

INTRINSIC MOTIVATION IN A PUBLIC GOOD ENVIRONMENT

by

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Introduction

One of the stylized facts of public good experiments is the existence of different types of individuals. Some appear to be more cooperative than others, even though the extrinsic incentives are the same (see Ledyard, 1995). It seems that the reason should, therefore, be searched in variations in the cognitive (beliefs), motivational (interests) and/or emotional (feelings) determinants of behavior. Here, we report on a series of experiments that were designed to shed some light on the impact of the latter two determinants in a public good environment (see van Dijk, Sonnemans and van Winden, 2002; Sonnemans, van Dijk and van Winden, 2001). The basic idea driving this research is that individuals may have different intrinsic motivation for contributing to the public good, and that this motivation may be affected by sentiments triggered by the success of the interaction between the individuals involved. Two important socio-psychological concepts are used for the investigation. The first is that of a "social value orientation", which refers to stable preferences of individuals with respect to allocations of payoffs to themselves and an arbitrary other individual. Using the so-called decomposed game technique, psychologists have offered substantial experimental evidence that individuals typically fall into one of the following three categories: "individualists", maximizing payoffs to self; "cooperators", maximizing joint payoffs; or "competitors", maximizing the difference in payoffs to self and other (see, e.g., van Lange et al., 1997). Value orientations have been shown to be predictive for among others, helping behavior. They provide an intrinsic motivation for such behavior, which is of obvious relevance for the private provision of public goods. This was shown by Offerman et al. (1996) for a step-level public good game, where a funding threshold has to be reached for the provision of the good. Using a so-called ring-test to measure social value orientation (Liebrand, 1984), they found that in all treatments subjects classified as cooperators contributed consistently and significantly more than individualists. In the experiments discussed below a similar test is employed. The second concept focused on in these experiments is that of a "social tie". This concept refers to the willingness of individuals to forego narrowly defined self-interest to support specific others. Key element in the development of ties are the sentiments that individuals have regarding these specific others, which refers to the extent to which they care about the well-being of those others (suggesting a formalization in terms of utility interdependence; see Coleman, 1984). Positive or negative sentiments are formed dependent on whether social interaction is valued positively or negatively (cf. Homans, 1950, 1961, Feld, 1981, Fararo, 1989). In a public good game ties should, therefore, be expected to depend on the success of the interaction, as measured for instance in monetary terms. To establish the existence of a social tie, two orientations need to be measured: the orientation of an individual towards the interests of an arbitrary (generalized) other, and the orientation towards the interests of a specific other. In the experiments this is done by applying the ring-test twice, before the multiperiod public good game (where the other is a randomly selected

subject) and at some point during or after the game (where the other was a subject interacted with in all periods of the game). The difference between the two tests is a measure of the tie that has developed. Stability of the value orientation measure was shown by using an individual decision-making experiment instead of the public good game for a control group. Note that the establishment of social ties would suggest that intrinsic motivation is affected by social interaction. By investigating the impact of value orientation on (initial) contributions in the public good game, and the influence of ties on the further interaction with subjects that participants are matched with in that game, these experiments are informative on the important issue of the role played by intrinsic motivation and its dynamics (cf. Kreps, 1997; see also Becker, 1993).

Experimental design

In a ring-test each subject is randomly coupled with an unknown other subject and has to make a number of computerized choices (32 in the experiments) between two "self-other" payoff combinations. Each combination allocates a (positive or negative) amount of money to the decision maker her- or himself and the other subject. All combinations lie on a circle, with the origin as center and the x(y)-axis representing the payoffs to self (other), which explains the name of the test. Each allocation of money can be considered as a vector. If for each subject the preferred allocations are added, the angle of the resulting vector is a measure of the extent to which the individual cares about other, reflecting the marginal rate of substitution (MRS) between the other's payoff and own payoff. See figure 1. This test was used to measure a subject's social value orientation - orientation towards an arbitrary other - before the public good game ("pre-test"), and to measure the subject's orientation to her or his partner in the two-person games that were studied ("post-test"). The difference between the post-test and pre-test angles represents the social tie for this subject. For the four-person game investigated in one of the experiments this form of the ring-test is not practical, as it would result in too many questions and would cost too much time. Therefore, the circle-test was developed. In this computerized test the orientation of a subject towards another subject is measured by only one decision, that is, by having the subject directly choose the preferred point on a circle shown on the computer screen (see figure 1). In this case the post-test comprised three separate test, one for each of the other group members.

