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## Of the stability of partnerships when individuals have outside options, or why allowing exit is inefficient

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# JENA ECONOMIC RESEARCH PAPERS



# 2015 – 001

## **Of the stability of partnerships when individuals have outside options, or why allowing exit is inefficient**

by

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## Of the stability of partnerships when individuals have outside options, or why allowing exit is inefficient.<sup>☆</sup>

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### Abstract

Should people be allowed to leave joint projects freely or should they be deterred from breaking off? This depends on why people stop collaborating and whether they have good reasons to do so. We explore the factors that lead to the breakdown of partnerships by studying a public good game with imperfect public monitoring and an exit option. In our experiment, subjects were assigned a partner with whom they could contribute over several periods to a public good with stochastic outcomes. They could choose in each period between participating in the public project or working on their own. We find there was excessive exit especially because subjects over-estimated the likelihood their partner would leave. Treatments with high barriers to exit generated higher welfare overall as they fostered stability and prevented inefficient breakdowns in relationships. There were differences across treatments in the intensity with which different factors drove the choice to work alone. Differences in expected payoffs between independent and group work were more important as a driver of exit in treatments with low barriers to exit. The intensity of other factors was more constant across treatments, including whether the common project failed in the previous period, the belief that one's partner did not want to maintain the partnership and the belief that he exerted less effort than oneself.

*JEL Codes:* C23, C92, H41

*Keywords:* barriers to exit, cooperation, outside option, imperfect public monitoring, partnerships, public good game, repeated game, social risk.

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We study partnerships where the level of commitment of the other is difficult to observe. This is the case when a partner cannot properly evaluate his partner's contributions. An example is innovative activity (research joint ventures, co-authorship) where one cannot predict what idea will be successful and what idea will fail. Another example is when partners do not know each other well and find it difficult to communicate their personal requirements, so that even high effort on both sides does not guarantee success. The main difficulty in such settings is how to keep partners together and prevent them from inefficiently breaking off collaboration. There is a lot of research on the decline in contribution in partnerships over time ([Fischbacher and Gächter, 2010](#)) but there is very little research about when and why partners decide to set out on their own rather than maintain their participation to a common project. This lack of research is particularly evident for the case where partners can only imperfectly monitor each other's contributions.

We study the inner dynamics of such partnerships and specifically whether and how long partners maintain their involvement in such common projects. We set up an experiment where subjects can contribute to a joint project or work on their own on a project with similar characteristics but that is not open to contributions by others. We manipulate the level of barriers to exit from the common project and examine how this influences the beliefs and behavior of the partners.

We observe a high level of inefficient breakdown in partnerships, especially when barriers to exit are low. This is not compensated by having more efficient surviving partnerships. Indeed, we find that whether barriers to exit are high or low does not influence the level of cooperation in surviving partnerships. We then contrast two drivers of exit: a myopic cost-benefit analysis, which takes the situation as given and leads to permanent exit if working alone provides higher expected utility, and a longer term strategic outlook, where exit punishes failures in the partnership and occurs with the intent to come back later. We find that the cost-benefit drivers of exit are more important in treatments with low barriers to exit, while strategic motivations are the main drivers of exit in treatments with high barriers to exit. We relate those findings to the work of [Hirschman \(1970\)](#) which contrasts voice and exit as ways to either influence or escape a social environment, and the work of [Yamagishi \(1988\)](#) which explains that collectivist sanctioning systems are the product of environments with few outside opportunities for their actors. We conclude that lowering barriers to exit lowers the sense of collective-efficacy of individuals in teams ([Katz-Navon and Erez, 2005](#)) and encourage individuals to focus more narrowly on their individual self-interest rather than invest in improving collaboration in the team.

*Context.* Partnerships are situations in which two or more persons join to pursue a common project. Being together increases the chances of success of the project, whether the project aims at raising children, establishing a business or writing a scientific article. There has been much discussion about free riding in such situa-

tions, whereby one of the partners relies on the other to do most of the work while enjoying its benefits. This can lead both partners to contribute very little. Little attention has been devoted to the distinction between inefficient levels of contribution in a partnership and the dissolution of this partnerships. While both indicate failure in a partnership, the distinction is important; it is akin to the distinction between a dysfunctional marriage that keeps on going, and a marriage that ends in a divorce.

The small literature about exit focuses on how the ease of exit impacts how much effort individuals will devote to a common project and how likely it is that they will stay together. The question is whether it is better to have profitable outside options or for both partners to be tied to the project for its duration.

A number of arguments have been made in support of making it easy to exercise an exit option. 1) Exit is more efficient than staying in a dysfunctional partnerships if given present levels of effort in the partnership, both partners would be better off working on their own (MacLeod, 1993). 2) The threat of exit is necessary to enforce cooperation if partners find it difficult to monitor each other's contributions. Exiting then provides a clear way to tell one's partner that one is contributing nothing to the project for this period. This gets the message across more effectively than contributing nothing and staying in the project (Lin, 1990). 3) Exiting may reduce the payoff of the partner by more than one could do by not devoting efforts to the project. Therefore, exit can support cooperation in a stage game for parameters values that would not allow cooperation without the threat of exit (Fujiwara-Greve and Yasuda, 2011). 4) Allowing exit frames the collaboration as the product of the *free will* of both partners and thus promotes intrinsic motivations for cooperation (Yamagishi, 1988). 5) Staying in the partnership is a sign of trust rather than the product of coercion. Being able to give this sign of trust promotes cooperation because people are generally keen to uphold the trust of others (Bravo and Squazoni, 2013). 6) Allowing exit promotes efficient *self-selection*: those who do not trust others and would thus lead inefficient partnerships can work on their own rather than burden others. Those who are content working with others can thus signal so simply by being ready to partner with others. This promotes partnerships that are stable and efficient (Orbell et al., 1984; Rand et al., 2011).

Other authors have underlined the negative consequences of allowing exit. 1) Outside options reduce the interdependence between partners. One's partner cannot be punished for not contributing enough by withdrawing contribution as well because the partner can escape this punishment by working on his own (MacLeod, 1988; Putterman and Skillman, 1992; Dong and Dow, 1993) 2) Allowing exit frames the partnership as a self-interest competition, because partners are encouraged to think of their own self-interest (could I do better outside?) if an outside option is available. This goes against thinking in terms of the interest of the group (how can I make it better within the group?) (Tenbrunsel and Messick, 1999) 3) Making more severe sanctions available, such as exiting the partnership, may lower part-

ners' trust in each other or in their motives (Mulder et al., 2006), especially if the sanctions are small (Houser et al., 2008).

*Lessons from experimental research.* Experimental research on the benefits and drawbacks of giving outside options is quite sparse. In the standard implementation of the public good game, agents are endowed with funds that they may allocate in part or in full to the public project, with the remainder for them to keep. In that setting, one can liken exit to the amount that is not invested in the public good. The relative profitability of such "exit" can be changed by varying the return on the amount that is not invested, or by varying the return on the amount that is invested. Research shows "a strong negative relationship between the marginal rate of substitution (between private and public goods) and the rate of contribution" (Palfrey and Prisbrey, 1996, p. 413).

Equating low contributions with exit is not satisfactory when the outcome generated by contributions to the public good is stochastic. Indeed, it is then not possible to directly estimate from the outcome the average level of investment in the public good by the others. Subjects cannot therefore be sure that their action (contribute less, contribute more) will necessarily affect the outcome. It is then helpful to be able to publicly exit from the partnership because this gives one's partner a clear indication that one is not anymore willing to contribute to the public good. Conversely, staying in signals that one thinks the partnership is working well.

Some experimental research deals explicitly with the exit option in public good production. However, most of this research relies on a binary implementations of the public good game: subjects play a prisoner's dilemma where in addition to the option to contribute or defect, they can also choose to exit (see figure 2 in Kurrild-Klitgaard, 2010). A strategy of out-for-tat, whereby not cooperating is punished by exit, obtains higher payoffs than tit-for-tat in some settings (Hayashi and Yamagishi, 1998). We know of only one experimental study of the prisoner's dilemma that combines exit option and stochastic outcomes, Wilson and Wu (2014). In their paper, as in ours, subjects only observe outcomes but not their partner's decision. They find that subjects are more likely to exit in treatments with higher payoffs after exit. They report that the average frequency of cooperation within partnerships is higher in treatments with an exit option than in the one control treatment without an exit option. However, this does not control for time within the partnership. The average in the control treatment includes all periods, including late ones where cooperation usually starts to break down. The average in treatments with exit options is higher at least in part because it includes proportionally more of the earlier, more cooperative periods. Indeed, partnerships generally do not survive to the end in those treatments. There are other studies of the prisoner's dilemma with stochastic outcomes but they do not consider an exit option. They show however that cooperation is less frequent if outcomes are stochastic, whether the partner's actions are observable (Bereby-Meyer and Roth, 2006), or not (Aoy-

agi and Fréchette, 2009). They also show that giving agents the option to punish others leads to lower welfare if outcomes are stochastic, whether monitoring is perfect (Xiao and Kunreuther, 2012) or imperfect (Grechenig et al., 2010; Ambrus and Greiner, 2012). This is because people overuse punishment and means that giving the option to exit, in so far as it may be used as a punishment, may not improve overall welfare.

Some experiments implement the public good game with an exit option and continuous contributions, but they consider only the case where outcomes are deterministic. Keser and Montmarquette (2011) gives the option between public and private good production under perfect public monitoring and varies the value of the outside option. Subjects must choose what project to participate in and then choose how much to invest in their chosen project – either a public project or an individual project. They find that providing an outside option increases investments levels in public projects. My and Chalvignac (2010), who consider 5-players groups playing a linear public good game with fixed exit payoffs, does not however find such an effect of outside options on contribution levels.

Experiments with stochastic outcomes in a public good game do not consider the exit option. Dickinson (1998) makes an experiment based on a model similar to Radner et al. (1986) and does not find a clear effect of uncertainty on contributions. Cason and Khan (1999) underline that imperfect monitoring is the main issue in such settings rather than uncertainty. This is confirmed in Levati and Morone (2013), which finds that neither uncertainty nor risk aversion lead to lower contributions when there is perfect monitoring.

The above research on the prisoner's dilemma and on public good provision does not give us clear indications about whether giving the option to exit increases contributions in a partnership. There is as yet no explanation for how varying barriers to exit affects cooperation across treatments, and there is little evidence about what drives people to exit a partnership.

*Experimental design.* We propose to answer those questions with an experiment that is unique in considering a public good game with imperfect public monitoring and an exit option. Our experiment lets subjects vary their contribution to the public good game, outcome in the public good game is stochastic and is observed by both partners, and subjects may leave the partnership to work on their own. Five aspects of our design are particularly important: 1) *Subjects cannot monitor the contribution of others.* In particular, a higher contribution does make a high outcome more likely, but it cannot guarantee it. There is therefore no way to ensure correct signaling to ones partner. 2) *Exit is an individual decision.* Defection to an individual project by one agent does not imply the other agent has to exit as well. 3) *Exit is observable.* After deciding what project to participate in, agents are informed of the decision of their partner whether to participate in the public project or their own individual project. 4) *Exit is a binary decision.* Agents must

decide what project to participate in, they cannot choose to split their contributions between the public project and the individual project. 5) *Exit is reversible*. Exit in one period does not imply that the agent cannot return to the public project in the next period. This means that our subjects always face the same range of options each period. Every period is formally comparable to the other in terms of what decisions is to be taken. This simplifies the analysis of the game.

We decided to run an experiment because it would be difficult to know what leads to exit and how contributions vary over time and across partnerships when looking at real world partnerships. This would indeed require noting down the contributions of real life partners to their relationship over time and also how outside options varied over time. One would also need to know what is considered as a success or a failure by the partners. Given those difficulties, a laboratory experiment seems to be the best way to answer our questions.

Our experimental design borrows from the standard public good game (also called voluntary contribution mechanism) in so far as contributions to the public good are pooled and determine the outcome, and from simple models of moral hazard in so far as the amount of investment affects the *probability* a project will be successful and a partner cannot monitor the investment made by the other. Our experiment differs from the small literature on the public good game with stochastic outcomes in that our subjects are given the option to participate either in individual or in public good production. They are then asked to choose how much to invest in their chosen project. There is no option to invest in both public and individual projects at the same time. The sum of investments in the public good determines the probability of a good outcome, and similarly one's investment in the private good determines the probability it will be successful. Subjects must decide how much to invest in their chosen project based on the commonly known relationship between the amount of investment and the probability of success.

We chose to make outcomes stochastic because this gives meaning to exit: exiting is then different from contributing nothing as exiting is a public event while not contributing is a hidden decision. Stochastic outcomes also make the situation closer to the issues arising from collaboration in innovative teams, where the output is not in a one-to-one relation with input. Our design reflects salient aspects of team work in innovative and rapidly changing environments, whereby the outcomes of one's effort is difficult to predict. It also reflects modern organization of collaborative work whereby participants in teams may be located in different places and deal with different aspects of a project, which makes it difficult for them to monitor and judge their partner's commitment to the joint project. In keeping with the mounting precariousness of work relations, individuals in our experiment are able to independently choose each period whether to keep on working in a team or work on their own.

We believe that the difficulties in attributing failure to either low effort by others or to bad luck make this game more relevant to real world team situations



and more interesting from a psychological point of view than the standard, deterministic public good game. Individuals who face uncertainty about the level of contribution of their partner and about how their partner will respond to failure may become anxious, feel guilt in case of failure or worry that they are being exploited. Those who are most sensitive to such feelings may thus prefer to switch to individual production.

Stochastic outcomes are also interesting because they reduces some of the incentives and mechanisms driving public good contribution that have been identified in the literature, such as the warm glow effect (Palfrey and Prisbrey, 1997) and the setting of contributions based on the contributions of others (conditional cooperation, cf. Keser and Winden, 2000; Fischbacher et al., 2001). Repeated game effects are also reduced since contributions are only imperfectly monitored through success and failure. This makes the use of punishment less effective in maintaining cooperation; punishments tend to be overused as cooperative partners are almost as likely as non-cooperative ones to be punished (Ambrus and Greiner, 2012; Grechenig et al., 2010; Xiao and Kunreuther, 2012). For all those reasons, experimental research has generally found that uncertainty about the contribution of others or about the outcomes of cooperation reduces cooperation levels (Van Dijk et al., 2004; Van Lange et al., 2013, pp. 131–132).

The next part presents the game that was played by our participants. We also explain the different treatments our subjects were faced with, as well as other details of the implementation. Our statement of hypotheses follows.

## 1. The experiment

Our subjects first had to play a public good game and then were faced with a questionnaire and control tasks before receiving their payoffs.

### 1.1. A public good game with stochastic outcome

Each subject  $i$  was randomly paired with a partner  $j$  who remained anonymous and were asked to make a succession of decisions over several periods. We denote  $k$  the partnership composed of  $i$  and  $j$ .

*Within period timeline.* Subjects had to decide each period  $t$  whether to participate in the public project ( $d_{it} = 1$ ) or in their own individual project ( $d_{it} = 0$ ). They were then asked to state their belief about the project choice of their partner, in terms of likelihood that their partner had stayed in the public project ( $d_{jt}^e \in [0, 1]$ ). They then learned the decision of their partner,  $d_{jt}$ , and had to decide what level of effort to exert in their chosen project ( $e_{it} \in [0, 10]$ ). They were then asked to state their belief about the effort choice of their partner ( $e_{jt}^e \in [0, 10]$ ). For consistency, this was elicited whether the partner was in the same project as themselves or not. Belief elicitation was incentivized using a linear scoring rule.

Given their own effort and the effort of their partner, success in the chosen project was determined as follows:

- If they had chosen the public project, then their probability of success was  $f(e_{it} + d_{jt} \times e_{jt})$  with function  $f(z) = \sqrt{\frac{z}{22}}$  commonly known and presented as a table for all combinations of integer between 0 and 10. Subjects were also given an opportunity to compute success probabilities for non-integer levels of effort, and were allowed to express effort with a precision up to the second decimal point.
- If they chose to participate in their own individual project, then success occurred with probability  $f_l(e_{it})$ , with function  $f_l(e_{it})$  depending on the treatment  $l = \{0, 1, 2, 3, 4\}$  (see Section 1.4).

