_{22}). Moreover, the positive coefficients τ_{24} and τ_{25} suggest that additional information counterbalances the declining trend for contributions of H-types. In order to assess the global picture of those individual interactions and to test whether their joint effect is significant, we compute expected contributions and calculate marginal effects using our estimated parameters.[20] The results are presented in Figure 2. The upper panels in Figure 2 present predicted average nominal contributions as a proportion of the endowment for H- and L-types in each treatment, while the lower panels show the marginal effects of productivity on contributions with 95% confidence bounds.

The upper left panel in Figure 2 depicts the *No-info* treatment. It suggests that in the absence of information about heterogeneity both types make the same nominal contributions and exhibit a similar monotonic decay of their individual contributions. The marginal effects analysis for this case, presented in the lower left panel, confirms this observation. We cannot

[19]The detailed time function is given by:

$$\begin{aligned} f(t) &= \tau_{10} \cdot t + \tau_{11} \cdot t \cdot Part\text{-}info + \tau_{12} \cdot t \cdot Full\text{-}info \\ &+ \tau_{13} \cdot t \cdot High + \tau_{14} \cdot t \cdot High \cdot Part\text{-}info + \tau_{15} \cdot t \cdot High \cdot Full\text{-}info \\ &+ \tau_{20} \cdot t^2 + \tau_{21} \cdot t^2 \cdot Part\text{-}info + \tau_{12} \cdot t^2 \cdot Full\text{-}info \\ &+ \tau_{23} \cdot t^2 \cdot High + \tau_{24} \cdot t^2 \cdot High \cdot Part\text{-}info + \tau_{15} \cdot t^2 \cdot High \cdot Full\text{-}info \end{aligned}$$

[20]Details of the estimation procedure of the marginal effects are included in Appendix B.

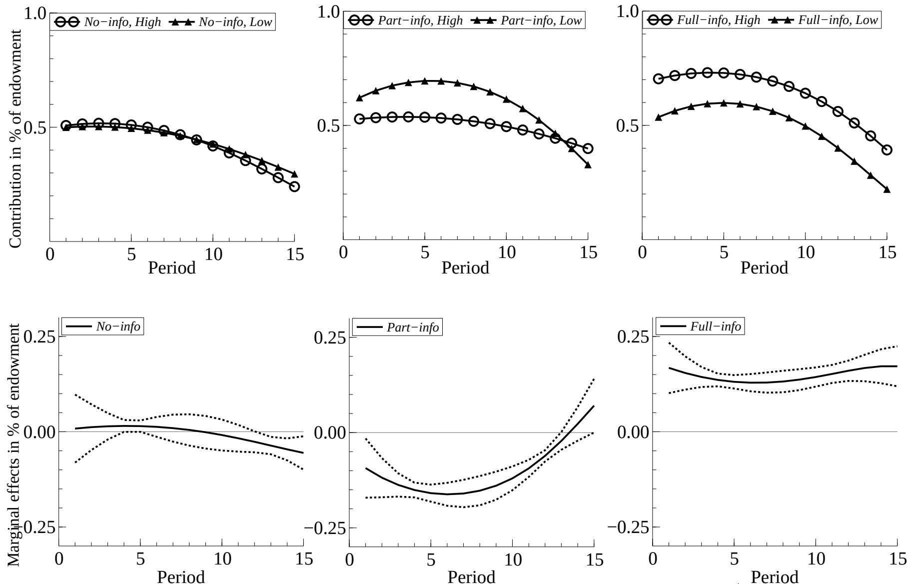

Figure 2: Upper panels: Predicted average contributions (as a proportion of the initial endowment) over time for each treatment and type.
Lower panels: Marginal effects of productivity on contributions for each treatment. (The graphs project the difference in relative nominal contributions between H-types and L-types.)

reject the null hypothesis of no effect throughout periods 1 to 12.

The other four panels illustrate the case for the treatments with more information. In contrast to the *No-info* treatment, we observe that contributions of both types are not monotonically declining but rather parabolic, depicting the tendency for average contributions to increase initially before following the standard pattern of decay. Furthermore, from the lower middle and lower right panels, we learn that contribution behavior differs significantly between the two types and also between the *Part-info* and the *Full-info* treatments indicating the extent to which types respond differently to the information about heterogeneity.