In all experiments subjects were, at the end of each period, informed about the contribution of the other group member(s). When doing the post-test, these individual results could still be looked up. No feedback on the choices of others in either the pre-test or the post-test was given during the experiment.

The following public good game was part of all the experiments. Subjects were randomly allocated to groups, which stayed the same for all periods of the game (so-called partners condition). In

each period a subject had to distribute 10 markers over two activities, X and Y. Activity X generated a payoff exclusively for the subject her/himself (private account), whereas activity Y generated a payoff to all group members (public account). For rational subjects that are only interested in their own earnings, the game had an internal subgame-perfect Nash equilibrium where it was a dominant strategy to put 3 (7) markers in the public (private) account, while the Pareto-optimal solution was to put all markers in the public account. Each of the experiments consisted of three parts: (1) pre-test, (2) public good game, and (3) post-test. Subjects got only instructions for the part at hand. Two experiments concerned a two-person public good game: one with 25 and one with 32 periods (to check for the impact of the so-called end-effect). A third experiment concerned a four-person public good game of 32 periods. The post-test (third part) was always after 25 periods. In case of a 32 periods game subjects did not know exactly when the third part would take place. Figure 2 summarizes the design of the three experiments. This figure also shows the development of the average contribution level. We only note here that this level does not show the continuously declining trend that has been regarded as typical for this type of public good game. After an initial increase, contributions stay at a relatively high level, and only decline in the direction of the Nash-equilibrium (the dominant strategy for self-interested individuals) in the last two or three periods (end-effect).

Main observations

Different intrinsic motivation for contributing. As shown by the first three columns in the top-panel of table 1, on average, around half of the subjects appear to be non-neutral towards the interests of the other in the pre-test (testing social value orientation). The great majority of these subjects show a positive orientation, in the sense that they are willing to sacrifice money to the benefit of an arbitrary other, implying a positive MRS between the other's payoff and own payoff. But, there are also subjects who show a negative orientation (MRS). The predictive nature of these orientations is manifested by the (significant) correlation between the angle in the pre-test and the contribution in the first (five) period(s); see the first two columns in the bottom-panel of the table. Thus, it turns out that the aforementioned findings of Offerman et al. (1996) for a step-level public good game carry over to a continuous public good game. It seems that individuals with different social value orientations, as measured by the ring-test, enter the public good game with a different intrinsic motivation for contributing to the public good.

Intrinsic motivation changes with social interaction. On average, the orientation towards the specific other(s) that subjects were matched with in the public good game, as measured by the post-test, does not differ much from the pre-test orientation towards an arbitrary (generalized) other. Orientations appear to

be somewhat less neutral, but the mean change of angle is small (circa 3 degrees); see the one but last column in the top-panel of table 1. This slight drift in orientations obscures developments at the individual level, however. As the last column shows, absolute changes of angle are much larger (about 11 degrees on average). The last two columns of the bottom-panel show that also the post-test angles are (strongly) correlated with the respective subjects' contributions in periods following the test (for the four-person experiment the average of the three post-test angles per subject is taken). These results suggest that intrinsic motivation may change under the influence of the interaction with the specific other(s) in the public good game. The next observation addresses this issue.