They were then informed of the success or failure of their chosen project, but not of that of the project chosen by their partner if they participated in another project. They never learned the effort exerted by their partner. Subject  $i$  obtained payoff  $v_i$  if the project he was involved in was successful, 0 else.  $v_i$  and  $v_j$  were commonly known by both partners. Payoff for subject  $i$  in period  $t$  was thus  $v_i - e_{it}$  in case of success and  $-e_{it}$  in case of failure.

*Between period timeline.* Subjects were told that the identity of their partner would remain unchanged in the next period with probability 95%. If the partner changed, they were told so and were paired with a new partner for a number of periods. Subjects were told they would be assigned three partners in succession over the course of the experiment and that they would not be matched with the same person over the course of the experiment, neither with anyone who was matched with someone they were previously matched with (perfect stranger matching). We drew the number of periods in each partnership beforehand according to the announced random process, so that in each sessions the first partnership lasted 8 periods, the second partnership 14 and the last partnership 10.

Success was determined as follows: We drew a matrix with elements  $[r_{kt}]_{16 \times 32}$  from a uniform distribution over the interval  $[0, 1]$ , independently across periods ( $t$ ) and partnerships ( $k$ ) – there was a total of 32 periods, with 16 partnerships being active in each period. Success occurred in period  $t$  of partnership  $k$  for individual  $i$  if  $f(e_{it} + d_{jt} \times e_{jt}) > r_{kt}$  if the individual was in the public project, and if  $f_l(e_{it}) > r_{kt}$  if the individual was in an individual project. The same matrix  $[r_{kt}]_{16 \times 32}$  was used for all sessions. This was to control for possible effects of biased random draws in small samples.

The participants were shown at the end of each period a history box showing their past project and effort choices in the current partnership, as well as whether their chosen project was a success or a failure. They also saw their own past project choices and those of their partner in the current partnership. They were given

no information about the effort and success of their partner, unless their partner participated with them in the public project.

### 1.2. Control tasks, control questions and socio-demographic questionnaire

At the end of the main part of the experiment, participants completed two unannounced and incentivized control tasks to assess their attitudes to risk, to strategic uncertainty and their social value orientation. We used the Strategic Uncertainty and Risk Aversion tasks (*su* and *ra*) of [Heinemann et al. \(2009\)](#) and a short, 6-item version of the Social Value Orientation (*svo*) measure by [Murphy et al. \(2011\)](#). In addition to those incentivized controls, we collected the gender (*female*), age (*age*) and field of education (*educ*) of the participants. We also assessed their degree of trust in others along [Gächter et al. \(2004\)](#) (*trust*, high values indicate more trustful individuals). Appendix L gives more details about the tasks and the questionnaire. For a recent review of the impact of social value orientation and trust on cooperation in social dilemmas, see [Van Lange et al. \(2013\)](#), pp. 132–133). Risk aversion may lead subjects to invest more in order to reduce uncertainty, while strategic uncertainty aversion could lead them to avoid joint work. About gender effects, [Kuhn and Villeval \(2014\)](#) give evidence that women are more attracted to cooperation. Age and education were collected because older people may be more pro-social ([List, 2004](#)), while economics students may be more likely to free-ride ([Marwell and Ames, 1981](#); [Frank et al., 1993](#)).

### 1.3. Payment

A random period was drawn at the end of the experiment. Subject  $i$  received 0 or  $v_i$  depending on the result of her decisions in that period, minus effort  $e_{it}$  exerted in that period. In addition to this, agents were paid for the accuracy of their elicited beliefs that period (linear scoring rule), and also received payments for the control tasks. The final payment also included a €5 participation fee which was enough to cover any possible loss in the experiment.

### 1.4. Treatments

As in [Keser and Montmarquette \(2011\)](#), treatments varied in terms of barriers to exit and in terms of the individual payoffs that participants obtained upon successful completion of their project. There were 5 levels in terms of barriers to exit, and for each of those we looked at two cases in terms of payoffs, symmetric and asymmetric. There was therefore a total of 10 treatments (Table 1.1).

Table 1.1: Treatments by barriers to exit and individual payoffs.

Payoffs \ Barriers to exit	No exit	Payoff 0 in indiv. project	$x_l = 0$	$x_l = 2$	$x_l = 4$
Symmetric payoffs $v_i = v_j = 20$	Treatment 0, symmetric	Treatment 1, symmetric	Treatment 2, symmetric	Treatment 3, symmetric	Treatment 4, symmetric
Asymmetric payoffs $v_i = 24, v_j = 16$	Treatment 0, asymmetric	Treatment 1, asymmetric	Treatment 2, asymmetric	Treatment 3, asymmetric	Treatment 4, asymmetric

*Barriers to exit.* *Barriers to exit* were manipulated through the function  $f_l(e_{it})$  that determines the probability of success of the individual project as a function of effort. Treatment 0 was our control treatment, whereby subjects could not exit the public project. Treatment 1 gave payoff 0 when the subject chose an individual project. In treatments 2, 3 and 4, probability of success in the individual project was  $f_l(e_{it}) = f(e_{it} + x_l) = \sqrt{(e_{it} + x_l)/22}$  with  $x_l = \{0, 2, 4\}$  in treatment  $l = \{2, 3, 4\}$  respectively. We choose 4 as the highest level for  $x_l$  because beyond that level, having two individual projects is socially more efficient than what can be attained even under the first best with a public project (Appendix A). The higher probability of success in an individual project for a given  $e_{it}$  is, the lower are barriers to exit. Treatment 1 thus exhibits high barriers to exit, while treatment 4 exhibits low barriers to exit.

*Individual payoffs.* For each level of barriers to exit, we ran two sub-treatments, whereby in one case both partners received payoff 20 upon successful completion of the project they were involved in (symmetric payoffs), and in the second case one partner obtained payoff 16 and the other payoff 24 (asymmetric payoffs). We ran treatments with symmetric and with asymmetric payoffs to assess the robustness of our results, in particular because Nash predictions under payoff asymmetry are dramatically different from those under payoff symmetry (Appendix B).

### 1.5. Terms and notations

Before presenting our hypotheses, we need to introduce some terms and notations. We will use the term “*common project*” when both partners participate in the public project, and will use the term “*public project alone*” when a subject is the only one to participate in the public project in a given period. The term “*exit*” generally refers to choosing an individual project after a period in a common project, although we sometime extend the term to more generally mean choosing an individual project. A subject will be said to “*follow exit*” when choosing an individual project after a period when they were alone in the public project. In terms of notations,  $ec_{it}$  denotes agent’s  $i$ ’s effort in the common project at time  $t$  and  $ec_{jt}^e$  denotes agent’s  $i$ ’s expectation about the level of effort devoted by her partner  $j$  in the common project.  $epa_{it}$  is agent’s  $i$ ’s effort in the public project when alone and  $ei_{it}$  is agent’s  $i$ ’s effort in the individual project. Table C.1 lists the names of our variables and their meaning.

## 2. Hypotheses

We will use the following hypotheses to guide our discussion of the results:

**Hypothesis 1.** *Common projects will be more efficient in treatments with lower barriers to exit.*

This hypothesis is driven by our review of the literature, which mostly focused up to now on the welfare costs and/or benefits of easier exit from partnerships. We rely on findings in the closest related experimental literature. Our hypothesis is weaker than that of many supporters of easy exit: we do not believe that treatments with lower barriers to exit will generate higher overall welfare. This stronger formulation would require not only that surviving common projects in treatments with low barriers to exit be more efficient, but also that breakdown in partnerships is efficient – that is, partnerships that break down be those that are so dysfunctional that both partners benefit by selecting individual work instead. Our hypothesis is more limited than this, but we will also check whether the above stronger alternative hypothesis is verified, and if not, why.

**Hypothesis 2.** *Exit from common projects will be driven by expected opportunity costs of exit.*

This hypothesis is driven by our analysis of the Nash equilibrium of the one-shot version of our partnership game when agents are risk neutral (Appendix B). We show in that appendix that a myopic and risk neutral agent  $i$  with  $v_i \geq v_j$  will choose to stay in the public project in period  $t$  if his *expected opportunity cost of exit* is more than zero:

$$\underbrace{d_{jt}^e \times ec_{jt}^e - x_l}_{\text{expected opportunity cost of exit}} > 0 \quad (2.1)$$

In words,  $i$  chooses the public project as long as the expected effort of her partner times the probability he chooses the public project is more than the subsidy to individual projects.

Our next hypotheses are alternative explanations for exit. A first alternative hypothesis considers the impact of beliefs about the effort of the partner.

**Hypothesis 3.** *Exit from common projects will be driven by the difference between one's effort and the expected effort of the partner.*

While 2 assumes that exit is driven by questions of efficiency – for example, is  $x_l$  more than  $ec_{jt}^e$ ? – hypothesis 3 supposes that he cares about issues of payoff distribution and fairness – does my partner make more profit than myself? The difference  $ec_{it} - ec_{jt}^e$  indicates the extent to which one believes one's partner is exploiting oneself or is being exploited. This variable allows us to consider the

role of “exploitation aversion” (Fehr et al., 2005) in driving exit from the common project.

A second alternative hypothesis considers the fear that one’s partner will leave the partnership in the next period.

**Hypothesis 4.** *Exit from common projects will be driven by the fear that one’s partner will not participate in the common project.*

This second hypothesis appears to be implied by hypothesis 2, since lower levels in  $d_{jt}^e$  imply higher likelihood of exit under that hypothesis. Both factors – fear of exit *and* opportunity cost of exit – may however play an independent role. A subject who observes her partner leaving may think that the partner has information that she does not have – for example, that working on one’s own is more profitable than staying in the partnership. She may indeed think she did not fully understand the instructions or did not interpret payoffs correctly. She would then exit as well in order to ascertain the consequences of exit. Another possibility is that a subject would leave as a retaliation against the decision of the partner to leave, as the partner then cannot simply renew the partnership next period by coming back to the public project next period. This would lead to subjects following exit by the other even in the absence of monetary incentives to do so, such as in treatment 2 where staying in the public project alone is as efficient as choosing the individual project.

A third alternative hypotheses considers the direct impact of failure in the common project.

**Hypothesis 5.** *Exit from common projects will be driven by failure in the common project.*

When effort is not directly observed, failure may be taken as an indication that one’s partner exerted lower effort than expected. It would also lead one to believe one’s partner will leave next period, since the partner may interpret failure as coming from low effort on my part and therefore think it is not worth staying. If those were the only reason that failure may drive exit, then hypothesis 5 would not be necessary since hypothesis 2 would also predict exit, as well as 3 and 4. Hypothesis 5 comes into its own only if there is an independent role for failure in driving exit. This hypothesis is inspired by the literature on the repeated version of the public good game, whereby subjects enforce high level of efforts in the partnership by punishing (perceived) low effort of their partner. In that case, failure has an impact that is independent of how it drives expectations about effort or likelihood to stay of the partner.

Finally, our last hypothesis allocates the drivers of exit as a function of the height of barriers to exit:

**Hypothesis 6.** *Opportunity costs of exit will be more important as a driver of exit in treatments with low barriers to exit. The converse will hold for failure as a driver*

of exit.

This hypothesis is inspired by [Hirschman \(1970\)](#): exit is both a way to *voice* dissatisfaction (as per hypothesis 5) and a way to *escape* a dysfunctional team (as per Hypothesis 2). [Hirschman \(1970\)](#) observed that the greater the availability of exit, the less likely voice would be used. This is the source of our hypothesis. [Yamagishi \(1988\)](#) makes some related point when contrasting *collectivist* and *individualistic* drivers of exit. Collectivist motivation for exit is driven by wanting to make the partnership work better by influencing the behavior of one's partner. Individualistic motivation for exit is driven by payoff considerations and takes the behavior of the other as given. We could also call one set of motives "*optimistic*" about the ability of one's partner to respond to pressure towards cooperation and the other "*pessimistic*" about the ability of the partner to change his behavior. Under our hypothesis, high barriers to exit give participants a higher sense of self-efficacy in common projects because their partners cannot leave easily so that sanctions are effective. This will lead them to undertake to influence their partner by their actions, including by exiting ([Kerr and Kaufman-Gilliland, 1997](#)). Low barriers to exit will lower the sense of self-efficacy of our subjects, so that without the prospect of the possibility for others to change behavior, subjects will take present expected behavior as the basis for their decision to exit.

### 3. Experimental findings

Sessions were run in March 2012 in the laboratory of the Max Planck Institute for Economics in Jena (Germany). There were 32 subjects in each of our 10 sessions, except for one session with only 28 subjects. There were thus a total of 316 participants. Almost all subjects were university students in Jena, 55% of them were female, average age was 24 and 16% were studying economics or business administration. This composition was stable across treatments (Table D.2). Average remuneration was €15 and the experiment lasted about one hour and a half. The experiment was computerized with the Zurich Toolbox for Ready-made Economic Experiments (z-Ttree, [Fischbacher, 2007](#)) and subjects were recruited using the Online Recruitment System for Economic Experiments (ORSEE, [Greiner, 2004](#)). Translated English instructions are provided in Appendix K. The experimental software and the original German instructions are available upon request.

#### 3.1. The inefficiency of exit

Table 3.1 shows average payoffs across treatments depending on which project the subjects participated in as well as overall. Payoffs are shown in ECU, whereby 1 ECU=€0.50.



Table 3.1: Average payoff in ECU and its components, by treatment.

Treatment	Statistics	payoff common	payoff public alone	payoff individual	average payoff
0	mean (sd)	7.9 (9.5)	.	.	7.9 (9.5)
	N	1920	0	0	1920
1	mean (sd)	8.0 (9.4)	3.7 (9.7)	-1.1 (2.6)	7.9 (9.4)
	N	2004	22	22	2048
2	mean (sd)	8.0 (9.6)	3.7 (9.3)	4.4 (10.0)	7.4 (9.7)
	N	1778	123	147	2048
3	mean (sd)	8.2 (9.3)	2.7 (9.3)	5.8 (10.0)	7.1** (9.7)
	N	1300	189	559	2048
4	mean (sd)	8.1 (9.5)	4.0 (9.9)	7.4 (9.7)	7.2* (9.7)
	N	610	246	1192	2048

Difference w.r.t. treatment 0: <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

We report Satterthwaite's  $t$  test for data with unequal variances to test equality in means. Differences are also significant under the Wilcoxon rank-sum test and the Kolgomorov-Smirnov test.

Table 3.1 shows that Hypothesis 1 is rejected: there were no significant differences in average payoffs in common projects depending on the treatment. Figure D.1 shows that effort in public projects did not appear to depend on project value or treatments. Unlike Kölle (2014) and against Nash predictions (Appendix B), we therefore found that payoff asymmetries between subjects did not negatively impact cooperation.

In an ideal world, subjects would have left the common project only when it was efficient to do so, *i.e.* when their partner exerted effort lower than the subsidy. In that ideal world, allowing exit would have provided an improvement in welfare as partnerships that did not function well due to free-riding would have been replaced by individual projects where former partners chose their effort to maximize their own payoff. However this is not what we observed as surviving partnerships in treatments 2, 3 and 4 were not on average more efficient than “forced” partnerships in treatments 0 and 1.

We also find that lower barriers to exit led to an overall loss in welfare that is significant according to Satterthwaite's  $t$  test. This is because subjects were less likely to participate in the public project when barriers to exit were low (*cf.* column  $d_i$  in Table D.1), and individual projects had lower success probabilities than common projects for a given level of effort on average. Indeed,  $ec_{it} > x_l$  on average, see table D.1. Not only were payoffs lower on average in individual projects (Table 3.1), but exiting the common project also imposed costs on the remaining partner as she was then often left alone in a public project that was even less efficient than the individual project in treatments 3 and 4.

*Why was exit inefficient?* There are several possible explanations for the lower welfare in treatments with low barriers to exit.

**Non monetary costs of cooperation:** It may be that subjects disliked joint



work and were therefore ready to sacrifice monetary payoff to avoid it. The loss in monetary welfare would therefore be at least partially compensated by a gain in individual freedom, as subjects who disliked depending on others were able to evade such situations. We checked in our regressions (to be presented later) if a tendency to exit was related to levels of trust in others, strategic uncertainty aversion or social value orientation. They were not. This first explanation does not therefore seem to be supported by our data, but it might be that better data on individual characteristics and motivations would support such an explanation.