The upper and lower middle panels illustrate behavior in the *Part-info* treatment. There, we observe L-types contributing between 5% and 10% more of their endowments than H-types. The findings so far support our behavioral prediction (iii.1) with behavior that goes in the direction of equal effective contributions. According to our prediction (iii.2), we expected behavior in the *Full-info* treatment to reconfirm the finding from the *Part-info* treatment because in the former coordination is facilitated by informing group members additionally about a contributor's type. Contrary to this conjecture, we observe a reversal of contribution behavior between H- and L-types. The predicted contributions and marginal effects for the *Full-info* treatment, illustrated in the upper and lower right panels, indicate that when contributions can be linked to the type of the contributor, H-types give significantly more than L-types. The lower right panel indicates that this difference comprises around 15% of the endowment and remains constant over time as contributions of both types follow the same time trend.

The dynamic behavior that we observe in different treatments is very similar between types, with two notable exceptions. In the *No-info* treatment, contributions by H-types decline in the last three periods slightly faster than those made by L-types, leading to a significant but almost negligible difference in contributions between the two types. In the *Part-info* treatment, the general decline in contributions over time is less pronounced for H-types. As a result, in the last three periods, contributions by the two types are no longer significantly different.

A summary of the above observations is in order. On one hand, we find evidence against the *efficient contribution norm*, where individuals are supposed to react solely to their individual productivity parameter. This comes from the findings in the *No-info* and *Part-info* treatments, where contribution behavior instead supports an *equal effective contribution norm*. On the other hand, in the *Full-info* treatment, we observe contribution behavior that is opposite to the behavior observed in the *Part-info* treatment, providing evidence for the *efficient contribution norm*.

Given this mixed evidence, we conclude that individuals do not react solely to their own productivity, nor do equal contribution norms persist in the presence of sufficient information on heterogeneity. Second, efficient contributions emerge when information is provided within a group about individuals' characteristics and contribution behavior. Third, the information structure affects types differently.

6 Discussion

The present experiment was designed to investigate the impact of productivity isolated from costs of contribution. Therefore, we excluded subjects from the returns of their own contributions. This is quite different from the standard experimental public goods literature, in which a person always benefits from his or her own contribution (see Ledyard (1995) for a survey). Despite this difference in design, in agreement with findings in this literature, we found positive contributions to the joint project and a common decay in contributions over time.

There are few studies in the literature on public goods experiments that examine groups whose members vary in the marginal returns that a contributed unit generates for themselves and others, also referred to as MPCR ("marginal per capita return") (Fisher et al. (1995) and Tan (2008)). In these experiments, group members receive the marginal returns of their own contributions. As a consequence, contributions of members with high productivity are less costly for the donor. Our experimental design allows us to isolate the effect of productivity on contributions; hence, our results complement the findings of those studies.

In Tan, the same groups of four persons participate in three subsequent treatments. Her second treatment is comparable to our *Full-info* treatment. There, half of the group is assigned a high MPCR (0.9) and the other half a low MPCR (0.3). She finds that members with a high MPCR contribute more than those with a low MPCR, a finding qualitatively similar to our results. In Fisher et al., two out of four group members have a high MPCR (0.75) and the other two a low MPCR (0.3). The same group members interact in two parts of ten periods each. After the first ten periods, members with a low MPCR are assigned a high MPCR and vice versa. In the first part of the first sessions they conducted, Fisher et al. observed behavior that they named "poisoning of the well" as high types contributed less than low types. The difference in contributions between types was reversed in the second part, when high types contributed more than low types. These findings resemble the differences between our *Part-info* and *Full-info* treatments. Given our results, we conjecture that their findings occurred due to the different information scenarios in the two parts of their experiment. Indeed, participants in their experiments were only implicitly informed about the heterogeneity in the group. They might have anticipated different MPCRs in the first part, but they knew about it for sure in the second part after they had switched types. Our conjecture might find even more support in further observations of Fisher et al. After recognizing the poisoning of the well effect, in the remaining sessions, participants were explicitly reminded before the first part of the experiment of the possibility of different private MPCRs. In those later sessions, the poisoning of the well effect disappeared.[21]

The similarity of our results to those of Fisher et al. (1995) and Tan (2008) indicates that the same information structure leads to similar contribution patterns between types regardless of whether they have the same or different contribution costs. The findings in our experiment and the comparison with the literature underline the importance of the information structure. Therefore, we will conclude by discussing differences in behavioral responses to information by productivity type.

