

Information and the Creation and Return of Social Capital: An Experimental Study *

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November 2002

Forthcoming in: H. Flap and B. Völker (eds.), *Creation and Returns of Social Capital*, Routledge.

Abstract

We run a set of experiments where we are able to investigate the relation between investment in and the return of social capital (cooperation rates). Pairs first play a repeated public good game, followed by a dictator game where one of the partners is the dictator. Experimental treatments differ in the information provided regarding the dictator game before starting the public good game: no information at all, partial information (game explained plus announcement of 50% chance of becoming the dictator), and full information. In this way short-term and longer-term forms of social capital, and their returns, can be investigated. Results show that the short-term type is largest when there is either complete uncertainty or complete certainty about the future of the relationship. Surprisingly, it is lowest if people do not know for sure their future role in the dictator game (partial information). Knowledge of future dependency triggers investment. Compared to short-term investment it is relatively low, though, and it occurs rather late in the relationship. Correlation between preceding cooperative behaviour and help received later is strongest under full information about the common future. Under no information no such correlation is found.

*This paper is part of the NWO project 510-05-0200 "Creation and Returns of Social Capital: Social Networks in Education and Labor Markets" (SCALE) and the EU-TMR research network ENDEAR (FMRX-CT98-0238). We wish to thank our colleagues from SCALE, in particular Henk Flap, Tom Snijders, and Beate Völker as well as Vincent Buskens and Werner Raub and participants of the 1999 SCALE conference in Amsterdam for helpful discussions and comments on earlier versions of this paper. We are particularly grateful to Jos Theelen for programming the software used in the experiment. Needless to say that all remaining errors are ours.

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1 Introduction

The economic and sociological literature knows many different definitions of social capital (see e.g. Dijk van, 1997; Serageldin and Grootaert, 1999; Dasgupta, 1999; Lin, 1999; and Paldam and Svendsen, 2000). For the purpose of our investigation the following description suffices. To be regarded as capital in the usual economic sense social capital needs to satisfy at least two basic requirements. Firstly, its creation entails a sacrifice of resources. Secondly, it is expected to generate a stream of benefits in the future. What distinguishes *social* capital from human capital and (physical) capital is that the expected flow of future benefits relates to beneficial actions originating from others outside markets for goods and services. Its constituents - comparable to the physical goods in case of real capital - are those features of social interaction that can improve efficiency by facilitating coordinated cooperative actions (see Putnam et al., 1994). One can think of norms and networks but also of trust, reciprocal behavior and other social mechanisms with such a property. The value of the current social capital stock equals the present value of the flow of benefits that it will generate in the future, while positive social capital is created only if the net (of resource cost) additional present value is positive.

Skeptics of the idea of social capital argue that the first requirement for being regarded as capital, which relates to the investment of scarce resources, fails. In particular, prominent critics claim that important elements of social capital, like trust, accrue as a by-product of social interaction and that the arising reward is intrinsic to the interaction itself (Arrow, 1999). While admitting that trust, trustworthiness, capacity and disposition to cooperation is valuable and important for the proper functioning of societies in the small and the large these critics doubt that there is any instrumental value incorporated in social capital (Solow, 1999).

In contrast, scholars of social capital theory state that the premise behind the notion of social capital, namely that people deliberately invest in social relationships in the hope and anticipation of beneficial returns is generally fulfilled (Coleman, 1988; Lin, 2001). However, also strong supporters of the idea of the instrumental value of social interaction admit that not all social capital need to be the result of a conscious investment decision. It may be inherited by birth or obtained as a by-product of joining a group with a prevailing high level of trust, for instance. It may actually also be partly a by-product of social relationships and social interactions having other goals than deliberately building up social capital (Flap, 1999). Intuitively, it seems easily possible that elements regarded as part of social capital - like cooperative behavior and trust - may spill-over from one social situation to another similar one. This may

especially hold true if in both situations the same set of people is involved. Consider, for example, a situation where two persons have to work together at a dangerous work place implying that they have to rely on each others effort and work quality. In a sense people in such situation are forced into a relationship where trust, reliability and cooperative behavior are crucial. Intuitively one would expect that this experience spills-over to other not that frequent social encounters. One might expect, that people with such an experience feel more strongly inclined to help each other in exceptional situations than people without such an experience.

Difficulties arise when one wants to disentangle empirically the two potential components of social capital accumulation: investment in a relationship with an eye on possible returns in the distant future, on the one hand, and ‘by-product social capital’ brought about by the mere existence of social interaction itself, on the other hand. How can we observe whether behavior perceived as trustworthy or cooperative is due to deliberate investment in the relationship or ‘just’ the by-product of achieving a short-term goal? With traditional empirical methods it seems very hard to disentangle these two elements. In this contribution we take therefore another route and use the method of laboratory experimentation to trace the nature of the investment decisions of people.

One important advantage of the experimental method is the possibility to change important parameters of the (social) environment in a controlled way. For investment in social capital the information about the future of the relationship plays a crucial role. For instance, if a person knows for sure that she will never meet her present interaction partner again then there is no need to invest in this relationship. However, if the same person knows for sure that relationship continues and that she will need help from her present interaction partner in the future then there may be good reason for investment in the relationship. Therefore, we run a set of experiments where we are able to investigate the relation between investment in social capital and returns of social capital under different information conditions. To operationalize social capital for our purposes we follow a suggestion of Paldam and Svendsen (Paldam and Svendsen, 2000) and define social capital as the frequency of cooperative behavior in an experimental dilemma situation. In our setting this is a very natural definition as will become clearer below.

We implement three different treatments in the experiment. In all treatments subjects play first a two-person public good game and thereafter a dictator game. In the dictator game one of the two partners in the public good game plays the role of the dictator who can keep a given endowment of money or allocate any part of it to the partner in the public good game. Because of the dependence of the latter on the for-

mer, we shall refer to the possibility of allocating money to the partner as having the opportunity to ‘help’.¹ The treatments only differ with respect to the information given about the second stage of the experiment (the dictator game). In the first treatment (no information), subjects know nothing about the second part of the experiment. In a second treatment (partial information), all know that there will be a dictator game but no information about the roles in the game are given. In the third treatment (full information), all know not only the content of the second part but also who will be the dictator and who will be the non-dictator. Hence, only in this treatment people know who may need help and who will be able to deliver help.

The use of these treatments allows us to distinguish between social capital built up under complete uncertainty, partial uncertainty and no uncertainty about the nature of future interaction. In addition, we are able to investigate any short-term returns to social capital showing up already in the first part of the experiment and longer-term returns of social capital which is built up in the first part but generates return only in the second part.

The rest of this article is organized as follows. In the next section, we present the experimental set-up and information treatments more thoroughly. In section 3, we put forward and discuss some research hypotheses concerning the creation and reward of social capital under the different information conditions. In section 4, the results are presented and some conclusions are drawn, while Section 5 concludes.