**Overuse of exit as punishment:** Another possibility is that subjects did not understand enough about the game they were playing and therefore overused exit as a punishment for failure, possibly because they (mistakenly) believed that they would then be able to return to improved collaboration. We did not elicit the intentions and plans of our subjects so that we cannot check this possible explanation. We however discuss in Section 3.2 how inefficient it would have been to use exit as punishment in the context of our experiment, given how unlikely it was that collaboration would be re-established and how effort of the partner did not increase upon return. Given that we later show that part of the motivation for exit was directly linked to failure in the common project, we do have some circumstantial evidence that from a monetary viewpoint, subjects overused exit as a punishment for failure. From a non-monetary viewpoint however, subjects may simply have enjoyed punishing others (Fudenberg and Pathak, 2010). In any case, overuse of punishment fits previously mentioned literature about cooperation in situations of uncertainty (Van Dijk et al., 2004; Grechenig et al., 2010; Xiao and Kunreuther, 2012; Ambrus and Greiner, 2012; Van Lange et al., 2013).

**Overly pessimistic beliefs:** A last possible explanation for inefficient exit is that those who left common projects had overly pessimistic beliefs about the effort invested by others or about the decision of others whether to participate. This would lead subjects to leave common projects too often compared to when this was called for. Table 3.2 shows the average difference between expected partner's effort before exit ( $ec_{jt}^e$ ) and actual effort of the partner before exit ( $ec_{jt}$ ), as well as the average difference between the expected participation decision of the partner ( $d_{jt}^e$ ) and the actual participation decision ( $d_{jt}$ ) at the time of exit.

Table 3.2: Statistics upon exit, by treatment.

Treatment	1	2	3	4
Number of exits	15	57	60	61
Exits s.t. $ec_{jt-1}^e > x_l$	-	55	54	49
$ec_{jt-1}^e - ec_{jt-1}$	0.12	0.31	0.87*	0.57
$d_{jt}^e - d_{jt}$	-19.6%**	-19.9%***	-20.6%***	-28.8%***
$d_{jt}^e - d_{jt-1}^e$	-0.2%	-7.8%**	-5.5%	-9.0%*

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

We report a one-sided  $t$ -test for equality to 0 vs.  $H_a : ec_{jt-1}^e - ec_{jt-1} > 0$ ,  $H_a : d_{jt}^e - d_{jt} < 0$  and  $H_a : d_{jt}^e - d_{jt-1}^e < 0$

Inefficient exit does not appear to have been due to inaccurate beliefs about the effort of the partner (third row) but rather to over-pessimistic beliefs about the likelihood of exit of the partner (fourth row). This exaggerated fear of being left alone led to exit even though most subjects believed staying in would be more efficient – *i.e.* they believed their partner did enough effort for staying in to lead to higher probability of success than the alternative –  $ec_{jt-1}^e > x_l$  (second row). The result of such pessimistic beliefs is that the payoff from staying was consistently underestimated in all treatments; subjects were overly afraid of being left alone in the public project, which is inefficient in treatments 2, 3 and 4. Over-pessimistic beliefs at exit did not result from a temporary shock in beliefs. Indeed, while change in belief was on average negative before exit (fifth row), this change could not account for much of the difference between beliefs and reality at the time of exit.

We think that this fear of being left alone can be likened to betrayal aversion (Bohnet et al., 2008) or exploitation aversion (Fehr et al., 2005). Indeed, a subject left in the public project alone does not have the same opportunities as his partner in treatments 3 and 4, as he does not then receive subsidy  $x_l$  for individual projects. Therefore a subject left alone would feel betrayed and disadvantaged. In treatment 2, staying in the public project alone merely deprived one from the effort of one's partner, while in treatment 1, staying in the public project was advantageous. Even then, there is still a psychological cost to being left alone in all treatments, as a subject will feel rejected by their partner. Subjects may have dealt with this fear by taking the initiative to leave rather than facing being left.

*Robustness.* We relied in the above on beliefs about effort in the period before exit as a proxy for beliefs in the period when exit occurred. We tested our results for robustness by estimating  $ec_{jt}^e$  at the time of exit from beliefs elicited in phases where individuals both participated in the public project. We explain in Appendix H.1 how we did so. We assume beliefs are updated over time according to success or failure in the common project. There is an amount of forgetting (depreciation factor). Initial beliefs provide our starting point. We show our estimate of the parameters in the equation determining  $ec_{jt}^e$  in Table J.1. Overall estimates show that expected effort increased after successes and decreased after failures. Since

most exit followed failures, estimated  $ec_{jt}^e$  at the time of exit (which we denote  $\hat{ec}_{jt}^e$ ) was generally lower than  $ec_{jt}^e$  in the period before exit, but only by a small amount.  $\hat{ec}_{jt}^e$  was therefore most of the time higher than subsidy  $x_l$  in treatments 2, 3 and 4.

We also took account of difference in how subjects updated their beliefs after a failure. Figure F.1 shows how much beliefs about partner's effort increased or decreased following failures and successes on average, individual by individual. A significant number of subjects seem to have expected  $ec_{jt}$  to decrease following a success and increase following a failure (points in the upper left quadrant), but a majority believed the opposite would happen. Both types of beliefs can be justified depending on one's depth of reasoning. We used estimates of individual reactions to success and failure to obtain alternative estimates  $\hat{ec}_{jt}^e$  of  $ec_{jt}^e$  at the time of exit. We found that those were equal to  $ec_{jt}^e$  on average in the period before exit.

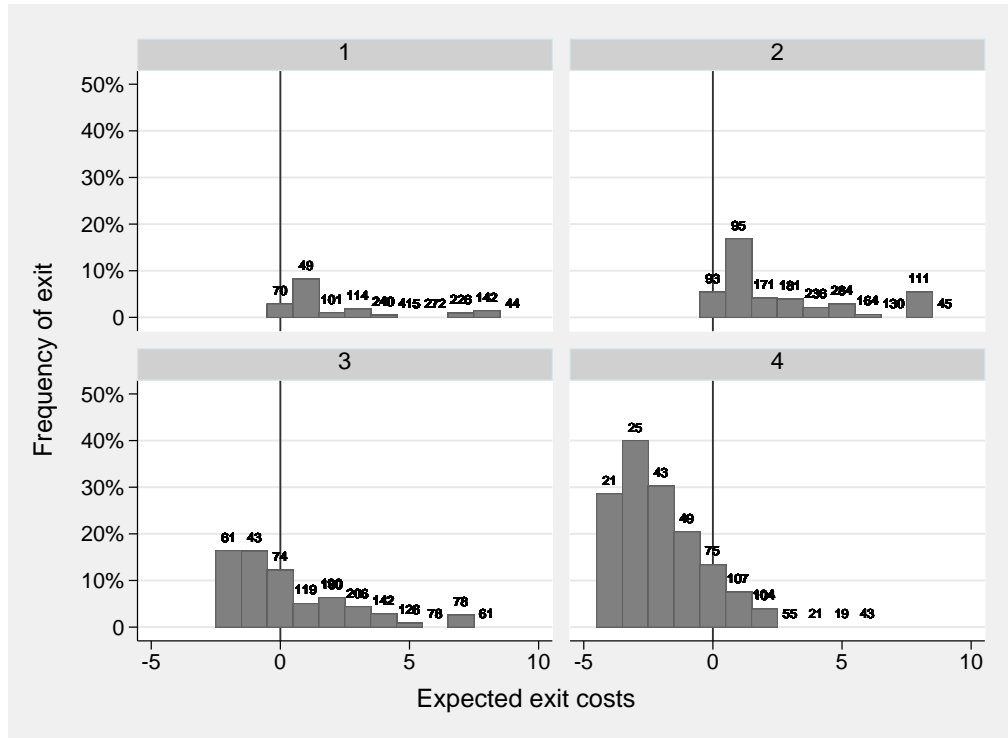
We now explore the drivers of exit.

### 3.2. The drivers of exit

We show in this section that exit was driven by failure in the common project in treatments with high barriers to exit and by cost-benefit comparisons in treatments with low barriers to exit. Appendix E gives a graphical overview of the participation decisions of subjects over time (Figure E.1), along with some summary statistics (Table E.1). We see there that lower barriers to exit meant subjects were more likely to choose an individual project at the outset and more likely to exit common projects if such were established. They also became more likely to follow exit and less likely to try re-establishing cooperation (returning to the public project) once they left the public project. As a result, the likelihood that a common project would be re-established after breaking down became lower as the incentive to work alone increased.

#### *Hypothesis 2: Opportunity costs as a driver of exit*

Figure 3.1 shows the frequency of exit as a function of the estimated expected opportunity cost of exit  $d_{jt}^e \times ec_{jt-1}^e - x_l$  (grouped in unit intervals from -4 to +10 ECU) in each treatment. For treatment 1, we assess the cost of exit as  $d_{jt}^e \times ec_{jt-1}^e$ . We use  $ec_{jt-1}^e$  as an estimate of  $ec_{jt}^e$  because  $ec_{jt}^e$  is not available if individual  $i$  chose to lead an individual project in period  $t$ . Similar figures obtain when using different estimates  $\hat{ec}_{jt}^e$  of beliefs at the time of exit (see discussion of robustness).



Numbers on the horizontal axis denote exit cost. Those were grouped in unit intervals. On top of each bar is the number of periods in which subjects with an exit cost in the corresponding interval were in a common project and the height of each bar corresponds to the frequency, shown on the vertical value axis, with which such subjects left the common project in the subsequent period.

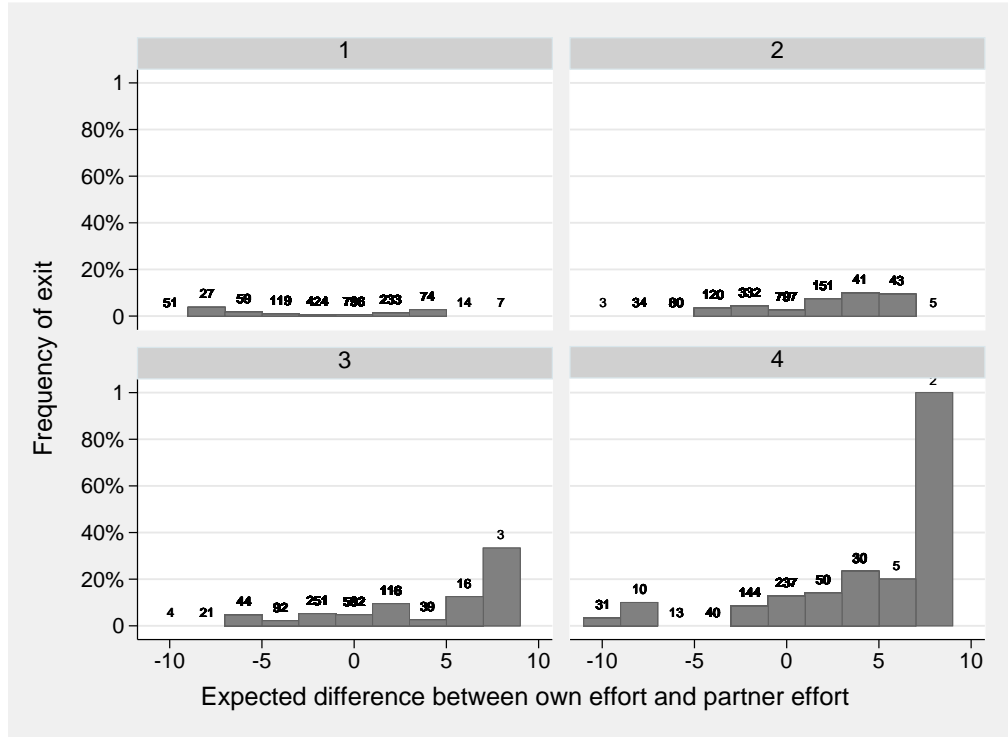
Figure 3.1: Exit frequency as a function of expected opportunity costs of exit, by treatments.

We see that exit in treatments 1 and 2 occurred even for high expected opportunity costs of exit. Exit is therefore unlikely to have been driven by a cost-benefit analysis in treatments with high barriers to exit. We see a more obvious relationship between expected opportunity costs of exit and exit frequency in treatments 3 and 4. Furthermore, the frequency of exit was more sensitive to variations in expected opportunity costs of exit in treatment 4 than in treatment 3. We will confirm this when running regressions for project choice. We can however already state that hypothesis 2 appears to be verified in treatments with low barriers to exit but not so in treatments with high barriers to exit.

*Robustness:* . We relied in the above on beliefs about effort in the period before exit as a proxy for beliefs in the period when exit occurred. We obtain a very similar figure when using estimates  $\hat{ec}_{jt}^e$  of  $ec_{jt}^e$  at the time of exit from NLS regressions with selection correction, as explained in Appendix H.1. We also checked the result above by estimating  $ec_{jt}^e$  at the time of exit from individual average response to failure and success in the common project in terms of beliefs  $ec_{jt}^e$  (see Figure F.1).

*Hypothesis 3: Exploitation aversion as a driver of exit*

Figure 3.2 shows the frequency of exit as a function of the difference between own effort  $ec_{it}$  and expected effort from the partner  $ec_{jt}^e$  in the period before exit, for each treatment.



We consider periods following periods with a common project, as well as the first period of a partnership. Numbers on the horizontal axis denote beliefs  $ec_{it} - ec_{jt}^e$ , which were grouped in intervals of size 2. On top of each bar is the number of periods in which subjects had beliefs in the corresponding interval. The height of each bar corresponds to the frequency, shown on the vertical axis, with which subjects with such beliefs chose an individual project in the next period.

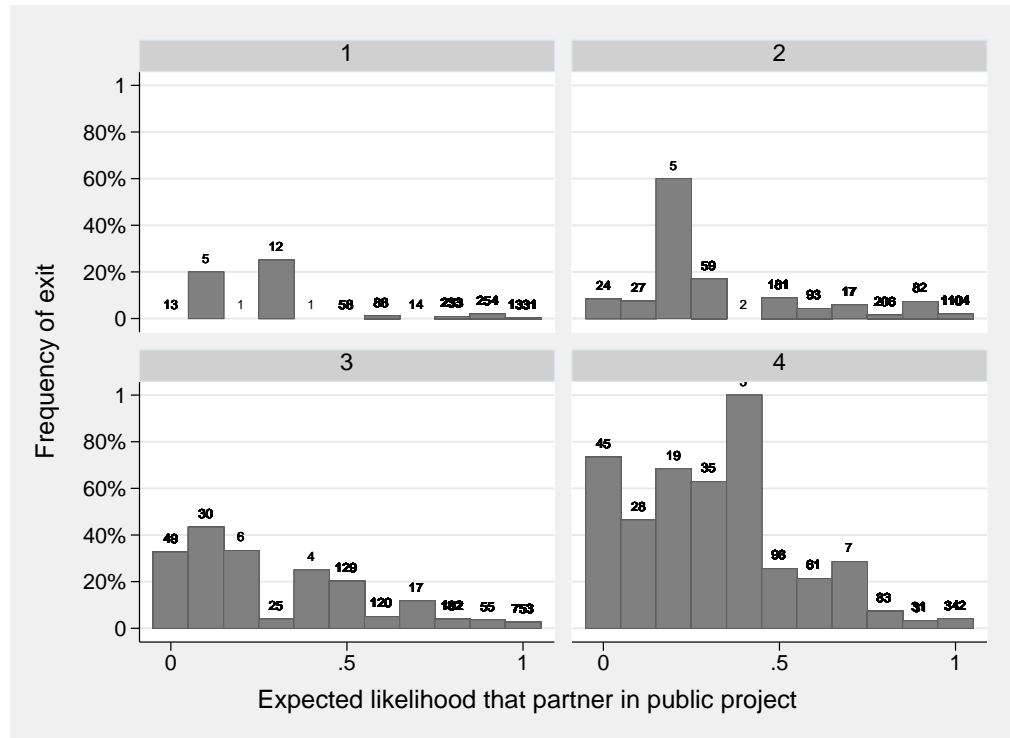
Figure 3.2: Choice to exit common project as a function of expected excess effort vs. partner, by treatments.

The figure shows that perceived excess effort did seem to motivate higher frequency of exit from common projects except in treatment 1. However, as shown by the numbers above the bars, which indicate the number of periods in which subjects had beliefs in the corresponding interval, this impression is driven by relatively few observations with perceived excess effort higher than 5 in treatments 3 and 4. If one excludes those observations, then the pattern is not as obvious anymore. We conclude that there is some evidence for Hypothesis 3, but the pattern is not overwhelming.

*Hypothesis 4: Fear of being left alone as a driver of exit*

Table E.1 shows that subjects were likely to follow exit by their partner in treatments 3 and 4, but not in treatments 1 and 2. Figure 3.3 shows how many subjects

who were in a common project or were in the first period of a partnership chose an individual project in the following period, as a function of their beliefs  $d_{jt}^e$  at the time of exit.