Reactions of types to information

In order to investigate how both types react to the provision of information about heterogeneity, we computed marginal effects. Results are presented in Figure 3, with marginal effects of information about heterogeneity on the individual contribution behavior of H-types in the upper panels and of L-types in the lower panels.

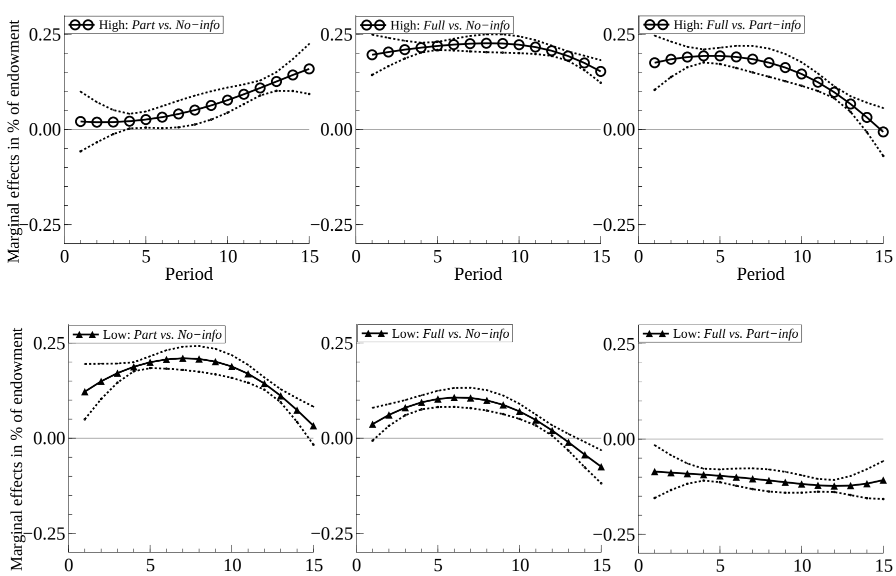

Figure 3: Marginal effects of information on contribution for L-types and H-types. (The graphs project the difference in relative nominal contributions between two treatments.)

[21]Fisher et al. write, "This greater occurrence of poisoning type behavior in *only* Year 1 with *only* the high MPCR types in *only* the first five groups remains a mystery to us." p. 265, Footnote 11.

The upper left corner panel shows the marginal effects of H-types knowing that group members vary in their productivity (*Part-info*) vs. having no information (*No-info*). In the first half of the experiment, H-types in both treatments contributed similarly, but from period 8 onwards, they contributed significantly more in the *Part-info* treatment. This can be explained by the fact that contributions of H-types in the *No-info* treatment exhibited the standard pattern of decay whereas, in the *Part-info* treatment, they remained relatively stable over time. The marginal effects of having (partial) information (*Part-info*) vs. additional feedback on the type of contributor (*Full-info*) are depicted in the upper right panel. For most of the experiment, H-types contributed between 10 and 20 percent more of their initial endowment in the *Full-info* treatment than in the *Part-info* treatment. However, in the last two periods, contributions no longer differed significantly. Once again, this can be explained by the fact that contributions of H-types in the *Part-info* treatment do not exhibit the pattern of decay, whereas they do in the *Full-info* treatment. The upper middle panel shows the overall positive and relatively stable effect of around 20 percent on H-types' contributions of passing from having no information (*No-info*) to having full information (*Full-info*).

We find very different marginal effects for L-types, as shown in the lower panels of Figure 3. The lower left and middle panels present the effect of having (partial) information (*Part-info*) and being fully informed about the type of the contributor (*Full-info*), respectively, compared to having no information about group heterogeneity (*No-info*). The two figures indicate that information on heterogeneity generally increases the contributions of L-types. Whereas contributions were around 15 percent in the *Part-info* treatment, they were only around 5 percent in the *Full-info* treatment. This explains the negative marginal effect of L-types' contributions in the *Full-info* vs. *Part-info* treatment depicted in the lower right panel.