2 The Experiment

The experiment consisted of two parts. In the first part subjects played a 2-person public good game for 15 rounds. During all 15 rounds the persons in a dyad did not change. The second part of the experiment was a dictator game that was played immediately after the public good game was finished. One of the partners from the public good game was chosen as the “dictator” and had the possibility to allocate some extra money to his *own* non-dictator (that is, the partner in the public good game) as well as to a stranger (*other* non-dictator) from another group. The partners in a dyad had always the possibility to review the whole history of their own public good game when making decisions. They had no information about the behavior in other groups. This means in particular that dictators were able to look up the behavior and earnings of the own non-dictator but did not receive any information about the behavior of the other non-dictator.

The Public Good Game. Before the public good game began subjects were randomly coupled and they stayed together in the dyad for all 15 rounds. In each round subjects decided - simultaneously and anonymously - how much of a given endowment to keep privately and how much to allocate to the public good.² In each round the endowment given to each subject consisted of 20 francs. (In the experiment we used the “franc” as the experimental money unit. After the experiment the earnings in francs were converted to real money at the exchange rate 1 franc = 6 Dutch cents \approx 3 US cents.) Investment into the private good generated earnings exclusively for the subject her/himself, whereas investment into the public good generated income for both group members. The per round payoff (in francs) in the public good game was given by

$$u_i = 20 - g_i + 0.7(g_i + g_j) - 6, \quad i = 1, 2, \quad i \neq j, \quad 0 \leq g_i, g_j \leq 20,$$

where g_i (g_j) denotes subject i 's (j 's) contribution to the public good. Thus, the payoff per round was between 8 and 28 francs. Hence, over all 15 rounds the payoff range was 120 to 420 francs. Clearly, assuming rational and purely selfish individuals it is a strictly dominant strategy to allocate nothing to the public good. Efficiency, on the other hand, requires that both players allocate everything of their endowment to the public good.

Dictator Game. After the last round of the public good game the dictator game was played. In the dictator game each dictator received - in addition to the earnings from the public good game - two times 300 francs. From this additional money the dictator had to allocate one part (i.e. 300 francs) between him/herself and the partner from the public good game (the own non-dictator). The other 300 francs had to be allocated between self and an anonymous stranger, a non-dictator from another group (the other non-dictator). The identity of the other non-dictator was never revealed and subjects knew this. The dictator was allowed to give all the money, a part of it, or nothing to the non-dictators. In addition, accentuating the dependency of the non-dictator, a dictator also had the possibility to take away money from the non-dictators. However, taking away money was costly and the costs to be paid exceeded the money taken at an increasing rate.³ Obviously, the dominant strategy for a rational payoff maximizer was to give nothing to (and to take nothing from) each non-dictator. It was common knowledge that after the dictator game the experiment was over. Hence, non-dictators had no possibility to reward or punish the dictator's behavior and everybody knew this.

Treatment variable - Information. Our treatment variable was the information given about the second part of the experiment, the dictator game. We implemented

three different information conditions shortly described below:

No information (NOINF) At the beginning of the experiment, that is before the public good game, subjects received only the information that after the first part there would be a second part of the experiment. They did not receive any information about the content of the second part before they had finished the public good game.

Partial information (PARTINF) In this treatment, participants received information about the content of the second part of the experiment before they started to play the public good game. They were informed that there would be a dictator game after the public good game and they were also informed about the exact rules of conduct in that game. Additionally, they were given the information that after the public good game a chance move would determine roles of the dictator and non-dictator, with a chance of 50 percent of becoming the dictator (non-dictator). Hence, when playing the public good game, participants knew that a dictator game would be played after the public good game but they did not know in which role they were to play this game.

Full information (FULLINF) Under this information condition participants were informed about the content and exact procedures of the second part of the experiment before the public good game started. In addition to that, they were also informed about their role in the dictator game, before the public good game started. Hence, in each dyad everybody knew who would be the dictator and who would be the non-dictator in the second part of the experiment.

The computerized experiment was run at the CREED laboratory at the University of Amsterdam. Participants were mainly students in economics and econometrics with a minority coming from various other fields. In total nine experimental sessions were run. Three sessions (involving 52 subjects) were conducted with the NOINF condition, three sessions (56 participants) with the PARTINF condition, and another three sessions (56 participants) with the FULLINF condition.

Before the experiment started written instructions (available upon request) were read aloud, to ensure common knowledge of the experimental procedures. The subjects also received a payoff table showing all possible investment combinations and the associated earnings in the public good game. In PARTINF and in FULLINF the instructions for the dictator game were given immediately after the instructions for the public good game. In the NOINF condition this information was given only after the end of the public good game. The dictator game instructions contained also a table

showing the cost of taking away money from the non-dictator. During and after the instruction phase participants were given the opportunity to raise questions.⁴

The instructions contained three control questions to check whether the subjects had understood them correctly. The experiment started after everybody had correctly answered these questions. Each subject was seated at a computer terminal in a separate cubicle. Communication other than via the decisions made was not allowed. At the end of the experiment participants were - anonymously and confidentially - paid out in real money according to the earnings in the experiment. The average earning per subject was DFL 34.00 (USD 17.00). Each session lasted approximately 90 minutes.

3 Research hypotheses: creation and return of social capital

As mentioned already in the Introduction we follow a suggestion of Paldam and Svendsen (Paldam and Svendsen, 2000) by operationalizing social capital as the amount of cooperative behavior in a social dilemma situation. In our experiment the only way to (signal one's willingness to) cooperate in the public good game is to invest in the public good. Therefore, the most natural way to measure social capital in a relationship is the amount of investment in the public good. Note, that because the public good game is played in a dyad investment in the public good is at the same time a specific investment in the relationship with the partner in the game. Notice, however, the double role such an investment may play in a relationship. Firstly, being cooperative (i.e. investing in the public good) may trigger a cooperative climate and induce cooperative behavior of the partner in the public good game itself. This can be interpreted as an investment leading to a *short-run* return, namely a higher payoff in the public good game. Such investment with short-run return is observed in many public good game experiments and is based on what is called *conditional cooperation*. Conditional cooperation is a social mechanism based on reciprocal behavior that induces cooperative behavior after cooperative behavior and uncooperative behavior after uncooperative behavior.⁵ Secondly, investment in the public good may also involve a longer time horizon. One may invest in the relationship in the hope of a return in a more *distant future* (e.g. one may need assistance or help of the partner in the future). For our experiment that means that persons who knew already, or had a fair chance, that they would be in the role of the non-dictator might invest in the public good in the hope of a return ('help') in the dictator game after the public good game. These two roles of investment relate to the idea of 'generalized reciprocity' (Sahlins, 1965) which states that 'people spend their

resources on others (...) also with an eye to the future' (Flap, 1999:9). For relationships outside the laboratory it is virtually impossible to disentangle these two roles. In the experimental laboratory, however, we are able to separate them by controlling the information given to the subjects.