We consider periods following periods with a common project, as well as the first period of a partnership. Numbers on the horizontal axis denote beliefs  $d_{jt}^e$ , which are grouped in 10% unit intervals. On top of each bar is the number of periods in which subjects had beliefs in the corresponding interval. The height of each bar corresponds to the frequency, shown on the vertical axis, with which subjects with such beliefs chose an individual project.

Figure 3.3: Choice to exit common project as a function of expected decision of partner, by treatments.

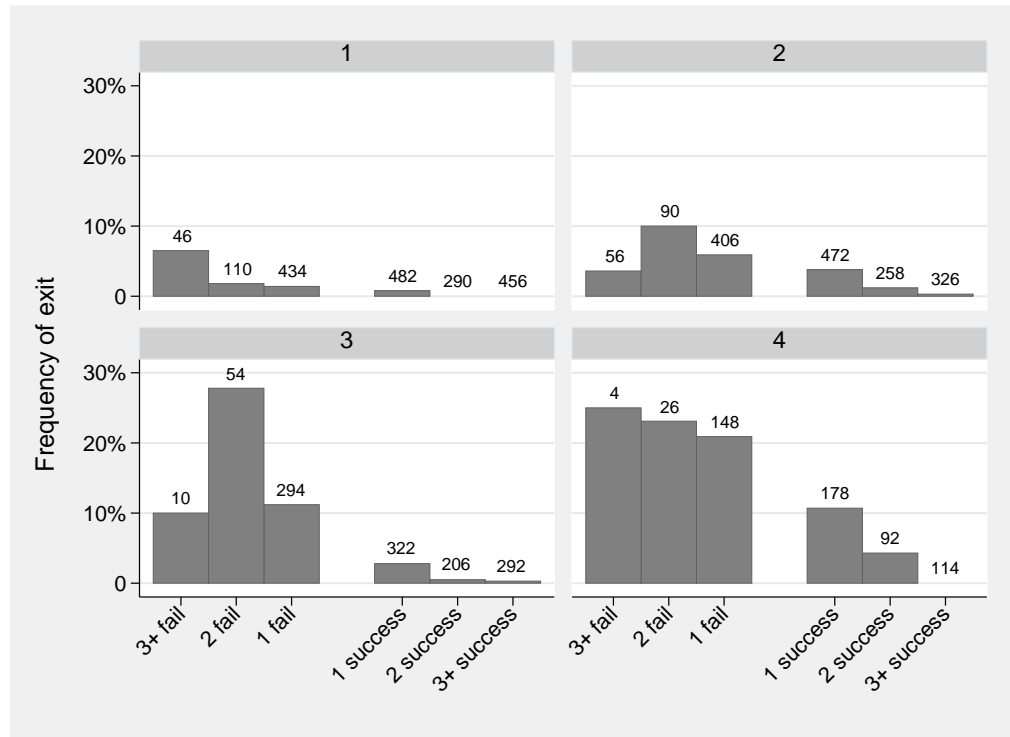
In treatments 1 and 2, doing the same as what one expects one's partner to do does not confer any monetary benefit. However subjects were still more likely to exit if they expected their partner to do so as well. In treatments 3 and 4, making the same project choice as one's partner is advantageous, and the relation between expected decision of the partner and own decision is indeed more sharply defined. Subjects were more likely to choose an individual project for a given  $d_{jt}^e$  in treatment 4 than in treatment 3, and again in treatment 3 than in treatment 2. This shows that monetary considerations – avoiding the loss of the opportunity to get subsidy  $x_l$  by avoiding being left alone in the public project – play a role in motivating exit. In treatments 1 and 2, subjects who exited expected their partner to do so as well because they assume their partner thinks in the same way as them. This is an example of projection bias, *i.e.* the tendency to assume that most people think just like us. We conclude that Hypothesis 4 appears to play an independent role since it influences choice in treatments 1 and 2, but it cannot explain why subjects

were more likely to be out for a given level in  $d_{jt}^e$  in treatments with higher subsidy  $x_l$ .

We checked the above findings by looking at how frequently subjects were in an individual project as a function of their belief  $d_{jt}^e$  about the decision of their partner. Figure G.1 shows similar results to those shown in figure 3.3. This confirms that beliefs  $d_{jt}^e$  influenced both the choice of project generally and the decision to exit a common project in particular.

#### *Hypothesis 5: Failure as a driver of exit*

While exit was apparently not driven by cost-benefit considerations in treatments 1 and 2, it may have been meant as a punishment for failure in the common project as per hypothesis 5. We show in Figure 3.4 the frequency of exit from a common project after one, two and more than two consecutive failures or successes within a common project.



Shown on top of each bars is the number of corresponding event patterns that occurred within each treatments in a common project, while the height of each bar corresponds to the frequency, shown on the vertical value axis, with which subjects exited following such an event pattern.

Figure 3.4: Exit frequency following strings of successes and failures in the common project, by treatments.

Failure increased the frequency of exit from a partnership, while successes decreased it. Hypothesis 5 therefore appears to be verified. Repeated failures did not however appear to consistently increase exit frequency compared to just one failure, although repeated success did reduce exit frequency in a consistent way. Part

of the effect of failure on exit may however be due to how it impacts other variables. Indeed, failure generally led to more pessimistic beliefs about effort of the partner (Figure F.1), although it did not consistently lead to more pessimistic beliefs about the likelihood to stay in the partnership (Figure F.2).

Hypothesis 5 was grounded on the belief that exit would be used as a motivational tool. However, exit did not seem to promote cooperation. Indeed, subjects who were left alone in the public project did not exert higher effort in the common project upon return of their partner to the common project. We see this when running regressions for effort in common projects (Table J.7, explanations in Appendix I). Variable  $1 - d_{jt}$ , which takes value 1 if the partner was in an individual project last period, was not associated with higher effort in the common project, except in treatment 3. Further reducing the potential effectiveness of exit as a motivational tool, only few exit were followed by a return (cf. Table E.1).

Finally, Hypothesis 5 does not explain why the average frequency of exit after a failure was so much higher in treatments with low barriers to exit than in treatments with high barriers to exit.

Several variables have been shown to influence exit, but all those variables evolve in ways that are linked to each other. This raises the issue of what variables were responsible for exit and how, and of whether the main motivations for exit differed across treatments. Hypothesis 6 makes a prediction about how punishment for failure *vs.* cost-benefit considerations will motivate exit across treatments. Our analysis of the role of each variable gives us only an unclear idea of the extent to which exit was *indirectly* motivated by failure – in so far as failure decreased how much effort one expected one’s partner to exert or increased fear of the partner exiting – *vs.* how far exit was *directly* motivated by wanting to punish failure. We therefore compare the strength of the different drivers of exit across treatments in the next section.

### 3.3. Comparing the strength of different drivers of exit

In order to test hypothesis 6, we need to assess econometrically how far exit was due to myopic payoff considerations (Hypothesis 2) and how far it was motivated by punishment (Hypothesis 5). We also test hypothesis 3 by including variable  $ec_{it} - ec_{jt}^e$  in our regressions, and we test hypothesis 4 by including expected probability  $d_{jt}^e$  that the partner participates in the public project.

We ran our regression as explained in Section H.2. Our regressions use estimates of expected opportunity cost of exit along formula 2.1. Results are shown in table J.3, which show marginal effects of our variables on the project participation decision  $d_{it}$  of our subjects over time. Our results show that success in the common project and higher expected exit costs both made staying in the common project more likely, while failure made staying less likely. This confirms hypotheses 2 and 5. We find however that hypothesis 4 is not verified: Changes in expected participation  $d_{jt}^e$  of the partner do not appear to have an independent effect. Finally,



hypothesis 3 is verified; belief that one is being exploited does play an independent role in motivating exit.

We checked our results for various controls. We find that value  $v$  derived from the project does not appear to make a subject more likely to exit. This is the case whether we use value  $v$  in our regressions or if we assign dummies for subjects with value 16 and subjects with value 24. Time spent within a partnership (*per*) tends to make it more likely one will exit the common project, but there is no difference in likelihood to exit across phases. Treatments 2, 3 and 4 exhibit higher likelihood of exit than treatment 1 (*treatment dummies*). This is because we assessed the cost of exit as  $d_{jt}^e \times \hat{c}_{jt}^e$  in treatment 1, which is an underestimate. Age, gender, education (*economist*), levels of risk aversion (*ra*) and aversion to strategic uncertainty (*su*), social value orientation (*svo*) and level of trust in others (*trust*) did not appear to influence the decision of our subjects.

We test hypothesis 6 by breaking down the regressions results by treatment. We show marginal effects and parameter estimates for population averaged regressions in Tables J.4 and J.5. We also show parameter estimates for within-subject regressions (Table J.6). Population averaged estimates tell us how changing the value of a variable affects the probability that a participant picked at random would be in the public project. Fixed effect estimates tell us how changing the value of a variable affects the decision of a given participant. We comment on the results of the population averaged regressions as they are more relevant to a discussion of aggregate behavior.

Results show that expected cost of exit and failure last period are both good predictors of choice for treatments 3 and 4 while choice in treatment 2 is explained by failure last period only. This means that subjects are always more willing to stay in case of success compared to in case of failure. This is independent of how failure affects their beliefs, since this is controlled for by other variables. Subjects in treatment 3 and 4 appear to be sensitive to the belief that their partner exerts less effort than themselves in the common project. This partial verification of Hypothesis 3 lends credence to the hypothesis mentioned in our literature review whereby allowing exit may frame collaboration as a self-interest competition so that subjects are more likely to leave if they feel they are subjected to distributive injustice. Finally, we find that behavior in treatment 1 is not predicted by our model, perhaps because exit was so seldom in that treatment so there is an insufficient number of observations.

Our results confirm part of hypothesis 6. Indeed, we do observe a higher influence of expected opportunity costs of exit in treatments with lower barriers to exit, but we do not observe a reduction in the direct role of failure ( $sc_{it-1}$ ) across treatments. This finding is robust even when considering only experienced subjects by excluding the first partnership in the experiment (results not shown). Overall, lower barriers to exit led subjects to be more sensitive to payoff comparisons, both

across options – staying in or exiting – and across partners – does my partner do less effort than me – but they did not prevent them from punishing failure and rewarding success as would be consistent with wanting to promote cooperation over the long term.

Beyond establishing the role of various hypothesized drivers of exit, we clarified in this section the relationship between the drivers of exit and barriers to exit. As suggested by Yamagishi (1988), we found that whether one motivation or the other was prevalent depended on how easy or difficult exit was. Making exit more attractive by increasing the return on individual work did not only make exit more frequent, but also changed the motivations for exit. This is because if exit is easy, then not only is the investment in improving the functioning of the relationship likely to be lost as the partnership may irrevocably dissolve, but the meaning of exit also becomes ambivalent, as it is not clear if it is meant as a punishment or if it means one is not ready to work together anymore. Easy exit thus lowers one's ability to influence the action of others in public projects and therefore makes partners focus on comparisons of payoffs between individual and public projects and comparisons of payoff between themselves and their partner. Conversely, harder exit makes people more confident that the partnership will not break down. Indeed, exit is then too costly to be motivated by payoff comparisons across projects, so the only motivation for exit that is left is to attempt to make one's partner more cooperative.

#### 4. Conclusion

We examined the causes and consequences of individuals stopping collaboration with their partners. We set up an original experiment where subjects contributed to a public good over several periods, the outcome was binary and stochastic, and subjects could choose to exit and work on their own. Stochastic outcomes made it difficult to evaluate the contribution of one's partner. We varied the barriers to exit across treatments in order to see how this influences the level of cooperation within partnerships as well as their stability.

We found that subjects underestimated the pay-off from staying, in large part because they had an exaggerated fear of being left alone in the collaborative project. Treatments with low barriers to exit thus exhibited lower welfare than treatments with high barriers to exit because exit, which occurred when staying in would have been more efficient, was frequent in those treatments. We looked for a range of drivers of exit and determined that exit was driven both by the difference in expected payoff between being alone or together and by whether joint work was successful in the previous period. Low barriers to exit made subjects more sensitive to payoff comparisons across individual and joint work and between themselves and their partner. Success and failure played an independent role in motivating exit in all treatments. Indeed, it was a significant determinant of project choice even after

taking into account the impact of good and bad outcomes on the beliefs of participants about their partner. This indicates that participants may have followed an “out-for-tat” conditional cooperation strategy. Such a strategy was however inefficient especially in treatments with low barriers to exit as subjects who exited were unlikely to be able to reestablish joint work later on and even in that case, their partner did not significantly increase effort upon coming back together.

Our first main contribution is to have identified an original source of inefficiency in partnerships with an exit option; subjects over-estimate the likelihood their partner will leave the partnership and therefore preempt exit by exiting first. The risk of being left alone is a *social risk*, as another human being is the primary source of uncertainty (Bohnet et al., 2008). That risk is similar to the risk of being betrayed or exploited, and the main issue we identified here is that subjects overestimate this risk. We believe that this issue would be a factor in every case where leaving first is more advantageous than leaving later. For example, individuals may not be able to rapidly switch from the joint project to their own. Suppose for example an individual agreed to meet with his partner at a specific point in time in a specific location. If his partner does not turn up, then he lost the time going to that location and may not have alternatives of a comparable value for at least part of the allocated time period. He furthermore has to deal with disappointment and with establishing new plans that take into account the changes in his expectations about future collaboration.

Our second main contribution is to have allocated weights to different drivers of exit as a function of the level of barriers to exit. We confirmed theory according to which the reason that low barriers to exit threaten the cohesion of groups is because they prompt individuals to focus on the present situation and to give more importance to their own short-term individual interests. We also found that low barriers to exit did not motivate partners to contribute more, which one could have believed would be the result of aversion to the risk of exit of their partner. Rather, the main effect was that individuals left more often, which is inefficient. In our experiment, there was no way for individuals to make it highly probable that a project would be successful and furthermore, the marginal cost of increasing the probability of success was increasing with effort. We believe however that results similar to ours would be observed even if one used other functions to link contributions to success. However, it would be interesting to explore the difference between settings where effort is a complement and settings where it is a substitute to the effort of one’s partner.

*Extensions.* Further work may control for the exaggerated fear that one’s partner will leave the collaborative project. This could be done in two ways, either by preventing one of the partners from leaving the collaborative project, or by having both partners leave the collaborative project even if only one decides to do so. This later design would avoid the issue whereby subjects wish to preempt exit in order to

avoid being left alone. In both alternative designs, a subject would rationally exit only if he believes his partner exerts low effort. Both alternative designs would however break down the symmetry in terms of the action space of both subjects in every period of the game. Our design also has the advantage of keeping the expected payoff of staying in the public project comparable across treatments. This made it easy to isolate the effect of varying the payoff to individual projects.

The organization of joint work in open-source projects would be an ideal source of empirical data to further examine individual motivation to work in teams. Two types of licenses are prevalent in the open-source community, the GPL and the BSD. The BSD gives more freedom for developers to exploit source code for their own purposes while the GPL does not allow a developer to withhold contributions from others. A conclusion from our study is that the GPL, which imposes high barriers to exit, promotes efficiency by fostering trust between developers who need not fear that their partners might leave and set up alternative projects on their own. However, open source development differs from what is modeled in our experiment in that there is accumulation of value (code base) over time in software development. Furthermore, developers usually have the choice between different teams rather than between being in a team or alone.

Finally, we did not find significant individual determinants of the decision to work jointly or individually. It would therefore be interesting to investigate further the psychological determinants of favoring one or the other type of work, such as one of the big five personality traits (Driskell et al., 2006; Wilfling, 2013, Chapter 5) or levels of identification with the group (Täuber, 2009, Study 3). It is however likely that our design does not provide a rich enough work environment for psychological measures to predict behavior of our subjects. Introducing communication, the need to reach agreement or the possibility to give feedback would go some way towards giving individual characteristics more chances to influence the progression of joint work.

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## References

- AMBRUS, A. AND B. GREINER (2012): “Imperfect Public Monitoring with Costly Punishment: An Experimental Study,” *American Economic Review*, 102, 3317–3332. (ref. p. 5, 7, 15).
- ANDERSON, T. AND C. HSIAO (1981): “Estimation of Dynamic Models with Error components,” *Journal of the American Statistical Association*, 76, 598–606. (ref. p. 44).