Effect of success of social interaction (social ties). As argued above, differences between the angles in the post-test and pre-test are a measure of social ties. It is expected that the development of ties depends on the success of the interaction in the public good game. For the two-person games own earnings are selected as indicator of success, whereas for the four-person game we take the contributions by each of the other group members. Table 2 presents the outcomes of a statistical analysis where the post-test angle is regressed on the pre-test angle and the success indicator. Not surprisingly, social value orientation (the pre-test score) has a substantial impact on the post-test score. However, the success indicator has a significant additional positive effect, suggesting that individuals having experienced an (un)satisfactory interaction with a partner show a tendency to (dis)like this specific other individual. The previous result showed that such changes are predictive of subsequent behavior. Interestingly, whereas in the two-person games the interaction during the last five periods turns out to be particularly important for the success indicator, earlier periods are more important for the four-person game. This stands to reason because subjects may realize that the behavior of a partner is partly a reaction to the behavior of the other group members. Earlier periods are then more indicative of true intentions. Finally, it is noted that changes in orientation are typically not the same for the different partners in the four-person game, since they are dependent on their contributions. This shows that the orientation uncovered by a post-test differs from a social value orientation. Of course, experiences with (many) specific others may affect an individual's social value orientation.

Social ties structure in groups. An important question that can be addressed with our experimental results is whether orientations (measured by the angles in the post-test) and social ties (measured by the difference in the post- and pre-test angles) develop harmoniously among group members. Table 3 presents the observed frequencies of different types of orientations and social ties characterizing pairs of subjects in the four-person game experiment. In only about 20% of the cases orientations are mutually neutral and social ties are absent. Symmetry is most frequent among orientations (29% of the pairs, all

mutually positive), whereas asymmetry is much more common among social ties (66% of the pairs). Apparently, even with equal endowments and payoff functions, individual differences in social value orientation and reaction patterns lead to complex dynamics resulting in very different types of groups in terms of the mutual attractiveness of group members, a major determinant of group cohesiveness. This is illustrated by the figures in table 3. The left (right) figure shows the social ties network of the worst (best) performing group in terms of mean contributions to the public good (respectively, 3.7 and 9.9 markers). Even with highly successful interaction mutually positive social ties are not guaranteed. These results tone down the suggestion in the literature that bonds (via identification) form easily and lead to cooperative behavior towards group members (see, e.g., Baumeister and Leary, 1995).

Conclusions

- Subjects differ in social value orientation as measured in the pre-test. The contributions in the first periods of the public good game are positively correlated to the value orientation.
- The success of social interaction in the public good game influences the orientation towards group members (social ties).
- Subjects in 4-person groups discriminate between group members: a social tie is positively correlated with the contributions of the other. However, most relations are not symmetric. Apparently individual differences in social value orientation and reaction patterns can lead to complex group-dynamics.

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Table 1. Pre -test and post-test orientation, and correlations of orientation with own contributions to the public good.

<i>experiment</i>	<i>Social value orientation (pre-test)</i>			<i>Orientation towards specific other (post-test)</i>			<i>Mean change of orientation</i>	<i>Mean absolute change of orientation</i>
	<i>Negative <-5°</i>	<i>Neutral between -5° and +5°</i>	<i>Positive >+5°</i>	<i>Negative <-5°</i>	<i>Neutral between -5° and +5°</i>	<i>Positive >+5°</i>		
2 persons 25 periods	24%	28%	48%	26%	33%	41%	-3.7°	11.4°
2 persons 32 periods	10%	54%	36%	10%	50%	40%	3.3°	9.4°
4 persons 32 periods	2%	51%	47%	8%	44%	48%	-2°	13°

About 50% of subjects are not neutral in orientation, most of them showing a positive orientation towards interest of others

Mean changes in orientations are small, but there are large differences: absolute changes are considerable

<i>Experiment</i>	<i>Correlation pre-test with own contribution in period(s)</i>		<i>Correlation post-test with own contribution in period(s)</i>	
2 persons 25 periods	.14	.28*	n.a.	n.a.
2 persons 32 periods	.44***	.41***	.27*	.35**
	Social value orientation is positively correlated with contributions in first periods		Social tie is positively correlated with contributions after period 25	

Note: * significant p<0.10 ** significant p<0.05 *** significant p<0.01

Table 2. Regressions with orientation towards specific group member after the public good game (post-test) as dependent variable and the social value orientation (pre-test) and own earnings (2-person game) and contributions of specific group members (4-person game) as independent variables.