The creation of social capital. Notice that in NOINF our experimental subjects face complete uncertainty about the future in the sense that they have no knowledge about whether they have a common future after the public good game or not. Therefore, any investment into the public good can only be of the conditional cooperation type (CC-type, for short).⁶ Of course, we can not completely exclude the possibility that some subjects may have thought that they might have to play a dictator game with their partner in the second part of the experiment. This, however, is very unlikely because they did not even know whether they would stay together with the same person in the second part of the experiment. We are therefore quite confident that considerations about possible future rewards after the public good game played no or only a minor role during the public good game, under this information condition. Things differ, however, in the other two information treatments: PARTINF and FULLINF. In these two treatments it is common knowledge that there is a dictator game after the public good game, already during the play of the public good game. Hence, under these two conditions investment in the public good may comprise longer-horizon (LH) investment, in addition to investment of the CC-type. Actually, it may be that this LH-investment not only adds to the CC-type investment but may - via the conditional cooperation mechanism - even reinforce it. These considerations lead us to our first hypothesis concerning the creation of social capital.

Hypothesis 1

In PARTINF and FULLINF cooperation rates in the public good game, i.e. investments in social capital, will be higher than in NOINF.

Notice that if social capital is a pure by-product of social interaction without any forward looking elements (as argued by e.g. Arrow, 1999) then the rate of cooperation should not differ between treatments.

In the FULLINF condition subjects know their role in the dictator game already during the play of the public good game. Obviously, it is the non-dictator who depends on the 'help' of the dictator in the dictator game. If LH-investment in social capital plays a role one would expect that non-dictators have a stronger incentive to exhibit cooperative behavior than dictators or people who do not know their role, yet.⁷ If this

holds true and if conditional cooperation plays a role than we may also observe that - due to reinforcing effects - the total investment levels (i.e. the sum of investments) in a dyad are highest under the condition FULLINF.

Hypothesis 2

In FULLINF cooperation rates, i.e. investments in social capital, of non-dictators will be higher than those of dictators. Furthermore, in a dyad total investment in social capital will be largest under this information treatment.

Note, however, that there is also the possibility that dictators may try to exploit the relatively weak position of their partners. One way to do that is by always investing a little less than the partner (the non-dictator), thereby saving investment costs. If this holds true the first part of the above hypothesis may still carry (or may even be strengthened) but the second part may be falsified. Moreover, if conditional cooperative behavior of the non-dictators is strong enough such opportunistic behavior of dictators may even lead to a downward spiral in cooperation and drive out social capital investment or at least reduce it below the levels of the other two treatments.

The returns of social capital investment. An important part of the definition of deliberate investment in social capital is that the investor expects some future benefit from his or her investment. A necessary condition for deliberate social capital investment to be a stable phenomenon is that it yields a positive return. In our experiment we can measure the longer-term return of social capital to a non-dictator straightforwardly by relating the cooperative behavior in the public good game to the benefits (or punishment) received in the dictator game. Additionally, we can investigate whether the CC-type investment in social capital also has a longer-term return and how this return differs when also LH-type investment may be present. It is, of course, not impossible that the pure fact of being conditional cooperative already leads to a reward in the dictator game, through the development of social ties, for instance. From the viewpoint of social capital theory the more interesting question is whether there accrues a benefit from social capital investment of the LH-type. If this is the case, we should observe that the longer-term return from investment in social capital is higher under the conditions of common knowledge of the future of the relationship than under the condition of complete uncertainty about the future. This leads to our third hypothesis, concerning the rewards of social capital in our experiment.

Hypothesis 3

The longer-term return of investment in social capital is higher in PARTINF and FULLINF than in NOINF.

Whether the return to social capital investment differs between the conditions PARTINF and FULLINF and, if so, in which direction may depend on the perception and interpretation of this investment by the dictator. For instance, in FULLINF the dictator may view a higher investment level by the non-dictator as opportunistic behavior which may devalue it in his or her perception. From the viewpoint of social capital theory it seems, however, most natural to assume that the return to investment is neutral with respect to the information of knowing ones role in the future. Our next hypothesis captures this view.

Hypothesis 4

The longer-term return of investment in social capital does not differ between PARTINF and FULLINF.

Another interesting issue is the relative treatment of the own non-dictator (partner) and the other non-dictator (stranger). In all information conditions dictators do not receive any information about the behavior and earnings of the other non-dictator. Hence, from this perspective dictators should treat these non-dictators equally across treatments.

Hypothesis 5 *The behavior of dictators towards non-dictators coming from other groups will be independent of the information condition.*

Notice, that giving to non-dictators from other groups can serve as a benchmark concerning the social preferences of the dictator. Any difference in treatment of the own and the other non-dictator must be due to the experience with the own non-dictator in the public good game. In this respect, it is also interesting to investigate whether experiences in the dyads produce spill-over effects towards strangers.

4 Results

In the following we shall first report on the results concerning the creation of social capital by investigating the investment behavior of dictators and non-dictators in the public good game under the different information conditions. Thereafter, we shall turn to the question of whether investment in social capital pays and how this depends on the information given.

4.1 Behavior in the Public Good Game

We start with a first general observation concerning investment behavior in the public good game across the information conditions.

Observation 1 *Contribution rates to the public good do not differ between NOINF and FULLINF. In PARTINF, however, the contribution rate is significantly smaller than in the other two treatments, except for the very first rounds.*

First support for this observation comes from Figure 1. This figure shows the average and median contributions for each treatment across groups. The figure indicates that