- AOYAGI, M. AND G. FRÉCHETTE (2009): “Collusion as public monitoring becomes noisy: Experimental evidence,” *Journal of Economic Theory*, 144, 1135–1165. (ref. p. 4).
- BEREBY-MEYER, Y. AND A. E. ROTH (2006): “The Speed of Learning in Noisy Games: Partial Reinforcement and the Sustainability of Cooperation,” *American Economic Review*, 96, 1029–1042. (ref. p. 4).
- BOHNET, I., F. GREIG, B. HERRMANN, AND R. ZECKHAUSER (2008): “Betrayal aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey and the United States,” *American Economic Review*, 98, 294–310. (ref. p. 16, 25).
- BRAVO, G. AND F. SQUAZZONI (2013): “Exit, punishment and rewards in commons dilemmas: an experimental study,” *PloS one*, 8, e69871. (ref. p. 3).
- CASON, T. N. AND F. U. KHAN (1999): “A laboratory study of voluntary public goods provision with imperfect monitoring and communication,” *Journal of Development Economics*, 58, 533–552. (ref. p. 5).
- DICKINSON, D. L. (1998): “The voluntary contributions mechanism with uncertain group payoffs,” *Journal of Economic Behavior & Organization*, 35, 517 – 533. (ref. p. 5).
- DONG, X. Y. AND G. K. DOW (1993): “Does Free Exit Reduce Shirking in Production Teams?” *Journal of Comparative Economics*, 17, 472–484. (ref. p. 3).
- DRISKELL, J. E., G. F. GOODWIN, E. SALAS, AND P. G. O’SHEA (2006): “What makes a good team player? Personality and team effectiveness,” *Group Dynamics: Theory, Research, and Practice*, 10, 249–271. (ref. p. 26).
- FEHR, E., U. FISCHBACHER, AND M. KOSFELD (2005): “Neuroeconomic Foundations of Trust and Social Preferences: Initial Evidence,” *American Economic Review*, 2, 346–351. (ref. p. 12, 16).
- FISCHBACHER, U. (2007): “z-Tree: Zurich toolbox for ready-made economic experiments,” *Experimental Economics*, 10, 171–178. (ref. p. 13).
- FISCHBACHER, U. AND S. GÄCHTER (2010): “Social Preferences, Beliefs, and the Dynamics of Free Riding in Public Goods Experiments,” *The American Economic Review*, 100, 541–556. (ref. p. 2).
- FISCHBACHER, U., S. GÄCHTER, AND E. FEHR (2001): “Are people conditionally cooperative? Evidence from a public goods experiment,” *Economics Letters*, 71, 397–404. (ref. p. 7).
- FRANK, R. H., T. GILOVICH, AND D. T. REGAN (1993): “Does studying economics inhibit cooperation?” *The Journal of Economic Perspectives*, 7, 159–171. (ref. p. 9).

- FUDENBERG, D. AND P. A. PATHAK (2010): “Unobserved punishment supports cooperation,” *Journal of Public Economics*, 94, 78–86. (ref. p. 15).
- FUJIWARA-GREVE, T. AND Y. YASUDA (2011): “Repeated Cooperation with Outside Options,” *Working Paper, Keio University and National Graduate Institute for Policy Studies (GRIPS)*, 1092359. (ref. p. 3).
- GÄCHTER, S., B. HERRMANN, AND C. THÖNI (2004): “Trust, voluntary cooperation, and socio-economic background: Survey and experimental evidence,” *Journal of Economic Behavior and Organization*, 55, 505–531. (ref. p. 9).
- GRECHENIG, K., A. NICKLISCH, AND C. THÖNI (2010): “Punishment despite reasonable doubt—a public goods experiment with sanctions under uncertainty,” *Journal of Empirical Legal Studies*, 7, 847–867. (ref. p. 5, 7, 15).
- GREINER, B. (2004): “An Online Recruitment System for Economic Experiments,” in *Forschung und wissenschaftliches Rechnen, GWDG-Bericht Nr. 63*, ed. by K. Kremer and V. Macho, Gesellschaft für Wissenschaftliche Datenverarbeitung, Göttingen, 79–93. (ref. p. 13).
- GUAN, W. (2003): “From the help desk: Bootstrapped standard errors,” *The Stata Journal*, 3, 71–80. (ref. p. 44).
- HAYASHI, N. AND T. YAMAGISHI (1998): “Selective play: Choosing partners in an uncertain world,” *Personality and Social Psychology Review*, 2, 276–289. (ref. p. 4).
- HEINEMANN, F., R. NAGEL, AND P. OCKENFELS (2009): “Measuring strategic uncertainty in coordination games,” *The Review of Economic Studies*, 76, 181–221. (ref. p. 9, 59).
- HIRSCHMAN, A. O. (1970): *Exit, Voice and Loyalty: Responses to Decline in Firms, Organizations, and States*, Harvard University Press. (ref. p. 2, 13).
- HOUSER, D., E. XIAO, K. MCCABE, AND V. SMITH (2008): “When punishment fails: Research on sanctions, intentions and non-cooperation,” *Games and Economic Behavior*, 62, 509–532. (ref. p. 4).
- KATZ-NAVON, T. Y. AND M. EREZ (2005): “When Collective- and Self-Efficacy Affect Team Performance The Role of Task Interdependence,” *Small Group Research*, 36, 437–465. (ref. p. 2).
- KERR, N. L. AND C. M. KAUFMAN-GILLILAND (1997): ““... and besides, I probably couldn’t have made a difference anyway”: Justification of Social Dilemma Defection via Perceived Self-Inefficacy,” *Journal of Experimental Social Psychology*, 33, 211–230. (ref. p. 13).



- KESER, C. AND C. MONTMARQUETTE (2011): “Voluntary versus Enforced Team Effort,” *Games*, 2, 277–301. (ref. p. 5, 9).
- KESER, C. AND F. V. WINDEN (2000): “Conditional Cooperation and Voluntary Contributions to Public Goods,” *The Scandinavian Journal of Economics*, 102, 23–39. (ref. p. 7).
- KÖLLE, F. (2014): “Heterogeneity and Cooperation: The Role of Capability and Valuation on Public Goods Provision,” *Journal of Economic Behavior & Organization*. (ref. p. 14).
- KUHN, P. AND M. C. VILLEVAL (2014): “Are Women More Attracted to Cooperation Than Men?” *The Economic Journal*. (ref. p. 9).
- KURRILD-KLITGAARD, P. (2010): “Exit, collective action and polycentric political systems,” *Public choice*, 143, 339–352. (ref. p. 4).
- LEVATI, M. AND A. MORONE (2013): “Voluntary Contributions with Risky and Uncertain Marginal Returns: The Importance of the Parameter Values,” *Journal of Public Economic Theory*, 15, 736–744. (ref. p. 5).
- LIN, J. Y. (1990): “Collectivization and China’s Agricultural Crisis in 1959-1961,” *Journal of Political Economy*, 98, 1228–1252. (ref. p. 3).
- LIST, J. A. (2004): “Young, Selfish And Male: Field Evidence Of Social Preferences,” *The Economic Journal*, 114, 121–149. (ref. p. 9).
- MACLEOD, W. B. (1988): “Equity, efficiency and incentives in cooperative teams,” in *Advances in the economic analysis of participatory and labor-managed firms*, ed. by D. C. Jones and J. Svejnar, JAI Press, vol. 3, 5–23. (ref. p. 3).
- (1993): “The Role of Exit Costs in the Theory of Cooperative Teams: A Theoretical Perspective,” *Journal of Comparative Economics*, 17, 521–529. (ref. p. 3).
- MARWELL, G. AND R. E. AMES (1981): “Economists free ride, does anyone else?” *Journal of Public Economics*, 15, 295–310. (ref. p. 9).
- MULDER, L. B., E. V. DIJK, D. D. CREMER, AND H. A. WILKE (2006): “Undermining trust and cooperation: The paradox of sanctioning systems in social dilemmas,” *Journal of Experimental Social Psychology*, 42, 147–162. (ref. p. 4).
- MURPHY, R., K. ACKERMANN, AND M. HANDGRAAF (2011): “Measuring social value orientation,” *Judgment and Decision Making*, 6, 771–781. (ref. p. 9, 60).
- MY, K. B. AND B. CHALVIGNAC (2010): “Voluntary participation and cooperation in a collective-good game,” *Journal of Economic Psychology*, 31, 705–718. (ref. p. 5).

- ORBELL, J. M., P. SCHWARTZ-SHEA, AND R. T. SIMMONS (1984): “Do Cooperators Exit More Readily than Defectors?” *The American Political Science Review*, 78, 147–162. (ref. p. 3).
- PALFREY, T. AND J. PRISBREY (1996): “Altruism, reputation and noise in linear public goods experiments,” *Journal of Public Economics*, 61, 409–427. (ref. p. 4).
- PALFREY, T. R. AND J. E. PRISBREY (1997): “Anomalous Behavior in Public Goods Experiments: How Much and Why?” *American Economic Review*, 87, 829–846. (ref. p. 7).
- PUTTERMAN, L. AND G. L. SKILLMAN (1992): “The role of exit costs in the theory of cooperative teams,” *Journal of Comparative Economics*, 16, 596–618. (ref. p. 3).
- RADNER, R., R. MYERSON, AND E. MASKIN (1986): “An example of a repeated partnership game with discounting and with uniformly inefficient equilibria,” *The Review of Economic Studies*, 53, 59–69. (ref. p. 5).
- RAND, D. G., S. ARBESMAN, AND N. A. CHRISTAKIS (2011): “Dynamic social networks promote cooperation in experiments with humans,” *Proceedings of the National Academy of Sciences*, 108, 19193–19198, pMID: 22084103. (ref. p. 3).
- SEMYKINA, A. AND J. M. WOOLDRIDGE (2010): “Estimating panel data models in the presence of endogeneity and selection,” *Journal of Econometrics*, 157, 375–380. (ref. p. 44).
- (2013): “Estimation of dynamic panel data models with sample selection,” *Journal of Applied Econometrics*, 28, 47–61. (ref. p. 44).
- TÄUBER, S. (2009): “Should I stay or should I go? Strategies to regulate individual achievement needs within task groups.” Ph.D. thesis, Fakultät für Sozial- und Verhaltenswissenschaften, Friedrich-Schiller-Universität Jena. (ref. p. 26).
- TENBRUNSEL, A. E. AND D. M. MESSICK (1999): “Sanctioning Systems, Decision Frames, and Cooperation,” *Administrative Science Quarterly*, 44, 684–707. (ref. p. 3).
- VAN DIJK, E., A. WIT, H. WILKE, AND D. BUDESCU (2004): “What we know (and do not know) about the effects of uncertainty on behavior in social dilemmas,” in *Contemporary psychological research on social dilemmas*, ed. by R. Suleiman, D. V. Budescu, I. Fischer, and D. M. Messick, Cambridge University Press, 315–331. (ref. p. 7, 15).
- VAN LANGE, P. A., J. JOIREMAN, C. D. PARKS, AND E. VAN DIJK (2013): “The psychology of social dilemmas: A review,” *Organizational Behavior and Human Decision Processes*, 120, 125–141. (ref. p. 7, 9, 15).



- WILFLING, S. (2013): “Essays on entrepreneurial entry and exit,” Ph.D. thesis, Wirtschaftswissenschaftliche Fakultät, Friedrich-Schiller-Universität Jena. (ref. p. 26).
- WILSON, A. J. AND H. WU (2014): “At-will Relationships: How An Option To Walk Away Affects Cooperation And Efficiency,” *Working Paper, University of Pittsburgh*. (ref. p. 4).
- WOOLDRIDGE, J. M. (1995): “Selection correction for panel data models under conditional mean independence assumptions,” *Journal of Econometrics*, 68, 115–132. (ref. p. 43, 44, 46).
- XIAO, E. AND H. KUNREUTHER (2012): “Punishment and cooperation in stochastic social dilemmas,” Tech. Rep. No. 18458, National Bureau of Economic Research. (ref. p. 5, 7, 15).
- YAMAGISHI, T. (1988): “Exit from the group as an individualistic solution to the free rider problem in the United States and Japan,” *Journal of Experimental Social Psychology*, 24, 530–542. (ref. p. 2, 3, 13, 24).

### A. Optimal effort levels

Suppose both agents participate in the public project. Total expected welfare generated by the joint project is  $f(e_{it} + e_{jt})(v_i + v_j) - e_{it} - e_{jt}$ . Maximum social welfare when both agents are involved in a common project is then  $f(e^*)(v_i + v_j) - e^*$ , where  $e^* = e_{it} + e_{jt}$  is determined by the first order condition of the maximization problem,  $f'(e^*)(v_i + v_j) = 1$ . Suppose now both agents develop individually. In that case, total expected welfare generated by the two individual projects is  $f(x_l + e_{it})v_i + f(x_l + e_{jt})v_j - e_{it} - e_{jt}$ . Agent  $i$  chooses effort  $e_i^*$  such that  $f'(x_l + e_i^*)v_i = 1$  while  $j$  chooses effort  $e_j^*$  such that  $f'(x_l + e_j^*)v_j = 1$ . Social welfare when both agents are involved in individual projects is then  $f(x_l + e_i^*)v_i - e_i^* + f(x_l + e_j^*)v_j - e_j^*$ . Given  $f(z) = \sqrt{z/22}$  as in the experiment, we find that maximum expected welfare in joint work is higher than maximum expected welfare in individual work for any  $x_l < 4.54$  when  $v_i = v_j = 20$  (symmetric case).

### B. Nash equilibrium

We determine the Nash equilibrium for the one-shot version of the partnership game with outside options when agents are risk-neutral.

#### B.1. Effort

Agent  $i$  is in partnership with agent  $j$  and such that  $v_i \geq v_j$ . Suppose there is a common project in period  $t$ .  $i$  will maximize her own expected payoff  $f(ec_{it} + ec_{jt}^e)v_i - ec_{it}$ .  $f(\cdot)$  is strictly concave so the first order condition for the maximization of this function is  $f'(ec_{it} + ec_{jt}^e)v_i = 1$  and there is only one value, which we denote  $z_i$ , such that  $f'(z_i)v_i = 1$ . Since  $f'(\cdot)$  is decreasing in its argument,  $z_i$  will be an increasing function of  $v_i$ . We obtain  $z_i = v_i^2/88$  for the case  $f(z) = \sqrt{z/22}$  as in the experiment. Probability of success is then  $f(z_i) = v_i/44$ .

The best response function  $ec_{it}(ec_{jt}^e) = \max[z_i - ec_{jt}^e, 0]$  determines the optimal choice  $ec_{it}$  by  $i$  for every expected level of effort of  $j$ . Given that  $f'(\cdot)$  is decreasing in its argument,  $z_i$  will be higher than  $z_j$  whenever  $v_i > v_j$ . The Nash equilibrium  $(ec_{it}^*, ec_{jt}^*)$  is such that each player's effort is a best-response to the other player's effort, that is,  $ec_{it}^* = \max[z_i - ec_{jt}^*, 0]$  and  $ec_{jt}^* = \max[z_j - ec_{it}^*, 0]$ .

- If  $v_i > v_j$  then  $z_i > z_j$  and the Nash equilibrium is such that  $ec_{it} = z_i$  and  $ec_{jt} = 0$ .
- If  $v_i = v_j$  then any combination of efforts such that  $ec_{it}^* = z_i - ec_{jt}^*$  with  $ec_{it}^* \geq 0$  is a Nash equilibrium.

Similarly, the optimal level of effort in the individual project is  $ei_{it}^* = \max[z_i - x_l, 0]$  for treatments 2, 3 and 4. In treatment 1, the optimal level of effort is  $ei_{it}^* = 0$ . Finally, optimal level of effort in the public project alone is  $epa_{it}^* = z_i$ .

We summarize the Nash predictions for effort in table B.1.

Table B.1: Effort under the Nash equilibrium, by treatment.