In conclusion, the apparent "poisoning of the well" effect reported by Fisher et al. (1995) and replicated in our study is the joint result of divergent reactions of the two types. When there is (partial) information on heterogeneity, H-types do not contribute less compared to the situation without this information. However, L-types increase their contributions when group members have partial information on the heterogeneity in productivity and, albeit less so, when all group members have full information. Indeed, in the latter information scenario, H-types contribute much more, resulting in the finding of H-types contributing less than L-types in the *Part-info* treatment and more than L-types in the *Full-info* treatment. Whether there are particular forces of social pressure in place that emerge from lowering the anonymity of contributors (even though only the type of the contributor is known) that affect L-types and H-types differently is at this point open for discussion and left for further research.

Finally, few and inconclusive studies exist on the effect of information on contributions to VCMs. Andreoni and Petrie (2004) and Croson and Marks (1998) find that revealing information about individual contributions as well as individual characteristics increases individual contributions. Marks and Croson (1999) find that information on heterogeneous valuations of public goods does not significantly alter the aggregate level of contributions. Our results add empirical evidence of the behavior of heterogeneous groups to this literature.

7 Conclusions

This article studies the effects of heterogeneity in productivity on voluntary contribution behavior to a joint project using experimental data. We introduce heterogeneity in a standard linear voluntary contribution mechanism by varying the marginal products of individual contributions. In order to separate the effects of productivity from the costs of contribution, group members do not benefit from their own contributions. We use information as a treatment variable to distinguish between alternative plausible contribution norms. To this end, we gradually increase the level of information about heterogeneity in three treatments to control what subjects know about the heterogeneity.

An important finding of this study is that the information structure significantly affects individuals' contribution behavior when individuals differ in their productivity. Our analysis reveals that the information structure evokes different relative contribution patterns for the two types, resulting in no conclusive support for any particular contribution norm. The less information that is available, the more equal contribution norms prevail; but the more information that is available, the more efficient contribution norms take over.

Our findings outline the importance of the information structure concerning contributions to joint projects with heterogeneous group members, such as teamwork and charitable giving. Further studies that examine structurally how public information on individual behavior engenders contribution behavior will be particularly valuable for designing institutions in which persons with different abilities interact.

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Appendices

A Instructions

This is a translated version of the German instructions used for the experiment. We provide here the version for H-types in the No-info treatment. Differences between treatments are denoted as comments in the text. Comments by the authors included here as information to the reader but not in the original instructions can be found in parentheses and footnotes.

Welcome to this experiment! These instructions are for your private information. Please read the instruction carefully. Please do not talk to the other participants. If you have any questions, please raise your hand. We will come to you and answer your questions privately.
All amounts are displayed in *Points*. The exchange rate is: 80 points = 1 Euro.
The experiment consists of two phases of 15 periods each. Before each phase, all participants are randomly assigned to groups of six. The group's composition remains the same throughout the experiment.

Detailed Information
You are a member of a group of six. At the beginning of each period, every group member receives 17 points. In every period each group member decides how to split the 17 points. You can transfer points to a private account or to a group project. Your period payoff is the sum of your income from the private account and the income from the group project.

Your payoff from the private account:
For each point you transfer to the private account, you receive a payoff of one point. This means that if you transfer an amount of x points to your private account, your payoff increases by x points. Nobody except you benefits from your private account.
Your payoff from the group project:
The payoff you receive from the project is derived as follows. You receive one quarter of the project's outcome generated by four other members of your group. The project's outcome is the sum of all transfers, whereby each

transfer to the project is multiplied by an individual factor[, either 1.33 or 3.99. Two of the four members of your group whose transfers will benefit you have a factor of 1.33, and the other two have a factor of 3.99. Individual factors were randomly assigned to each group member in the beginning of the experiment such that three members were assigned a factor of 1.33 and three were assigned a factor of 3.99. Each member retains the same factor throughout the whole experiment.][22] The payoffs are calculated in the same manner for all six group members.
Each point you transfer to the group project generates 3.99 points.[23]
Please note that four other members of your group benefit from your transfer to the project, but you do not.