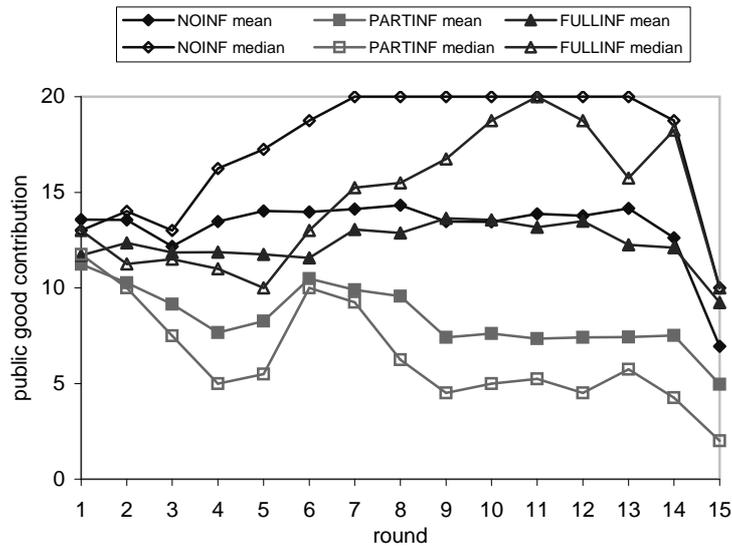


Figure 1 - Contributions to the public good across information conditions

at the beginning of the public good game investment behavior is very similar under the three information conditions. A non-parametric Kruskal-Wallis test⁸ for equality of population ranks confirms this impression. In rounds 1 to 3 the p-values are always larger than 0.1722 (two-sided tests). After round 3, however, the contribution levels evolve differently. In particular, the contributions under PARTINF fall short-of those under the other two information conditions. In PARTINF the median as well as the average contribution decreases sharply from round 1 to round 5. After a slight recovery in round 6 followed by another decrease the contributions stay constant at a rather low level in this treatment. In contrast, in FULLINF and in NOINF the average contributions stay relatively stable at a rather high investment level. The median contributions in these two treatments exhibit even an increasing pattern over time. The visual impression of similar contributions in NOINF and FULLINF and smaller contributions in PARTINF is corroborated by a statistical analysis. For most rounds after round 3 the

Kruskal-Wallis test rejects the hypothesis of equality of population rank at least at the 5 percent significance level (two-sided test).⁹ Furthermore, it appears that in rounds with significant differences in investment behavior contribution rates in PARTINF are indeed smaller than in NOINF and FULLINF, whereas no significant differences can be detected between the two latter conditions (Mann-Whitney tests, two-sided).

The above observation indicates that - as expected - the information about the future of the relationship indeed influences investment behavior in the public good game. Unexpectedly, however, and in contrast to our first hypothesis investment behavior is not lowest when there is uncertainty about the future but when there is only partial information about the future relationship. Moreover, the hypothesis that total investment in a dyad would be larger under FULLINF (second part of hypothesis 2), is also rejected, since contributions are similar under NOINF.

At first sight, this regularity seems to be at odds with social capital theory that assumes that people invest deliberately into the future of their relationship. In particular, the high cooperation rate in NOINF is somehow puzzling and shows that the interplay between CC-type investment and LH-type investment is more subtle than one may have conjectured at first sight. We want to emphasize that Observation 1 does not exclude the possibility of the existence of social capital investment of the LH-type. In particular, since the investment levels in FULLINF are significantly higher than in PARTINF one might hypothesize that deliberate LH-investment into the relationship plays a role in the investment decisions during the public good game. We shall investigate that more deeply by analyzing the behavior of dictators and non-dictators separately.

Behavior of dictators and non-dictators. If deliberate longer-term investment into the relationship is prevalent then this should hold for non-dictators in FULLINF, in particular. They know for sure that they need help in the future and also know that their partner in the ongoing relationship will have the opportunity to provide it.

Figure 2 shows the evolution of public good contributions of (ex-post) dictators and non-dictators for all three information conditions. As should be the case there seems to be not much of a difference in investment levels between ex-post dictators and non-dictators under conditions NOINF and PARTINF. For the larger first part of the public good game this seems also to be the case under information condition FULLINF. In the last third of the game, however, non-dictators show some tendency to contribute more than dictators under this information condition. To investigate whether this impression can be corroborated by a statistical analysis we divide the 15

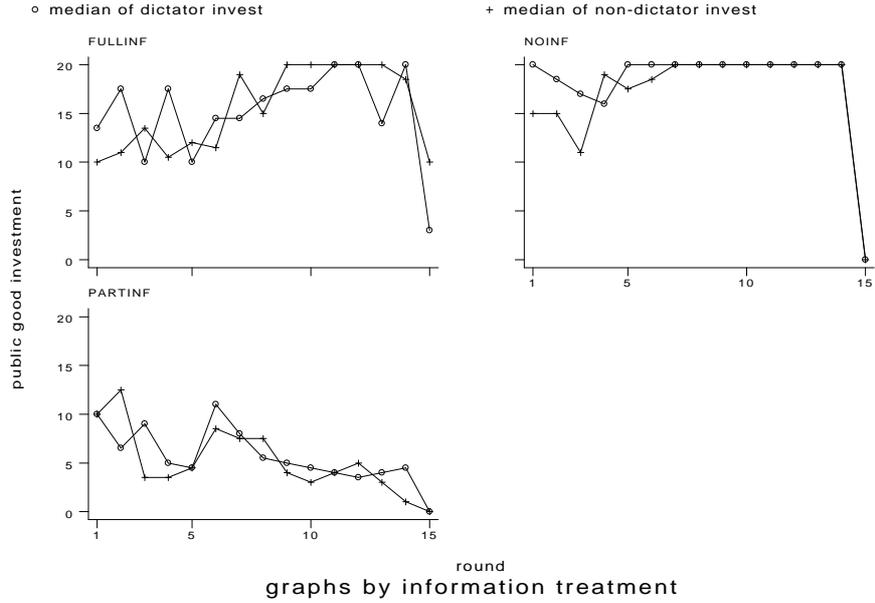


Figure 2 - Contributions to the public good of (ex-post) dictators and non-dictators by information condition

rounds of the public good game into three phases: an early phase (rounds 1 to 5), a middle phase (rounds 6 to 10), and a late phase (rounds 11 to 15). Then a sign-test is applied to the investment levels in each phase and each information condition. The null hypothesis is that the median of the differences in contributions by dictators and non-dictators is zero. Alternatively, we hypothesize that the median contribution of the non-dictator is larger. In line with the null hypothesis of no difference in investment behavior the sign test does not detect any difference (at any convenient significance level) in any phase for NOINF and PARTINF. In FULLINF the null hypothesis of no difference can also not be rejected for the early and the middle phase of the public good game. In the late phase, however, non-dictators contributions to the public good are indeed (marginally) significantly larger than those of dictators ($p = 0.084$, 1-sided).

Observation 2 *In general, there is no statistically significant difference between dictators' and non-dictators' contributions to the public good under the different information conditions. However, in FULLINF non-dictators tend to invest more than dictators as the public good game comes closer to its end.*

Thus, some evidence supporting the first part of hypothesis 2 is obtained. The differences in investment levels between dictators and non-dictators in FULLINF are not overwhelmingly large, but one has to keep in mind that conditional cooperation seems to be a strong behavioral force leading dictators to higher contributions when non-

dictators contribute more thereby mitigating differences in investment levels. We will come back to these reciprocal forces at the end of this section.