Payoffs \ Opportunity costs of exit	No exit	Payoff 0 in indiv. project	$x_l = 0$	$x_l = 2$	$x_l = 4$
Symmetric payoffs $v_i = v_j = 20$	$ec_{it}^* = 4.54 - ec_{jt}^*$ .	$ec_{it}^* = 4.54 - ec_{jt}^*$ $ei_{it}^* = 0$	$ec_{it}^* = 4.54 - ec_{jt}^*$ $ei_{it}^* = 4.54$	$epa_{it}^* = 4.54$ $ei_{it}^* = 2.54$	$ei_{it}^* = 0.54$
Asymmetric payoffs $v_i = 24, v_j = 16$	$ec_{it}^* = 6.54, ec_{jt}^* = 0$ .	$ec_{it}^* = 6.54, ec_{jt}^* = 0$ $ei_{it}^* = 0$	$ec_{it}^* = 6.54, ec_{jt}^* = 0$ $ei_{it}^* = 6.54$ $ei_{jt}^* = 2.91$	$epa_{it}^* = 6.54, epa_{jt}^* = 2.91$ $ei_{it}^* = 4.54$ $ei_{jt}^* = 0.91$	$ei_{it}^* = 2.54$ $ei_{jt}^* = 0$

### B.2. Participation decision

The decision  $d_{it}$  whether to participate in the public project depends on how expected payoff when staying compares with payoff in an individual project. In treatment 1, it is never optimal to exit, so  $d_{it}^* = 1$ . In treatments 2, 3 and 4, we obtain  $d_{it} = 1$  (participate in the public project) if:

$$(1 - d_{jt}^e) \times (f(epa_{it})v_i - epa_{it}) + d_{jt}^e \times (f(ec_{it} + ec_{jt}^e)v_i - ec_{it}) > f(ei_{it} + x_l)v_i - ei_{it} \quad (\text{B.1})$$

This can be rewritten given equilibrium levels of effort for individual  $i$  with  $v_i \geq v_j$ :

$$(1 - d_{jt}^e) \times (f(z_i)v_i - z_i) + d_{jt}^e \times (f(z_i)v_i - z_i + ec_{jt}^e) > f(z_i)v_i - z_i + x_l \quad (\text{B.2})$$

Simplifying, subject  $i$  with  $v_i \geq v_j$  stays if *expected opportunity cost of exit* is more than zero:

$$\underbrace{d_{jt}^e \times ec_{jt}^e - x_l}_{\text{expected opportunity cost of exit}} > 0 \quad (\text{B.3})$$

In words, subject  $i$  with  $v_i \geq v_j$  chooses the public project as long as the expected effort of her partner times the probability he chooses the public project is more than the subsidy to individual projects. The expression is different for individual  $j$  with  $v_j < v_i$ , as that individual exerts no effort in the common project.

### B.3. Beliefs

- In the symmetric case ( $v_i = v_j$ ), any belief  $ec_{jt}^e \in [0, z_i]$  can be sustained in a Nash equilibrium. A subject will decide to choose the individual or the public project as a function of his beliefs  $ec_{jt}^e$  and  $d_{jt}^e$ .
- In the asymmetric case ( $v_i > v_j$ ), then the only belief that can be sustained by  $i$  in equilibrium is that  $ec_{jt}^e = 0$ . Therefore subject  $i$  is indifferent between exiting and staying in treatment 1 and will exit in treatments 3 and 4. Subject  $j$  with  $v_j < v_i$  will have belief  $ec_{it}^e = z_i$  and will choose the individual project if  $d_{it}^e(z_j + f(z_i)v_j - f(z_j)v_j) < x_l$ . However, the only reasonable belief  $d_{it}^e$

in treatments 3 and 4 is that  $d_{it}^e = 0$ . Therefore subject  $j$  will choose the individual project for treatments 3 and 4 as well.

We summarize the Nash predictions for project selection in Table B.2.

Table B.2: Project selection under the Nash equilibrium, by treatment.

Payoffs	Opportunity costs of exit	No exit	Payoff 0 in indiv. project	$x_l = 0$	$x_l = 2$	$x_l = 4$
Symmetric payoffs		.	$d_{it} = 1$	$d_{it} = 1$ if $d_{jt}^e \times ec_{jt}^e > x_l$		
$v_i = v_j = 20$		.	$d_{jt} = 1$	$d_{jt} = 1$ if $d_{it}^e \times ec_{it}^e > x_l$		
Asymmetric payoffs		.	$d_{it} = 1$	$d_{it} \in [0, 1]$	$d_{it} = 0$	$d_{it} = 0$
$v_i = 24, v_j = 16$		.	$d_{jt} = 1$	$d_{jt} = 1$ if $d_{it}^e > 0$	$d_{jt} = 0$	$d_{jt} = 0$

## C. Variables

Table C.1: Description of variables

NAME	DESCRIPTION
$i, j, k, l, m$	individual $i$ , partner $j$ of $i$ , partnership $k$ composed of $i$ and $j$ , treatment $l$ to which $i$ as assigned, phase $m$ of the experiment, $= 1, 2, 3$ depending on whether $j$ is $i$ 's first, second or third partner.
$d_{it}$	participation <b>d</b> ecision by individual $i$ at time $t$ , $= 0$ if in individual project, 1 else.
$d_{jt}$	participation <b>d</b> ecision by partner $j$ of $i$ at time $t$ , $= 0$ if in individual project, 1 else.
$d_{jt}^e$	individual $i$ 's <b>e</b> xpectation about the participation <b>d</b> ecision his partner $j$ , in terms of probability of his being in the public project.
$ec_{it}$	<b>e</b> ffort in <b>c</b> ommon project by individual $i$ at time $t$ .
$ec_{jt}$	<b>e</b> ffort in <b>c</b> ommon project by partner $j$ of $i$ at time $t$ .
$ec_{jt}^e$	individual $i$ 's <b>e</b> xpectation about the <b>e</b> ffort in the <b>c</b> ommon project of partner $j$ at time $t$ . This is observed only if $d_{it} = d_{jt} = 1$ .
$ei_{it}$	<b>e</b> ffort in <b>i</b> ndividual project by individual $i$ at time $t$ .
$epa_{it}$	<b>e</b> ffort in <b>p</b> ublic project by individual $i$ at time $t$ when <b>a</b> lone (i.e. when $d_{it} = 1$ and $d_{jt} = 0$ ).
$e_{it} - e_{jt}^e$	difference between one's own effort in one's chosen project and the expected effort of the partner in his own chosen project.
$sc_{it}$	variable indicating <b>s</b> uccess in the <b>c</b> ommon project, $= -1$ if failure, $= 1$ if success, $= 0$ if there is no common project.
$si_{it}$	variable indicating <b>s</b> uccess in the <b>i</b> ndividual project, $= -1$ if failure, $= 1$ if success, $= 0$ if the subject is not in an individual project.
$spa_{it}$	variable indicating <b>s</b> uccess in the <b>p</b> ublic project when <b>a</b> lone, $= -1$ if failure, $= 1$ if success, $= 0$ if the subject is not alone in the public project..
$P_i$	Vector of <b>p</b> ersonal characteristics of $i$
$x_l$	value of the subsidy to the individual project for the treatment $l$ to which $i$ was assigned. $x_l$ is undefined for treatments 0 and 1.
$treatment\ l_i$	dummy variables indicating the <b>t</b> reatment to which $i$ was assigned, $= 1$ if $i$ was assigned to treatment $l$ , $= 0$ else, $l = \{0, \dots, 4\}$ , e.g. $treatment\ 1_i = 1$ if $i$ was assigned to treatment 1, 0 else.
$v_i$	<b>v</b> alue received on successful completion of the project for $i$ .
$female_i$	$= 1$ if <b>f</b> emale, 0 else
$age_i$	<b>a</b> ge of individual $i$
$economist_i$	Dummy variable equal to 1 for subjects studying business administration or economics, 0 else.
$ra_i$	index of <b>r</b> isk <b>a</b> version, taking value from 0 (most risk loving) to 10 (most risk averse). See Section L.1.
$su_i$	index of aversion to <b>s</b> trategic <b>u</b> ncertainty, taking value from 0 (most uncertainty loving) to 10 (most averse to strategic uncertainty). See Section L.1.
$svo_i$	index of <b>s</b> ocial <b>v</b> alue <b>o</b> rientation, see Section L.2.
$trust_i$	index of <b>t</b> rustfulness, see Section L.3.
$T_t$	Vector of <b>t</b> ime varying characteristics
$start_t$	Dummy variable $= 1$ if period $t$ is the <b>s</b> tart of a new partnership, 0 else. $start_t = 1$ for $t = \{1, 9, 23\}$ , 0 else.
$per_t$	<b>P</b> eriod within the partnership, $= 1$ at the start of a partnership, $= 2$ in the second period, and so on.
$phase_{mt}$	Dummy variable $= 1$ if at period $t$ the subject is in the $m^{th}$ phase, $m = \{1, 2, 3\}$ , e.g. $phase_{1t} = 1$ for $t \in [1, 8]$ , 0 else.

**D. Summary statistics**

Table D.1: Summary statistics, by treatment

TREATMENT	STATS	$d_{it}$	$d_{jt}^e$	$ec_{it}$	$ec_{jt}^e$	$ei_{it}$	$epa_{it}$	% success common project	% success individual project	% success public alone
0	mean	1.00	1.00	5.39	5.46	.	.	67%	.	.
	sd	0.00	0.00	2.46	2.18	.	.	47%	.	.
	N	1920	1920	1920	1920	0	0	1920	0	0
1	mean	0.99	0.93	5.57	5.92	1.05	5.08	68%	0%	41%
	sd	0.10	0.15	2.47	2.29	2.57	3.25	47%	0%	50%
	N	2048	2048	2004	2004	22	22	2004	22	22
2	mean	0.93	0.83	5.32	5.62	7.42	5.57	66%	58%	48%
	sd	0.26	0.27	2.73	2.51	2.75	3.15	47%	50%	50%
	N	2048	2048	1778	1778	147	123	1778	147	123
3	mean	0.73	0.67	5.76	6.11	4.85	5.67	70%	52%	43%
	sd	0.45	0.38	2.65	2.13	3.24	3.44	46%	50%	50%
	N	2048	2048	1300	1300	559	189	1300	559	189
4	mean	0.42	0.41	5.61	6.36	5.01	6.55	69%	62%	52%
	sd	0.49	0.40	2.72	2.03	3.43	3.09	46%	49%	50%
	N	2048	2048	610	610	1192	246	610	1192	246

Table D.2: Summary individual statistics, by treatment

TREATMENT	STATS	FEMALE	AGE	ECONOMIST	RA	SU	SVO	TRUST
0	mean	0.60	24.50	0.12	5.70	4.80	0.41	0.03
	sd	0.49	3.84	0.32	1.37	2.19	0.22	1.23
	N	60	60	60	60	60	60	60
1	mean	0.55	25.06	0.13	5.69	5.17	0.37	0.01
	sd	0.50	5.79	0.33	1.94	2.62	0.28	1.44
	N	64	64	64	64	64	64	64
2	mean	0.56	24.16	0.17	5.80	4.41	0.37	0.05
	sd	0.50	6.27	0.38	1.63	2.59	0.25	1.28
	N	64	64	64	64	64	64	64
3	mean	0.48	24.35	0.20	5.70	4.44	0.36	-0.08
	sd	0.50	4.16	0.41	1.81	2.39	0.22	1.44
	N	64	63	64	64	64	64	64
4	mean	0.55	24.08	0.17	5.48	4.91	0.36	0.00
	sd	0.50	3.40	0.38	1.60	2.74	0.25	1.41
	N	64	63	64	64	64	64	64

Figure D.1 represents the distribution of individual effort for each subject in our experiment, by treatment and value for the project. Superimposed on the figure for common projects is the effort predicted under a Nash equilibrium (Diamonds), and the welfare maximizing effort (Triangles). We represent in the figure the assumption that Nash effort in the common project in the symmetric case is proportional to the value derived from the project, i.e.  $ec_{it} = ec_{jt}$ .

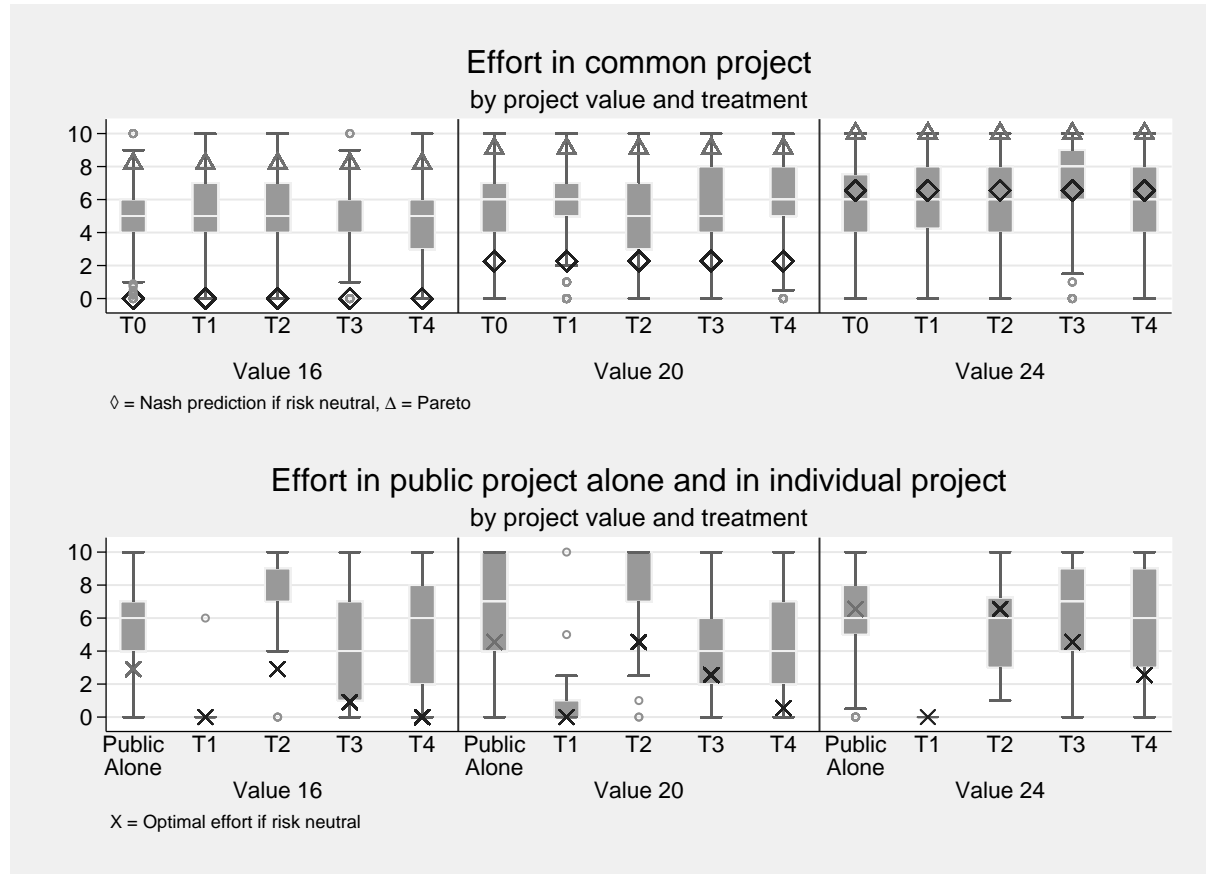


Figure D.1: Effort choice, by type of project and project value.