2 person game 25 periods: orientation towards specific other					
Independent variables	B	SE B	Beta	t	Sign. t
Social value orientation	0.832	0.110	0.752	7.574	0.000
Own Earnings periods 21-25	0.039	0.020	0.200	2.013	0.051
Constant	-30.127	13.593		-2.216	0.033
Adjusted R-square =0.597					

2 person game 32 periods: orientation towards specific other					
Independent variables	B	SE B	Beta	t	Sign. t
Social value orientation	0.715	0.141	0.564	5.056	0.000
Own Earnings periods 21-25	0.048	0.018	0.283	2.536	0.015
Constant	-33.074	14.661		-2.256	0.029
Adjusted R-square =0.484					

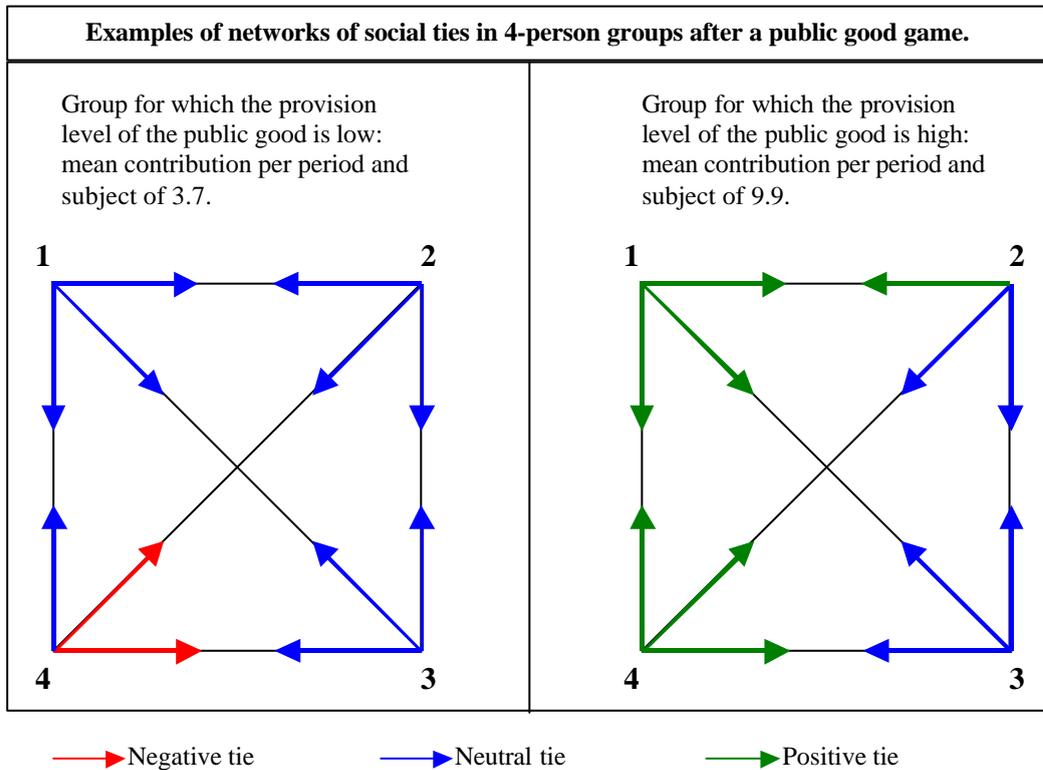
4 person game 32 periods: orientation towards specific groupmember					
Independent variables	B	SE B	Beta	t	Sign. t
Social value orientation	0.366	0.086	0.298	4.279	0.000
Contributions by other periods 1-25	0.126	0.025	0.355	5.099	0.000
Constant	-15.118	4.536		-3.333	0.001
Adjusted R-square =0.207					