Looking at last round contributions of dictators and non-dictators in Figure 2 it is eye-catching that under all three information conditions these contributions are significantly smaller than contributions in earlier rounds. A closer look, however, also reveals some notable differences between conditions. Firstly, it seems that the last round contributions in FULLINF are larger than in the other two information conditions. Secondly, whereas the median of last round contributions for ex-post dictators and non-dictators are equal and zero in PARTINF and NOINF they are unequal and non-zero in FULLINF. In this treatment, with a median contribution of 10 francs in the last round non-dictators seem to contribute significantly more than dictators with a contribution of only 3 francs. Application of the sign test, however, shows that this difference can not be regarded as significant ($p = 0.1051$, one-sided test). Similar comparisons between information conditions, however, show some difference in last round behavior behavior of subjects. With the help of non-parametric Mann-Whitney tests we look for significant differences in last round contributions between (ex-post) dictators and (ex-post) non-dictators, separately, across information conditions. Concerning the behavior of dictators it turns out that there is only a marginally significant difference in contributions between FULLINF and PARTINF ($p = 0.080$, one-sided test). All other differences are insignificant. For non-dictators it turns out that compared to NOINF and PARTINF last round contributions are significantly higher in FULLINF ($p = 0.050$ and 0.027 , respectively; one-sided tests).

Another way to look at behavior at the end of the public good game is by investigating the *change* in behavior in the last round compared to the previous rounds. There, however, we have to control for differences in overall investment rates since a drop from an average contribution of say 1 franc down to zero francs has to be interpreted differently compared to a drop from 10 francs to zero francs. We define, therefore, a *weighted end effect* that is given by the following formula.

$$endeff_i := \begin{cases} \frac{(x_i - y_i)x_i}{20} & \text{if } x_i \geq y_i, \\ \frac{(x_i - y_i)(20 - x_i)}{20} & \text{if } x_i < y_i, \end{cases} \quad (4.1)$$

where x_i is the average contribution to the public good over rounds 1 to 14 of individual (or group) i , and y_i is the last round contribution of the same individual (group). The measure is zero when last round contributions are not different from the average contribution across rounds 1 to 14. Furthermore, this measure has the desirable property that a decrease in investment from a high level gets a higher weight than a decrease by the same amount from a lower level. Similarly, it puts more weight on an increase

from a low level than an increase by the same amount from a higher level.

In Table 1 we report the medians of the end effects together with statistical test results for significant pairwise differences. In the table the first entry shows the value of the row variable and the second entry the value of the column variable. For NOINF and PARTINF we report the *group end effect* (i.e. average of *endeff* of both subjects in a dyad): ‘group NOINF’ and ‘group PARTINF’, respectively. For FULLINF we report the dictator’s (‘dict FULLINF’) and the non-dictators (non-dict FULLINF) end effect separately.

Table 1 - Comparison of median end effects

	group PARTINF	dict FULLINF	non-dict FULLINF
group NOINF	(4.87,0.85) ^a $p = 0.013^b$	(4.87,0.28) $p = 0.010^b$	(4.87,0.09) $p = 0.002^b$
group PARTINF		(0.85,0.28) $p = 0.142^b$	(0.85,0.09) $p = 0.055^b$
dict. FULLINF			(0.28,0.09) $p = 0.095^c$

Note: ^a First entry shows the value of the row variable, second entry shows the value of the column variable; ^b Mann-Whitney test, 1-sided; ^c Wilcoxon signed-rank test, 1-sided.

The end effect is unambiguously largest in NOINF (4.87) and second largest in PARTINF (0.85). Interestingly, in FULLINF both the non-dictators’ *and* the dictators’ end effects are smaller than the group end effects in the other two information conditions. The dictators’ end effect is given by 0.28 and the end effect of non-dictators by 0.09. All the differences are statistically significant, except for the difference of the dictator end effect in FULLINF and the group end effect in PARTINF (see Table 1). Another interesting result is that we can not reject the hypotheses of *no* end effect (that is, *endeff* = 0) for non-dictators in FULLINF at any conventional level of significance. All other end effects, in contrast, turn out to be statistically significant at least at the 5 percent level (Wilcoxon signed-rank tests, one-sided). The following observation summarizes the reported findings.

Observation 3 *Only non-dictators in FULLINF exhibit no significant end effect. In NOINF the end effect is larger than the end effect in PARTINF, which is in turn larger than the dictators’ and non-dictators’ end effect in FULLINF. Within FULLINF the dictators’ end effects are marginally significantly larger than those of non-dictators.*

Observations 2 and 3 point in the same direction. Firstly, they indicate some weak evidence for deliberate investment in social capital by non-dictators in FULLINF, and secondly, that such investment seems to take place rather late in the public good game (earliest in round 10 of the 15 rounds). Such myopic behavior seems at odds with social capital theory, which suggests that people consciously invest in social capital because of returns in a distant future. However, this result is perfectly in line with other experimental evidence on myopic behavior in repeated and sequential games (Isaac et al., 1994) and limited strategic sophistication in games (Nagel, 1995, Costa-Gomez et al., 2001).

Next we investigate the actual importance of conditional cooperative behavior in the public good game. By investigating how strongly the dictators and non-dictators reciprocated to the investment behavior of the partner we may also find some additional evidence for deliberate longer-term LH-type investment in social capital. A convenient way to analyze reciprocal behavior in public good games is to investigate how subjects change their investment behavior in a round, given the behavior of the partner in the previous round (see e.g. Keser and Van Winden, 2000, Dijk van et al., 2002). More specifically, we analyze whether subjects increase, do not change, or decrease the contributions in a round compared to the previous round when the partner contributed more, the same, or less in this previous round. Conditional cooperative behavior occurs when subjects change investment in the direction of the partner's previous period contribution to the public good. By investigating the changes in behavior, separately, for dictators and non-dictators we will be able to trace longer-term LH-type social capital investment of non-dictators in FULLINF. Table 2 shows that conditional cooperation is indeed at work. A contribution below the partner's investment level is typically answered with an increase in own investment whereas a contribution above that of the partner typically leads to a reduction in own investment.¹⁰

A closer look at the results for the full information condition reveals that - taking all rounds into account - the disposition to reciprocate does not differ very much between dictators and non-dictators, though the tendency to decrease one's investment when the partner had invested less is slightly weaker stamped for non-dictators than for dictators. Taking only the last five rounds into consideration it can be seen that the disposition of non-dictators to reciprocate negatively is indeed much weaker than that of dictators (in 70 percent of the cases dictators decrease their investment when the partner has contributed less in the previous round; non-dictators react like that only in 54 percent of the cases). In our view, this lack of immediate punishment of non-cooperative dictators is a clear indication that at the end of the public good game (some of the) non-dictators start to invest deliberately in longer-term social capital. They