## E. Exit patterns

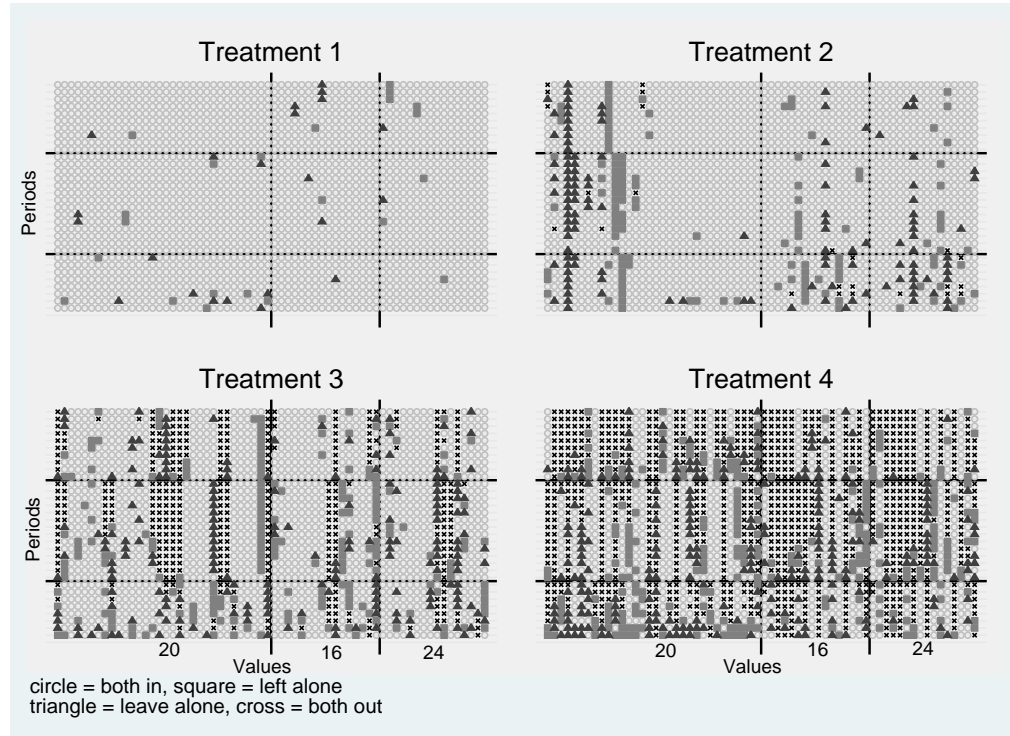


Figure E.1: Project choice by individuals over time, by treatment

Figure E.1 represents project choice by individuals over time. Each sub-figure corresponds to one treatment. Each point on the horizontal axis is an individual, and each point on the vertical axis is a period, starting with period 1 on the bottom up to period 32 at the top. The shape of the point represents the state of the partnership they are involved in: circle=they are in a common project, square=they are in the public project alone, triangle=they are the only one who chose an individual project, cross=both are in individual projects. Subjects in the symmetric sub-treatment are in the first half to the right of each sub-figures. The second half shows subjects in the asymmetric sub-treatment, first subjects who obtained value 16 and then those who obtained value 24. Horizontal lines in the background separate different phases in the experiment, corresponding to re-matching of subjects in pairs.



Table E.1 gives summary statistics about the pattern of exit across treatments.

Table E.1: Exit and return frequency by treatments.

Treatment	1	2	3	4
a. % periods with a common project	98%	87%	63%	30%
b. % choosing individual project at the start	1%	6%	18%	45%
c. Frequency of exit	1%	3%	5%	10%
d. % following exit	9%	6%	29%	37%
e. % returning to public project	68%	42%	17%	9%
f. % re-establishing common project	59%	39%	13%	7%

The number of periods with common projects gradually declined from treatment 1 to 4 (row a in table E.1). This was in part due to more subjects choosing individual projects at the outset of a partnership (row b), and in part also due to subjects exiting common projects (row c, showing how many periods with a common project were followed by a periods with an individual project, in %, within the same partnership). Finally, subjects were also more likely to follow exit in treatments 3 and 4 than in treatments 1 and 2 (row d, showing how many times a subject who was alone in the public project chose an individual project the next period, in %, within the same partnership). Since subjects who were in an individual project were ever less likely to return to the public project in the next period within the same partnership (row e), the frequency with which periods without common projects were followed by a return to collaboration declined from treatment 1 to treatment 4 (row f).

### F. Beliefs reaction function

Figure F.1 shows individual average percentage increases and decreases in  $ec_{jt}^e$  as a function of whether the common project was a success or a failure last period.

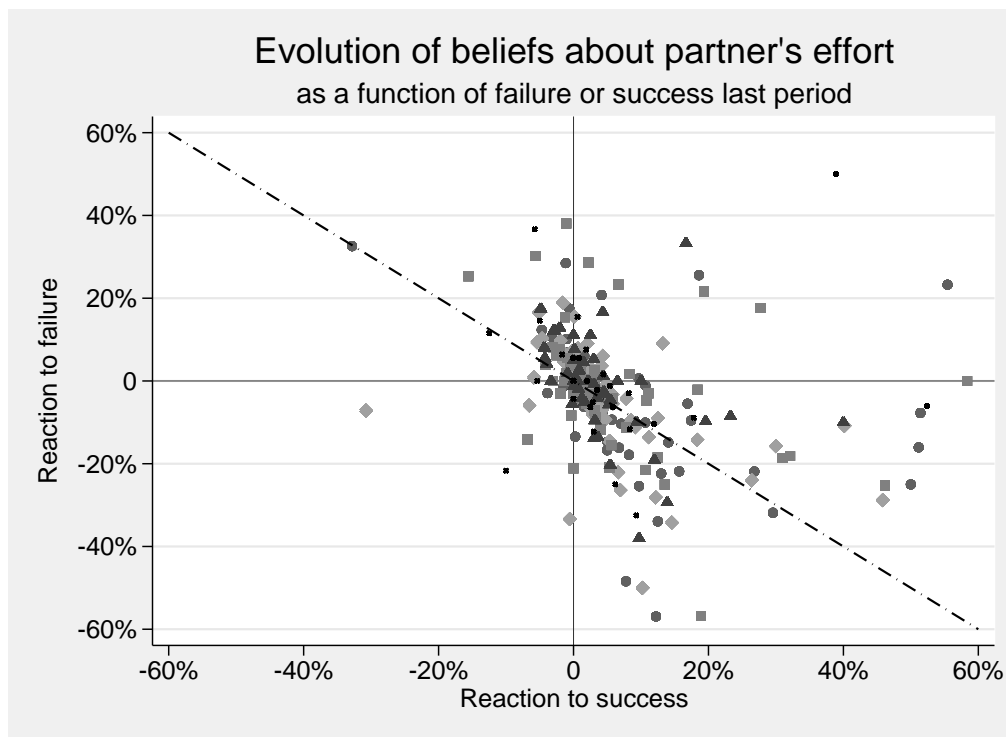


Figure F.1: Evolution of beliefs about partner's effort in the common project as a function of failure or success last period in the common project.

The shape of the point represents the treatment the individual was in: circle=Treatment 0, lozenge=Treatment 1, square=Treatment 2, triangle=Treatment 3, cross=Treatment 4.

Figure F.2 shows individual average percentage increases and decreases in  $d_{jt}^e$  as a function of whether the common project was a success or a failure last period.

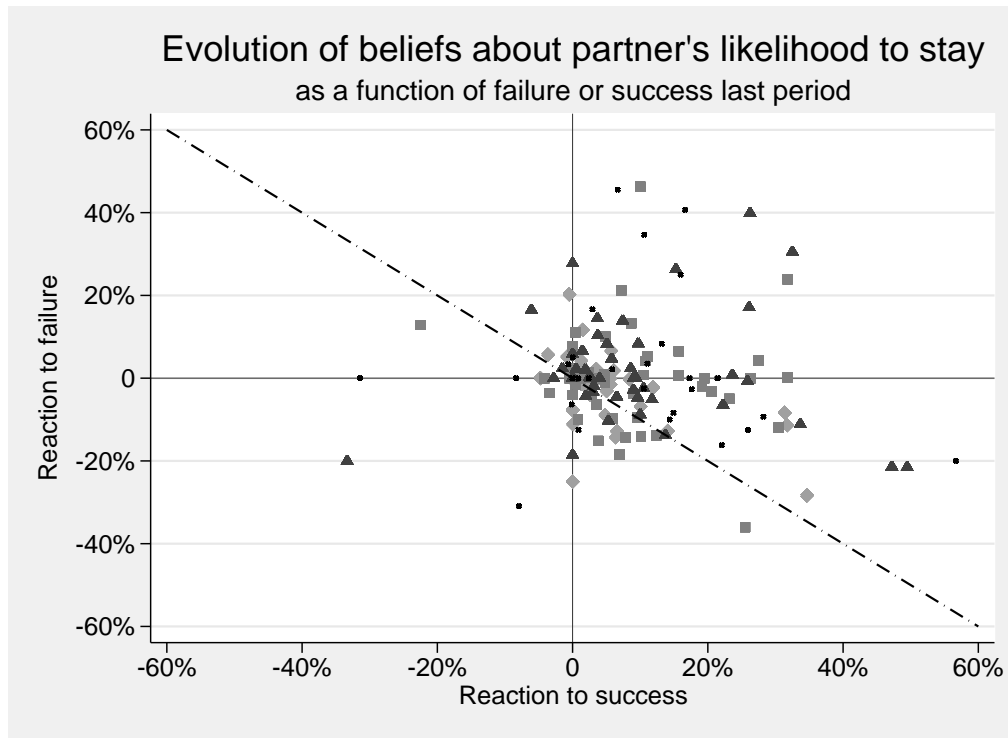
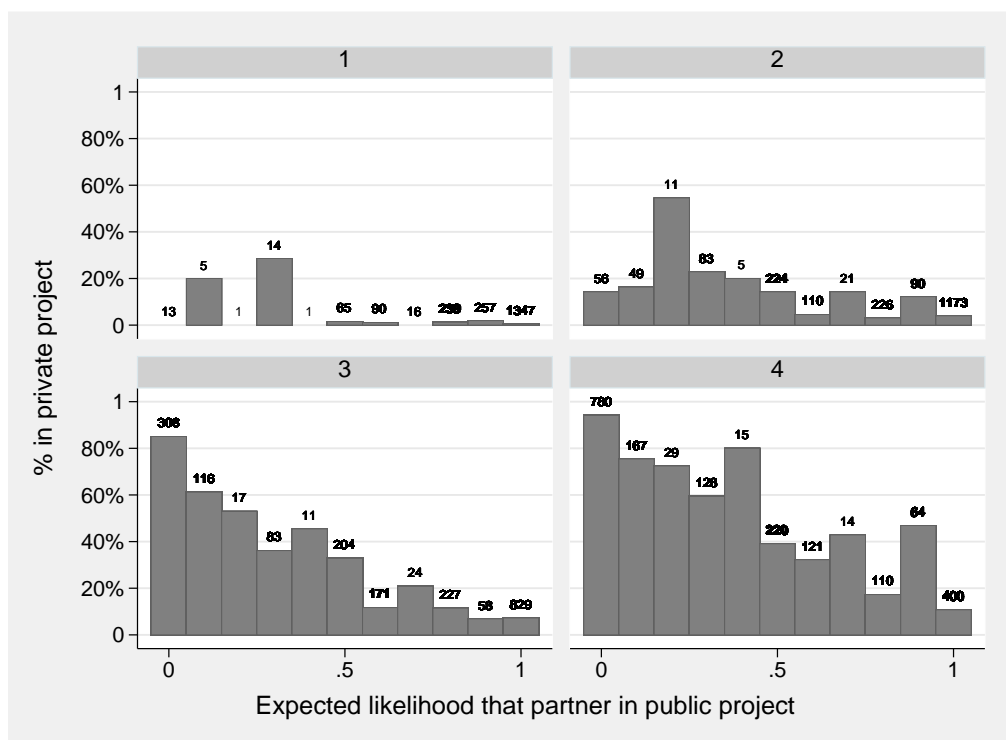


Figure F.2: Evolution of beliefs about partner choice of project as a function of failure or success last period in the common project.

The shape of the point represents the treatment the individual was in: circle=Treatment 0, lozenge=Treatment 1, square=Treatment 2, triangle=Treatment 3, cross=Treatment 4.

**G. Decision to exit as a function of expected decision of partner**

We consider all periods. Numbers on the horizontal axis denote  $d_{jt}^e$  is grouped in 10% unit intervals. On top of each bar is the number of periods in which subjects had beliefs in the corresponding interval. The height of each bar corresponds to the frequency, shown on the vertical axis, with which subjects with the corresponding beliefs were in an individual project.

Figure G.1: Choice of individual project as a function of expected decision of partner, by treatments.

## H. Steps in the estimation procedure

### H.1. Estimating expected effort

An issue given our belief elicitation mechanism is that we do not know  $ec_{jt}^e$  if at time  $t$  there was no common project ( $d_{it} = 0$  and/or  $d_{jt} = 0$ ). We therefore need to reconstruct  $ec_{jt}^e$  for those missing periods. Beliefs about the effort of the other in the common project will be assumed to follow a dynamic process for  $t > 1$ :

$$ec_{jt}^e = \alpha + \rho \times ec_{jt-1}^e + \beta \times sc_{it-1} + p \times P_i + c \times start_t + u_i + \epsilon_{it} \quad (\text{H.1})$$

with  $\rho < 1$ . Initial expectations  $ec_{j0}^e$  will be taken to be equal to the first elicited beliefs about effort of the other. Since subjects most often started out in a common project, this is usually beliefs in period 1. Beliefs evolve depending on whether the common project was successful last period ( $sc_{it-1} = 1$ ), unsuccessful ( $sc_{it-1} = -1$ ) or did not take place ( $sc_{it} = 0$ ). We expect that  $\beta$  will be positive (a success is a good signal about the effort of the other, assuming of course that success will not lead the other to decrease his effort next period). Expectations are carried over from phase to phase with possibly adjustments upwards or downwards with the start of a new phase ( $start_t$ ), which is reflected in parameters  $c$  in equation H.1. Expectations also depend on personal characteristics, including the value of the project to the other ( $v_i$  is a proxy for  $v_j$  as  $v_j = 40 - v_i$ ). Subjects ought to think that those with lower value for the project will contribute less, so the parameter on  $v_i$  should be negative.

Included in our regression are all observations for which  $ec_{jt}^e$  and  $ec_{jt-1}^e$  were observed, so our selection variable is  $selection_{it} = 1$  if  $d_{it} = d_{it-1} = 1$  and  $d_{jt} = d_{jt-1} = 1$ , 0 else. We assume selection depends on the following variables:

$$selection_{it} = 1[\alpha + \gamma \times d_{jt}^e + \delta \times sc_{it-1} + p \times P_i + c \times (phase_{mt}, per_t) + u_i + \epsilon_{it} > 0] \quad (\text{H.2})$$

with  $\epsilon_{it}$  distributed normally. Controls include  $P_i$ , a vector of personal characteristics, dummies  $phase_{mt}$  for the phase in which subjects are (second or third partnership) and a variable taking for value the period within the partnership.

We start with estimates of equation H.1 by restricting  $\rho$  to being equal to 1, which gets rid of issues with this auto-regressive term. The test for selection effect suggested in procedure 3.2 in Wooldridge (1995) is not significant (Inverse Mill Ratio (“IMR”) parameter, column 1 of Table J.1) but corrected estimates as per procedure 4.2 in Wooldridge (1995) show that the null of no selection bias is rejected at the 5% level as the  $IMR_t$ , obtained from estimating equation H.2 for each period separately across all individuals, are jointly significant (Wald test) (column 2 of Table J.1). Unlike Wooldridge (1995) we include the mean  $\bar{x}_i$  of time-varying variables  $x_{it}$  in the regressions along  $x_{it}$  rather than the full vector  $(x_{i1}, x_{i2}, \dots, x_{i32})$ . This is because there are too many periods for too few individuals to be able to estimate that many parameters reliably.

In a second step, we let  $\rho$  be a free parameter and apply a first difference instrumental variables estimator along procedure 3 in [Semykina and Wooldridge \(2013\)](#) (columns 3 and 4 of Table J.1). This consists in estimating equation H.1 in differences while correcting for sample selection in the same way as in [Wooldridge \(1995\)](#) and using  $ec_{jt-2}^e$  as an instrument for  $\Delta ec_{jt-1}^e$  as suggested in [Anderson and Hsiao \(1981\)](#). In that case, the selection variable is  $selection_{it} = 1$  if  $d_{it} = d_{it-1} = d_{it-2} = 1$  and  $d_{jt} = d_{jt-1} = d_{jt-2} = 1$ , 0 else, as we need to observe  $ec_{jt-2}^e$ , our instrument. The selection equation is as in equation H.2. We find here that the  $IMR_t$  are not jointly significant (Wald test).

Finally, we apply the NLS estimator as per procedure 1 in [Semykina and Wooldridge \(2013\)](#), whereby we estimate the following equation for  $t > 1$ :

$$\begin{aligned} ec_{jt}^e = & \rho^{t-1} \times ec_{j0}^e + \beta \times \sum_{j=1}^{t-1} \rho^{j-1} \times sc_{it-j} + \frac{1 - \rho^{t-1}}{1 - \rho} \times (\alpha + p \times P_i + \gamma \times ec_{j0}^e) + \dots \\ & \dots + c \times \sum_{j=1}^{t-1} \rho^{j-1} \times start_{t-j} + \varphi_t \times IMR_{it} + \epsilon_{it2} \end{aligned} \quad (H.3)$$

The selection variable is now  $selection_{it} = 1$  if  $d_{it} = 1$  and  $d_{jt} = 1$ , 0 else.  $IMR_{it}$  is the inverse Mills ratio obtained from estimating equation H.2 in period  $t$  for each individual  $i$ .