We find a robust positive relation between the success of interaction and the orientation towards specific groupmember

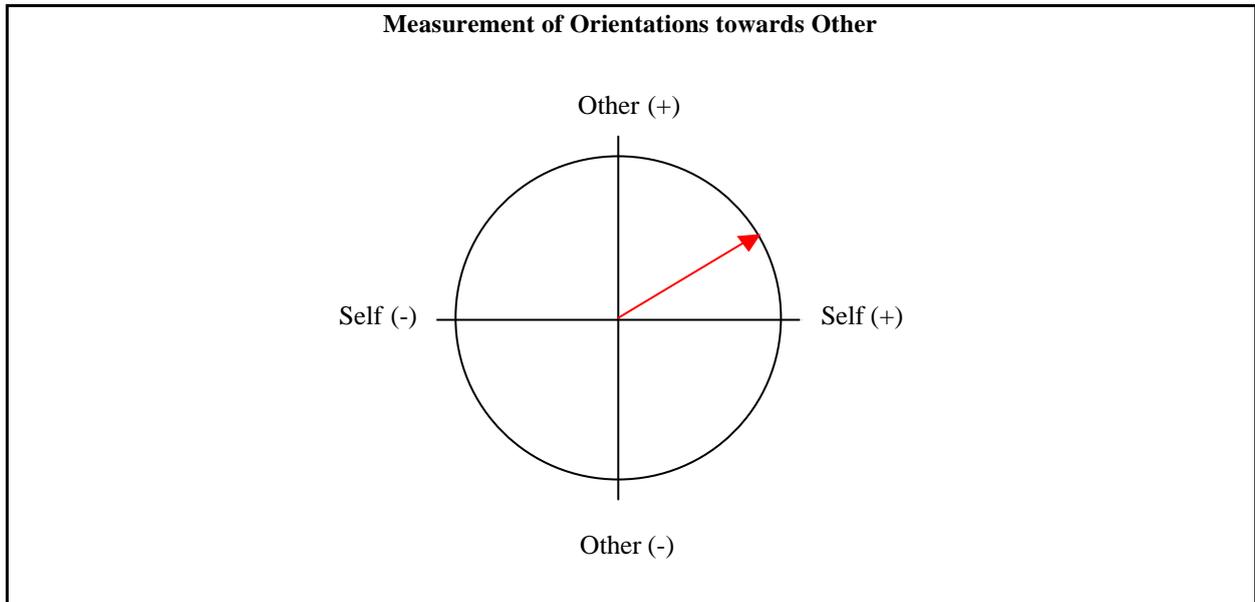


Table 3. Orientations and social ties after a 4-person public good game.

<i>type</i>	<i>sign</i>	<i>orientation towards specific others (percentage of pairs)</i>	<i>social ties (percentage of pairs)</i>
symmetric	++	29%	10%
	--	0%	5%
asymmetric	+0	37%	22%
	+ -	4%	10%
	0 -	8%	34%
mutually neutral	00	22%	19%



Orientations and social ties do not develop harmoniously; even with highly successful interaction mutually positive ties are not guaranteed.



<p>Ring-test: 32 choices between two allocations of payoff to oneself and payoffs to other, lying on the circle, of the following format:</p> <p><i>Choose allocation A or allocation B:</i> <i>A: x for self and y for other</i> <i>B: v for self and w for other</i></p> <p>The orientation towards other is found by adding up all preferred allocations: this gives a vector; its angle with the horizontal axis measures the orientation.</p>	<p>Circle-test (used for measuring orientations towards more than one individual): 1 choice of allocation of payoff to oneself and payoff to other on the circle, of the following format:</p> <p><i>Choose a point on the circle</i></p> <p>The orientation towards other is given by the angle of the vector with the horizontal axis.</p>
<p><i>Definitions of key concepts</i></p> <p>Social value orientation: orientation towards arbitrary other</p> <p>Social tie: difference between orientation towards a specific other and social value orientation</p>	