Table 2 - Conditional Cooperation

information	other invested ...	own investment					
		decrease		no change		increase	
		dict	non-dict	dict	non-dict	dict	non-dict
NOINF (all rds.)	less	39	43	28	16	6	14
		53%	59%	39%	22%	8%	19%
	same	11	13	194	189	13	16
		5%	6%	89%	87%	6%	7%
	more	8	6	19	22	46	45
		11%	8%	26%	30%	63%	62%
PARTINF (all rds.)	less	78	78	38	32	14	12
		60%	64%	29%	26%	11%	10%
	same	14	9	100	101	26	30
		10%	6%	71%	72%	19%	21%
	more	17	21	31	36	74	73
		14%	16%	25%	28%	61%	56%
FULLINF (all rds.)	less	59	51	26	30	10	12
		62%	55%	27%	32%	11%	13%
	same	12	9	176	180	16	15
		6%	4%	86%	88%	8%	8%
	more	12	10	26	27	55	58
		13%	11%	28%	28%	59%	61%
FULLINF (rds. 11-15)	less	14	15	3	8	3	5
		70%	54%	15%	29%	15%	18%
	same	9	6	80	82	3	4
		10%	7%	87%	89%	3%	4%
	more	7	2	8	9	13	9
		25%	10%	29%	45%	46%	45%

sacrifice money for strategic reasons, hoping to receive a reward in the dictator game. Interestingly, in their turn, in the last few rounds dictators exhibit some propensity to exploit non-dictators. They are relatively more often decreasing their investment when the partner has contributed more in the previous round.

Conclusion 1 CREATION OF SOCIAL CAPITAL

Knowledge about the future of a relationship influences investment behavior. The investment in social capital turns out to be highest when there is complete uncertainty or complete certainty about the future of the relationship. Only knowing that there is a

common future without knowing one's role in this future tends to decrease social capital. The stock of social capital built up during the public good game seems to be mostly of the CC-type. However, individuals who know that they will need help exhibit also behavior consistent with LH-type investment in social capital. This deliberate kind of investment takes place relatively late in the relationship, though.

4.2 Return of Social Capital

In this section we shall investigate whether social capital yields any reward. Firstly, we will explore whether CC-type investment in social capital leads to a positive return for one or both of the actors in a dyad. Thereafter, we shall investigate if social capital also yields a longer-term benefit. Here, it is of particular interest to establish whether the pure CC-type investment in NOINF already yields a positive longer-term return or that only investment under the shadow of a common future (as in PARTINF and FULLINF) has this feature.

Before we turn to the question of the longer-term reward of social capital we look at the short-term returns of conditional cooperation in the different information conditions. The social dilemma structure of the public good game implies that an increase in the investment level necessarily leads to a *decrease* in income of a subject if the partner does not reciprocate. The return of social capital of the CC-type can therefore be measured by relating investment behavior in the public good game to the earnings in this game. Only a positive relationship between investment and earnings in the public good game is consistent with a short-term return of social capital. To investigate whether such a relationship indeed exists we run the following regression for dictators and non-dictators, separately:

$$earn = \alpha_N D_N + \alpha_P D_P + \alpha_F D_F + \beta_N Y_N + \beta_P Y_P + \beta_F Y_F, \quad (4.2)$$

where *earn* denotes average earning per round in the public good game. D_N , D_P , and D_F denote dummies for the information conditions NOINF, PARTINF, and FULLINF, respectively. Each of them equals one for the respective information condition and zero otherwise. Y_N , Y_P , and Y_F are interaction variables representing the average (per round) contribution to the public good for the respective information condition.

The results of the regression analysis depicted in Table 3 clearly show that there is indeed a short-term return of social capital in the public good game. In all information conditions the earnings of dictators and non-dictators significantly increase with their contribution to the public good. Increasing the contribution to the public good by one franc is rewarded by an increase in earnings (per round) by 0.34 to 0.40 francs. The

Table 3 - The short-term return of conditional cooperation

ind. var.	dependent variable: average earning			
	coeff.	std.err.	t-value	p-value
dictator				
D_{NOINF}	14.62	0.623	23.49	0.000
$D_{PARTINF}$	14.04	0.452	31.06	0.000
$D_{FULLINF}$	13.80	0.568	24.32	0.000
Y_{NOINF}	0.35	0.044	8.19	0.000
$Y_{PARTINF}$	0.37	0.043	8.52	0.000
$Y_{FULLINF}$	0.40	0.041	9.87	0.000
# of obs. = 82				
$(Prob > F) < 0.001$				
Adj. $R^2 = 0.77$				
non-dictator				
D_{NOINF}	14.20	0.631	22.49	0.000
$D_{PARTINF}$	14.60	0.435	33.55	0.000
$D_{FULLINF}$	14.87	0.537	27.72	0.000
Y_{NOINF}	0.39	0.044	8.96	0.000
$Y_{PARTINF}$	0.36	0.043	8.42	0.000
$Y_{FULLINF}$	0.34	0.039	8.91	0.000
# of obs. = 82				
$(Prob > F) < 0.001$				
Adj. $R^2 = 0.76$				

Note: D_{NOINF} , $D_{PARTINF}$, and $D_{FULLINF}$ denote the dummy variables for the information conditions; Y_{NOINF} , $Y_{PARTINF}$, and $Y_{FULLINF}$ denote the interaction variables between the respective information condition and the average (per round) public good investment; estimations are corrected for using no overall intercept.

small differences between conditions turn out to be insignificant (Wald test). Further, there are virtually no differences in returns for dictators and non-dictators. This leads to the following observation.

Observation 4 *Both dictators and non-dictators earn a direct (short-term) return on social capital due to conditional cooperative behavior. The small differences in the returns between information conditions are statistically not significant. Returns to dictators and non-dictators are very similar.*

Behavior in the dictator game. We now turn to the question whether there are also some longer-term rewards to social capital for the non-dictators. Do dictators ‘help’

non-dictators in the dictator game and how does this relate to non-dictators' investment behavior in the public good game? Table 4 shows summary statistics concerning the behavior of dictators vis-à-vis the own non-dictator ('own') and the non-dictator from another group ('other'). It is obvious from the numbers in the table that - on average - dictators do not care much about the well-being of the non-dictators. Regardless of whether they are coming from the own dyad or from another dyad.¹¹ In all information conditions the median dictator keeps all the additional money given to him or her. That is, (s)he gives nothing to the non-dictators. Dictators behave equally selfishly in all three information conditions. Average dictator giving to the own non-dictator increases slightly when going from NOINF to PARTINF to FULLINF, whereas it stays more or less constant with respect to the other non-dictator. These differences turn out to be statistically insignificant. (The non-parametric Kruskal-Wallis test does not reject the null hypothesis of equal dictator behavior in all three information conditions ($p > 0.47$, two-sided)). This result provides support for hypothesis 5 (no difference in treatment of 'other' non-dictator across information conditions). Moreover, when looking only at

Table 4 Dictator giving (francs)

	NOINF		PARTINF		FULLINF	
	non-dictator		non-dictator		non-dictator	
	own	other	own	other	own	other
Median	0	0	0	0	0	0
Mean	14.7	15.7	23.5	8.1	39.6	7.7
St.dev.	41.2	38.8	42.9	25.0	70.4	25.2

Note: Each dictator could give (take) at most 300 (60) francs to (from) each of the two non-dictators.

the own non-dictator the data do not reveal any strong difference in behavior across information conditions either. Interestingly, however, a look at the *relative* treatment of the own versus the other non-dictator reveals some significant differences between treatments. When testing the hypothesis of no difference in dictator giving with respect to the own and the other non-dictator it turns out that in FULLINF as well as in PARTINF partners are treated significantly better than strangers ($p < 0.03$, Wilcoxon rank sum test, two-sided). In contrast, in NOINF dictators do not discriminate between the two non-dictators ($p > 0.7103$, Wilcoxon rank sum test, two-sided). The following observation summarizes these findings.