One period proceeds as follows:
In each period, you receive 17 points. You decide how many of your 17 points to transfer to your private account and how many to the project. You will make this decision by simply deciding how many points you wish to transfer to the project. The points you transfer to your private account are automatically calculated as the difference of the 17 points and the points you transferred to the project. After every group member has made a decision, the payoff for this period is calculated.
At the end of each period, you will receive the following information:

- The number of points that each member in your group transferred to the project (Please note that the numbers of points are listed in random order, i.e. the sequence of transfers is different in each period.)
- Your payoff from the private account
- Your payoff from the project
- Your payoff from the period
- Your total payoff from all previous periods in this phase

Then, the next period will start. In the second period, you will be shown a table (like the one below) with the following information for all previous

[22][The information in parentheses was **not given** in the *No-info* treatment but was **given** in the *Part-info* and *Full-info* treatments.]
[23][This was the factor for *H*-types. *L*-types had a factor of 1.33.]

periods: your transfer to the group project, your payoff in a period, and transfers made by the other 5 members of your group [with the information about their individual factors (H for 3.99 and L for 1.33)].[24] For each period, the transfers of group members are presented in random order, so columns showing the contributions of the other 5 group members will not correspond to the same person for all periods.

	Transfer to the joint project						
	You	Other group members					
		[H]	[H]	[L]	[L]	[L][24]	
Period		1	2	3	4	5	Payoff
1	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...

In total, you will interact over 15 periods in each phase. You will receive more detailed information on phase 2 after phase 1 ends.
We will ask you to complete a questionnaire after the experiment is completed. At the end of the experiment, your final payoff will be converted into Euros and paid to you immediately. Please remain seated until we call the number of your computer.

Thank you very much for your participation!

B Marginal effects of information and of productivity types

Marginal effects are calculated as the difference between the expected proportion of contribution for two realizations of a variable of interest.

For example, the effect of productivity on average nominal contributions in the *Full-info* treatment is calculated as

$$\begin{aligned} \Delta_{i,t}^{HL} &= E(y_{igt}|x_i, t, High = 1, \textit{Part-info} = 0, \textit{Full-info} = 1, c_i) \\ &- E(y_{igt}|x_i, t, High = 0, \textit{Part-info} = 0, \textit{Full-info} = 1, c_i) \end{aligned} \quad (7)$$

where the expected contribution levels are calculated using the parameter estimates of the model in eq. (4) to compute $y^{\star}_{igt}$ and applying the censoring

[24][Only participants in the *Full-info* treatment received the information allowing them to link a contribution to the contributor's type.]

rule in eq. (5) to obtain y_{igt}. We computed the effect in eq. (7) for all individuals who participated in the *Full-info* treatment and for each time period. We average over all individual effects $1/(NT)\sum_{\forall t,i}\Delta^{HL}_{i,t}$ to obtain the total effect. The variance of the marginal effects, that was used to calculate the t-values is simulated using 100 Halton draws (see Train (2003) and Judd (1999)).[25]

C Parameter estimates of background characteristics and time trend

		Specification 1		Specification 2	
Variable	Parameter	Coefficient	T-value	Coefficient	T-value
Age	β_1	-0.009	-6.022	-0.009	-6.006
Gender	β_2	-0.235	-19.973	-0.235	-19.754
Norm obedience	β_3	-0.044	-14.318	-0.044	-14.164
Time dummies	δ_2	0.147	0.934		
	δ_3	0.204	1.506		
	δ_4	0.180	1.367		
	δ_5	0.131	1.096		
	δ_6	0.090	0.790		
	δ_7	0.034	0.303		
	δ_8	0.067	0.526		
	δ_9	0.054	0.457		
	δ_{10}	-0.044	-0.389		
	δ_{11}	-0.048	-0.431		
	δ_{12}	-0.118	-0.971		
	δ_{13}	-0.146	-1.383		
	δ_{14}	-0.225	-2.167		
	δ_{15}	-0.411	-3.784		

Table 3: Parameter estimates of background characteristics and, for specification 1, the time trend

[25] We discarded the first 50 draws of a sequence, using draws 51-150.

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