Figure 1

Mean Contribution
to Public Good

The measurement of social ties after an ended interaction or during an ongoing interaction

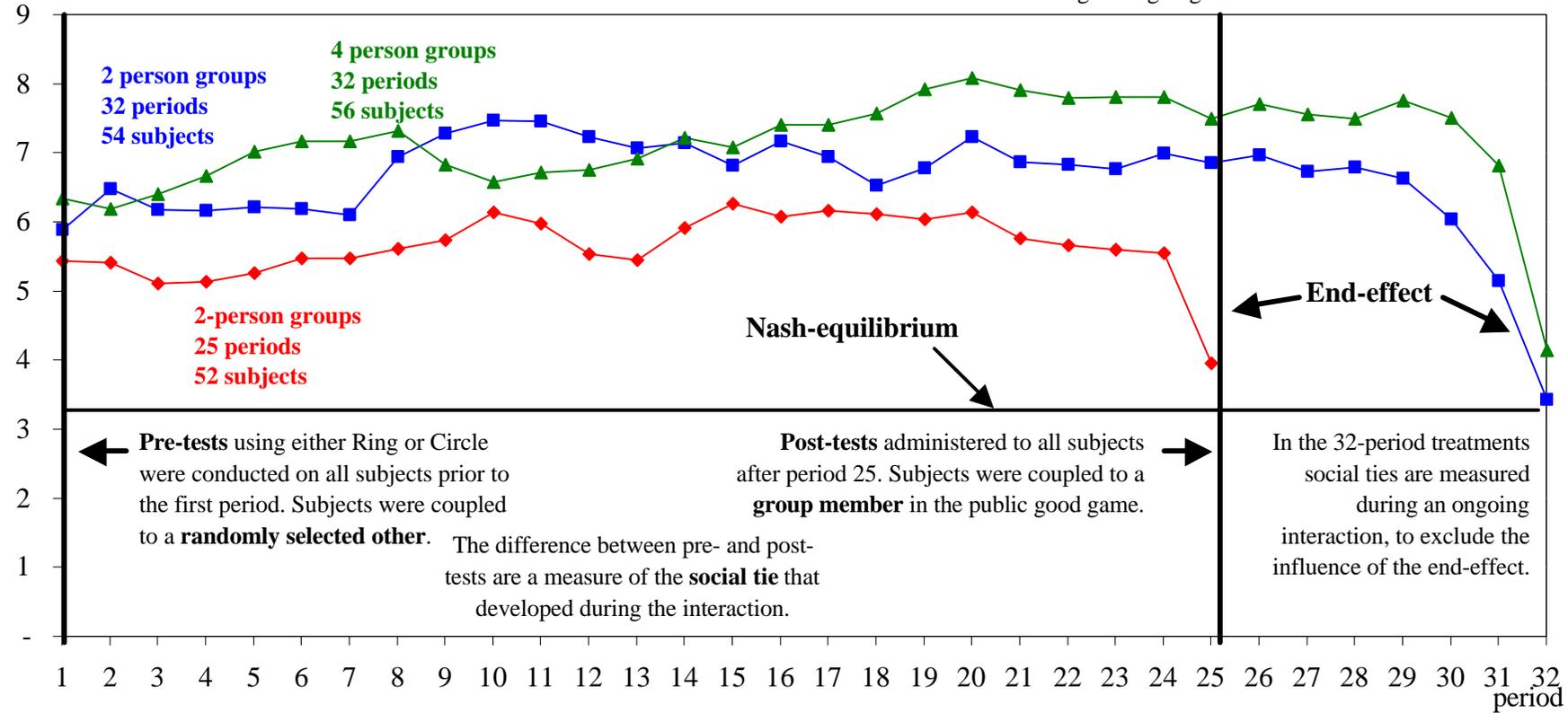


Figure 2