Observation 5 *In all three information conditions dictators behave selfishly and give neither their 'own' nor the 'other' non-dictator much of the additional money received.*

The slight differences in dictator giving between information conditions are statistically not significant. However, significant differences are found in relative treatment of the two non-dictators. In PARTINF and FULLINF dictators treat their own non-dictator more friendly than the other non-dictator. In NOINF such discrimination is not observed.

The evidence presented indicates that the different *levels* of social capital observed in the public good game do not lead to different rewards for non-dictators in the dictator game. In particular, the high levels of social capital in NOINF and in FULLINF have no significant positive effect on the helping behavior of dictators. Hence, neither the amount of social capital nor the different information during the process when the social capital is created seems to influence the *average* rewards to social capital.

This, however, does not necessarily imply that there is no relationship between social capital investment and helping behavior. In NOINF all (longer-term) social capital is a by-product of the subjects disposition to reciprocate. In PARTINF and FULLINF, however, investment decisions may incorporate longer-term considerations. Even if this is not the case the same level of public good investment may be perceived differently in the information conditions where it is known that there is a common future of the relationship. These different forms of investment, and in particular its potentially different perception by the dictators, may lead to differences in reciprocal behavior and rewards in the dictator game. To explore these questions we investigate - for each of the three information conditions separately - whether non-dictators' investment in social capital in the public good game is correlated with the amount of 'help' they receive in the dictator game.

Figure 3 shows scatter plots of dictator giving (vertical axis) as a function of average (per round) public good investment of the own non-dictator for all three information conditions. The scatter plots nicely show that there are indeed differences in the relationship between dictator giving and non-dictator investment across information conditions. In NOINF there is clearly no systematic relation between dictator behavior and non-dictator investment. Under FULLINF, in contrast, the scatter plot indicates a positive correlation between these two decision variables. For PARTINF the figure also indicates some positive correlation between dictator giving and non-dictator investment, though weaker than in FULLINF. Spearman correlation statistics corroborate these impressions. For NOINF Spearman's rho is found to be -0.17 and highly insignificant ($p = 0.475$, two-sided), for PARTINF the correlation statistics is 0.36 and marginally significant ($p = 0.062$), while for FULLINF Spearman's rho is with 0.39 highest and significant at the 5 percent level ($p = 0.041$, two-sided). In addition to

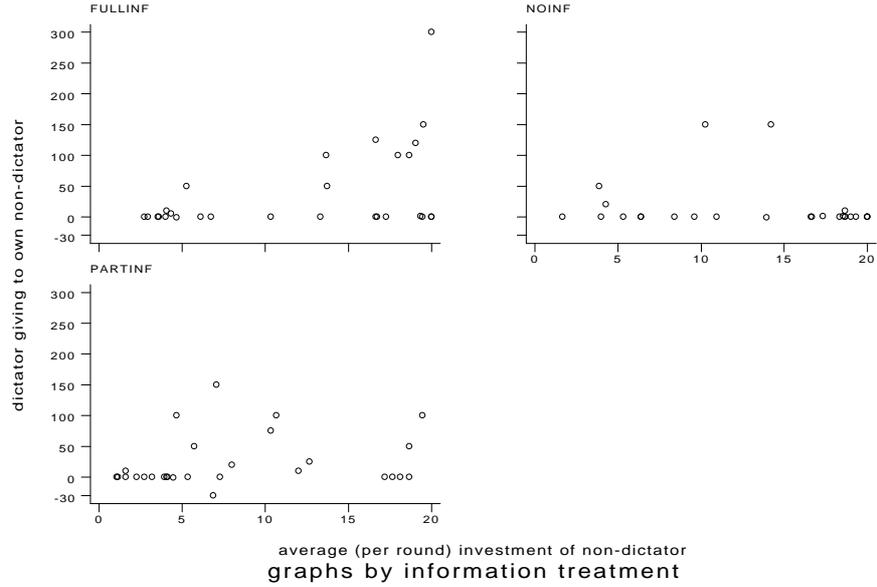


Figure 3 - Dictator giving to own non-dictator as a function of the latter's investment

these non-parametric statistics we do a similar regression analysis as for the short-term return of social capital (see equation (4.2)) but now with dictator giving as dependent variable and average (per round) investment in the public good by the non-dictator as independent variable. Table 5 shows the results. The result that the information specific intercepts are not significantly different from zero shows that if matched with

Table 5 - The longer-term return of social capital investment

ind. var.	dependent variable: dictator giving			
	coeff.	std.err.	t-value	p-value
D_{NOINF}	25.85	23.41	1.10	0.273
$D_{PARTINF}$	11.52	16.13	0.71	0.477
$D_{FULLINF}$	-17.44	19.90	-0.88	0.384
Y_{NOINF}	-0.85	1.62	-0.53	0.599
$Y_{PARTINF}$	1.46	1.58	0.93	0.358
$Y_{FULLINF}$	4.69	1.43	3.27	0.002

of obs. = 82
 $(Prob > F) < 0.015$
Adj. $R^2 = 0.11$

Note: D_{NOINF} , $D_{PARTINF}$, and $D_{FULLINF}$ denote the dummy variables for the information conditions; Y_{NOINF} , $Y_{PARTINF}$, and $Y_{FULLINF}$ denote the interaction variables between the respective information condition and the average (per round) investment in the public good by the non-dictator; estimations are corrected for using no overall intercept.

a non-dictator who plays the dominant strategy of no investment in the public good game the average dictator gives nothing in the dictator game. This is also in line with our earlier observation that dictators give very little to non-dictators, on average. Concerning the marginal returns of social capital investment during the public good game it turns out that neither in NOINF nor in PARTINF such investment exhibits a statistically significantly positive return. In FULLINF, however, such a positive reward exists. Under this last information condition each franc invested per round gives a return of 4.7 francs in the dictator game, on average.¹²

We have also investigated whether behavior in the very last round affects the helping behavior of dictators. It turns out that for no measure of last round behavior (that is, last round contributions to the public good or our measure of the end effect) there is a significant correlation between behavior of non-dictators and dictator giving, whatever the information condition (neither Spearman's rho nor simple linear regressions yield a significant result).

Observation 6 *The longer-term rewards of social capital investment depend crucially on the information about the future of the relationship. In case of complete uncertainty about the relationship (NOINF) no longer-term reward of social capital investment can be found. However, when partners know that there is a common future where one of them needs 'help' from the other (PARTINF and FULLINF) social capital investment exhibits a positive marginal return. This return is greatest and statistically significant for FULLINF.*

The fact that the longer-term return is absent in NOINF supports hypothesis 3. However, compared with PARTINF and in contrast with hypothesis 4, it turns out that the return is higher under FULLINF. Furthermore, together with our observation of the positive direct (short-term) return of social capital due to conditional cooperation our results show that under FULLINF social capital investment has actually a double reward. We close this section with the following conclusion.

Conclusion 2 RETURN OF SOCIAL CAPITAL *Investment in social capital has a direct reward due to conditional cooperation. This reward is independent of the information about the future of the relationship. The longer-term reward of social capital investment, however, depends on this knowledge. The longer-term marginal return is higher the more information about the future of the relationship is available. This gives support to the following claims: (i) deliberate social capital investment has a higher longer-term return than non-deliberate investment; (ii) social capital may have a double return due to cooperation during the social interaction and received help when it is needed.*

5 Concluding remarks

In short, social capital theory rests on two main hypotheses. Firstly, it claims that those with more social capital will succeed better in realizing their goals. Secondly, it maintains that people will deliberately invest in ties to the degree that they are instrumental in achieving their goals. In particular, the second claim is disputed and critics argue that social capital is mainly if not completely a by-product of social interaction with no deliberate sacrifice of resources for the good of potential future rewards. In our view, part of the unresolved dispute accrues from the fact that it is so difficult to disentangle deliberate from unconscious investment empirically. We therefore set up an experiment in which we are able to control the information people have about their common future. By manipulating this information we are able to investigate how social capital investment and its return change with this knowledge.

The results indicate that one has to distinguish between two sorts of social capital. One sort works on a short-term basis and helps to maintain a cooperative climate and to overcome a social dilemma. The second sort is based on the longer-term relation and throws a longer shadow into the future. However, both sorts are strongly intertwined and difficult to separate. Uncertainty about the future of the relationship plays a role in the accumulation of social capital but in a non-monotonic and rather surprising way. Short-term social capital - based on conditional cooperation in the ongoing relationship - is largest when partners have either complete uncertainty or complete certainty about the future of this relationship. Surprisingly, the level of social capital is lowest when people know that they have a common future but do not know their future role in the relationship. This first-order effect of information does, however, not carry over to the disposition to reciprocate or conditionally cooperate in the ongoing relationship. Reciprocal behavior is very similar for all information conditions.

Looking at longer-term social investments it turns out that people who know that they will need help in the future actually are investing in the relationship. However, compared to the short-term investment levels this investment is relatively low and occurs relatively late in the relationship. Nevertheless longer-term investment pays off. Those who invest more in social capital can indeed expect to receive more help in case they need it. This positive connection between preceding cooperative behavior and help received later is strongest when all future uncertainty is already resolved during the interaction in the social dilemma situation. When there is no knowledge about the future relationship no such correlation is found.

Notes

1. For control purposes, we also have the dictator allocate a same amount of money between ‘self’ and a ‘stranger’, which is a subject with whom the dictator did not interact with before.
2. In the experiment the terms private good and public good were avoided. Instead, participants were told that they had to decide how to allocate their endowment between activity X and activity Y .
3. The “take-away” costs were a discrete approximation of the function $0.5(-z + 1)^{1.63795}$, where z is the money taken. When $z = 0$ the cost were zero and the maximum amount to be taken away was 60 francs at a cost of 420 francs.
4. If subjects wanted to ask a question they had to raise a hand. An experimenter then went over to them to answer the question privately.
5. The most prominent of such behavior is probably TIT-FOR-TAT (Axelrod, 1984). Some recent work also finds support for conditional cooperative and reciprocal behavior in public good experiments (see e.g. Keser and Van Winden, 2000, Fischbacher et al., 2001, and Dijk van et al., 2002).
6. In principle cooperation could also be due to altruistic preferences. For two reasons we doubt, however, that altruism plays a role when observing cooperative actions. Firstly, experiments show little evidence of altruism (see e.g. Hoffman et al., 1994), and secondly, as shown later in this article, behavior in the last round of the public good game is generally inconsistent with altruistic preferences. Other potential explanations offered in the literature do not seem to satisfy either (see Keser and Van Winden, 2000).
7. Evidence supporting this hypothesis comes from social psychology research. For instance, it is found that “The average member tends to initiate deferential, approval seeking behavior toward high [attributed] power figures” (Lippitt et al., 1968:242).
8. For all non-parametric tests used we refer the reader to Siegel and Castellan Jr., 1988.
9. In round 6 the hypothesis of equality of population rank can not be rejected ($p = 0.1722$) and in rounds 7, 8 and 15 the differences are only marginally significant with p-values of 0.0745, 0.0719, and 0.0952, respectively (all tests two-sided).
10. Statistical tests corroborate this impression. We consider the reactions ‘decrease’ and ‘increase’ in the situations where the ‘other invested less’ and the ‘other invested more’

for dictators and non-dictators and all three information conditions separately (see also Table 2). If conditional cooperation is at work we should observe relatively more often the reaction ‘increase’ than the reaction ‘decrease’ in the situation ‘other invested more’ and the other way round in the situation ‘other invested less’. Applying the χ^2 -test with the null hypothesis that the likelihood of observing ‘increase’ and ‘decrease’ is equal for the two situations, we can reject the null hypothesis at the 1 percent level for each case.

11. Actually, compared to other dictator game experiments also not using the double-blind procedure the dictators in our experiment turn out to be extremely selfish (for a recent overview of dictator game allocations see Camerer, 2001.) We attribute this difference to three factors: (i) when the dictator game is played the non-dictators have already earned a considerable amount of money; (ii) the possibility of (costly) taking away money from the the non-dictators shifts the selfish solution of giving nothing from the corner to the interior of the action space; (iii) since the non-dictator is also linked to another dictator, a ‘by-stander effect’ may play a role. These factors may make it relatively more attractive to dictators not to give anything.
12. We have run the same statistical tests using the average contribution of various subsets of rounds - instead of all rounds - of the public good game (e.g. the last five rounds only or all rounds except the last round). All tests yield qualitatively the same results as those described in the main text.

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