Results are shown in columns 5 and 6 of Table J.1. We find that the IMRs are jointly significant. We test the results for robustness by breaking down the regression by treatment (Table J.2). Results are consistent across treatments except that success last period in the common project does not appear to impact expected effort in treatment 4. We also ran the same regressions using dummies for different values of  $v$ . We still found no effect.

All standard errors are obtained through “panel bootstrap”, which “involves re-sampling cross-sectional units (and all time periods for each unit sampled) and using the bootstrap sample to approximate the distribution of the parameter vector” ([Semykina and Wooldridge, 2010](#)). Bootstrapping is “an alternative method for estimating the standard errors when the theoretical calculation is complicated” ([Guan, 2003](#)). Panel bootstrap obtains a consistent variance–covariance matrix of the estimators in the presence of heteroskedasticity and serial correlation for  $N \rightarrow \infty$  and  $T$  fixed.

## H.2. Estimates for the decision to take part in the public project

Based on the results of the estimation of  $ec_{jt}^e$  from equation H.3, we obtain reconstructed beliefs  $\hat{ec}_{jt}^e$ . We then use those reconstructed beliefs to estimate the following reduced form selection equation for  $treatment_i \geq 1$ :

$$\begin{aligned}
d_{it} = & 1[\alpha + \lambda \times (d_{jt}^e \times e\hat{c}_{jt}^e - x_l) + \pi \times sc_{it-1} + \dots \\
& \dots + \delta \times d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e) + \theta \times d_{jt}^e + \dots \\
& \dots + p \times P_i + c \times (phase_{mt}, per_t) + u_i + \epsilon_{it} > 0]
\end{aligned} \tag{H.4}$$

Since  $x_i$  is not defined for treatment 1, we set it equal to 0 for the purpose of this regression. Parameters in the decision equation can be estimated with a conditional fixed-effects logit model. According to equation B.3, the decision to exit in treatments 2, 3 and 4 depends on whether the cross term  $d_{jt}^e \times e\hat{c}_{jt}^e$  exceeds the subsidy to individual projects  $x_l$ . The probability to participate in the public project also depends on the expected participation decision of the other individual ( $d_{jt}^e$ ), on success or failure last period in the public project,  $sc_{it-1}$  and on variable  $d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e)$  which is the difference between one's effort and the effort one expected one's partner was exerting when both were in the common project last period. Expectations about effort were elicited in every period whether one was in the same project as one's partner or not, but we expect this variable to play a role only when both subjects participate in the common project.

Results are shown in Table J.3, first with a pooled OLS regression, as before with bootstrapped standard errors for the parameter estimates (column 1). There is significant auto-correlation in the idiosyncratic error of our model, so we specify AR(1) within-panel error correlation structure in a population-averaged model (column 2). The column 3 shows results for a fixed-effect model, and column 4 for a random-effects model. A Hausman test rejects the hypothesis that the individual-level effects are adequately modeled by a random-effects model. We also ran the same regressions using dummies for different values of  $v$ . We still found no effect.

Regressions by treatments are shown in Tables J.4, J.5 and J.6.

## I. Effort in the common project

Effort in the common project is assumed to evolve according to the following equation:

$$ec_{it} = \alpha + \sigma \times ec_{jt}^e + \phi \times sc_{it-1} + \tau \times (1 - d_{jt-1}) + p \times P_i + c \times (phase_{mt}, per_t) + u_i + \epsilon_{it} \tag{I.1}$$

so that effort depends on the expected effort of the other. Experiments on the public good game show that  $\sigma$  in this setting is positive – conditional cooperation –, but temptation to free-ride might be greater in an environment where the outcome is stochastic so the partner's effort is not observable. We consider also the direct effect of success in the previous period  $sc_{it-1}$ . Indeed, while a rational agent would vary his effort only as a function of his beliefs about the effort of their partner,



success (or failure) may also have a psychological effect, such that for example a subject may want to “compensate” failure in the previous period by increasing effort and *vice-versa*. We also include  $1 - d_{jt-1}$  to determine if one’s partner returning to the common project had a positive effect on effort levels within the common project, as ought to be the case if punishment by leaving the common project is meant to have an incentive effect rather than being a purely punitive action. The selection variable is  $selection_{it} = 1$  if  $d_{it} = 1$  and  $d_{jt} = 1$ , 0 else, as this determines whether  $ec_{it}$  is observed. We include all regressors of equation H.4 in the selection equation. Results for fixed effect panel regressions are shown in Table J.7. The test for selection effect suggested in procedure 3.2 in Wooldridge (1995) is not significant at the 5% level (Inverse Mill Ratio (“IMR”) parameter). Corrected estimates as per procedure 4.2 in Wooldridge (1995) are very similar. Using dummies for different values of  $v$  rather than using  $v$  as a regressor does not impact the result.

## J. Regressions

Table J.1: Table of regression results for  $ec_{jt}^e$ 

<i>dependent variable</i>	1. FE TEST selection effect $ec_{jt}^e$	2. POOLED OLS w/ selection correction $ec_{jt}^e$	3. FD-IV w/o selection correction $ec_{jt}^e$	4. FD-IV w/ selection correction $ec_{jt}^e$	5. NLS w/o selection correction $ec_{jt}^e$	6. NLS w/ selection correction $ec_{jt}^e$
$ec_{jt-1}^e$	1	1	0.2664*** (5.54)	0.2601*** (4.69)	0.8098*** (28.34)	0.8099*** (28.26)
$sc_{it-1}$	0.2315*** (6.43)	0.2276*** (6.18)	0.1501*** (4.94)	0.1744*** (5.26)	0.3534*** (8.91)	0.3712*** (8.14)
$start_t$	0.1907* (2.39)	0.2324* (2.20)	0.1873* (2.44)	0.2559** (3.21)	0.1200 (1.56)	0.0369 (0.44)
$v$		0.0011 (0.41)			0.0121 (1.51)	0.0123 (1.55)
<i>treatment 1</i>		-0.0080 (-0.44)			0.0657 (1.15)	0.0617 (1.14)
<i>treatment 2</i>		-0.0497+ (-1.89)			-0.0041 (-0.08)	-0.0234 (-0.42)
<i>treatment 3</i>		-0.0211 (-0.65)			0.0639 (0.96)	0.0245 (0.35)
<i>treatment 4</i>		0.0157 (0.24)			0.1737* (2.31)	0.1002 (1.32)
<i>female</i>		-0.0019 (-0.13)			-0.0416 (-0.95)	-0.0481 (-1.06)
<i>age</i>		-0.0016 (-0.95)			-0.0039 (-1.02)	-0.0042 (-0.98)
<i>economist</i>		0.0228 (0.85)			-0.0255 (-0.38)	-0.0260 (-0.40)
<i>ra</i>		-0.0008 (-0.16)			0.0032 (0.20)	0.0037 (0.24)
<i>su</i>		-0.0021 (-0.76)			0.0005 (0.06)	0.0002 (0.02)
<i>svo</i>		0.0092 (0.28)			0.0275 (0.35)	0.0334 (0.37)
<i>trustful</i>		-0.0042 (-0.67)			-0.0313+ (-1.74)	-0.0318+ (-1.72)
$ec_{j0}^e$					0.0723*** (3.87)	0.0719*** (4.25)
<i>constant</i>		-0.1512 (-1.51)			0.3269 (1.45)	0.3362 (1.58)
<i>IMR</i>	0.1440					
$\chi^2(IMR_t)$		46*		31		54**
<i>N</i>	6962	6962	6513	6495	7353	7353
<i>Subjects</i>	281	281	275	274	294	294
<i>df</i>	3	47	3	32	17	48
<i>Wald test <math>\chi^2</math></i>	45***	125***	42***	78***	87152***	131850***

z statistics in parentheses, bootstrapped standard errors, 200 replications.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table J.2: Table of regression results for  $ec_{jt}^e$ , NLS by treatments

<i>dep. variable</i>	NLS w/ SELECTION CORRECTION				
	TREATMENT 0 $ec_{jt}^e$	TREATMENT 1 $ec_{jt}^e$	TREATMENT 2 $ec_{jt}^e$	TREATMENT 3 $ec_{jt}^e$	TREATMENT 4 $ec_{jt}^e$
$ec_{jt-1}^e$	0.8068*** (21.78)	0.8137*** (5.41)	0.7779*** (10.19)	0.7715*** (6.04)	0.6756*** (4.79)
$sc_{it-1}$	0.4818*** (6.62)	0.2472** (2.84)	0.5274*** (4.44)	0.2866** (3.07)	0.1126 (1.28)
$start_t$	0.0307 (0.26)	0.0677 (0.46)	0.1042 (0.51)	-0.0185 (-0.10)	0.1523 (0.38)
$v$	-0.0035 (-0.25)	0.0276 (0.70)	0.0156 (0.70)	0.0212 (0.63)	-0.0131 (-0.39)
<i>female</i>	-0.0439 (-0.57)	-0.2089 (-1.00)	-0.0328 (-0.25)	0.0396 (0.25)	0.1287 (0.68)
<i>age</i>	-0.0171 (-1.32)	0.0003 (0.03)	-0.0028 (-0.21)	-0.0075 (-0.39)	0.0074 (0.26)
<i>economist</i>	0.1832+ (1.76)	-0.2958 (-1.07)	-0.2084 (-1.24)	0.2204 (0.87)	0.1571 (0.49)
<i>ra</i>	-0.0262 (-0.63)	0.0284 (0.55)	0.0093 (0.20)	0.0280 (0.56)	-0.1309+ (-1.65)
<i>su</i>	-0.0083 (-0.41)	-0.0013 (-0.05)	0.0107 (0.31)	0.0256 (0.68)	-0.0211 (-0.46)
<i>svo</i>	-0.1108 (-0.57)	0.2171 (0.97)	-0.1346 (-0.55)	0.0440 (0.13)	-0.1066 (-0.25)
<i>trustful</i>	-0.0414 (-1.12)	0.0064 (0.15)	-0.0192 (-0.32)	-0.0806 (-1.34)	-0.0561 (-0.73)
$ec_{j0}^e$	0.0373 (1.14)	0.0891 (0.89)	0.1024* (2.29)	0.0827 (1.18)	0.1912+ (1.80)
<i>constant</i>	1.3921* (2.44)	-0.1873 (-0.25)	0.1064 (0.19)	0.1470 (0.17)	1.7710 (1.49)
$\chi^2(IMR_t)$	.	11.83	44.02+	43.03+	37.85
<i>N</i>	1860	1942	1722	1251	578
<i>Subjects</i>	60	64	64	59	47
<i>df</i>	13	44	44	44	44
<i>Wald test</i> $\chi^2$	32878***	34345***	22575***	21578***	17206***

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table J.3: Determinants of the decision to take part in the public project, marginal effects

<i>dependent variable</i>	(1) POOLED $\partial d/\partial x$	(2) PA $\partial d/\partial x$	(3) FE $d$ (see note 1)	(4) RE $\partial d/\partial x$ (see note 2)
$d_{jt}^e$	0.1009 (1.55)	0.0247 (0.45)	0.1039 (0.08)	0.0546 (1.09)
$d_{jt}^e \times ec_{jt}^e - x_l$	0.0327** (3.07)	0.0416*** (4.43)	0.8271*** (3.63)	0.0358*** (3.94)
$sc_{it-1}$	0.0436*** (7.11)	0.0285*** (4.76)	0.5510*** (5.30)	0.0317*** (5.66)
$d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e)$	-0.0116*** (-3.38)	-0.0107*** (-3.30)	-0.1587*** (-3.40)	-0.0085*** (-3.61)
<i>per</i>	-0.0047*** (-4.13)	-0.0062*** (-4.66)	-0.0969*** (-4.61)	-0.0051*** (-5.23)
<i>phase 2</i>	0.0045 (0.38)	0.0149 (1.14)	0.1722 (0.83)	0.0095 (0.80)
<i>phase 3</i>	-0.0019 (-0.17)	0.0080 (0.65)	0.1147 (0.51)	0.0041 (0.37)
<i>v</i>	-0.0031 (-0.89)	-0.0036 (-1.07)	.	-0.0026 (-0.96)
<i>treatment 2</i>	-0.1088* (-2.46)	-0.1128* (-2.49)	.	-0.0601+ (-1.81)
<i>treatment 3</i>	-0.1213** (-2.99)	-0.1264** (-3.13)	.	-0.0777* (-2.37)
<i>treatment 4</i>	-0.0953+ (-1.76)	-0.0866+ (-1.67)	.	-0.0578 (-1.38)
<i>female</i>	-0.0198 (-0.88)	-0.0214 (-0.94)	.	-0.0297 (-1.63)
<i>age</i>	0.0004 (0.19)	0.0004 (0.15)	.	0.0004 (0.24)
<i>economist</i>	0.0026 (0.10)	0.0070 (0.26)	.	-0.0007 (-0.03)
<i>ra</i>	-0.0024 (-0.26)	-0.0026 (-0.30)	.	-0.0031 (-0.46)
<i>su</i>	-0.0074+ (-1.67)	-0.0079+ (-1.81)	.	-0.0069 (-1.54)
<i>svo</i>	-0.0274 (-0.62)	-0.0324 (-0.80)	.	-0.0159 (-0.39)
<i>trust</i>	-0.0022 (-0.37)	-0.0011 (-0.17)	.	-0.0020 (-0.34)
<i>N</i>	7254	7254	3999	7254
<i>Subjects</i>	234	234	129	234
<i>ll</i>	-1783.5		-985.0	-1421.6
<i>df</i>	18	18	7	18
<i>Wald test <math>\chi^2</math></i>	487.5***	321.2***	337.3***	441.2***
<i>Lagrange multiplier test</i>	3.18	3.21	0.63	1.69
$Pr(\hat{d} = 1 \mid d = 1)$	95.9%	96.3%	81.8%	96.3%
$Pr(\hat{d} = 0 \mid d = 0)$	64.9%	61.8%	75.6%	62.1%

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Marginal effects are obtained by the delta method.  $\partial d/\partial x$  for factor levels is the discrete change from the base level.<sup>1</sup>In FE, we report parameter estimates for the logit model. FE regressions exclude 105 subjects who chose  $d_{it} = 1$  for every period  $t > 1$ .<sup>2</sup>In RE, marginal effects are computed assuming that individual effects  $u_i$  are equal to 0. The Lagrange multiplier test is obtained by doing a Wald test of zero coefficient for the added regressor  $(x' \hat{\beta})^2$ .

Table J.4: Determinants of the decision to take part in the public project, population-averaged regressions, marginal effects, by treatment.

<i>Dependent variable</i>	(1) TREATMENT 1 $\partial d/\partial x$	(2) TREATMENT 2 $\partial d/\partial x$	(3) TREATMENT 3 $\partial d/\partial x$	(4) TREATMENT 4 $\partial d/\partial x$
$d_{jt}^e$	0.0040 (0.13)	0.1068 (0.94)	-0.0320 (-0.18)	-0.2488 (-0.94)
$d_{jt}^e \times e\hat{c}_{jt}^e - x_l$	0.0049 (1.00)	0.0059 (0.31)	0.0758* (2.40)	0.1272** (2.68)
$sc_{it-1}$	0.0046 (0.87)	0.0280+ (1.81)	0.0442** (2.65)	0.0412+ (1.91)
$d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e)$	-0.0008 (-0.52)	-0.0094 (-1.63)	-0.0173* (-2.01)	-0.0227** (-2.66)
<i>per</i>	-0.0008 (-0.71)	-0.0006 (-0.32)	-0.0079* (-2.43)	-0.0207*** (-4.72)
<i>phase 2</i>	0.0077 (0.84)	0.0289+ (1.80)	-0.0192 (-0.58)	0.0568 (1.26)
<i>phase 3</i>	0.0045 (0.47)	0.0479+ (1.84)	0.0071 (0.21)	-0.0386 (-0.81)
<i>v</i>	0.0018 (0.61)	-0.0045 (-0.61)	-0.0146 (-1.42)	-0.0030 (-0.22)
<i>female</i>	0.0020 (0.11)	-0.0278 (-0.35)	-0.0551 (-0.98)	0.0100 (0.14)
<i>age</i>	0.0019 (0.47)	0.0062 (0.55)	-0.0064 (-0.54)	0.0031 (0.28)
<i>economist</i>	-0.0001 (-0.01)	-0.0013 (-0.01)	-0.0109 (-0.14)	0.0363 (0.35)
<i>ra</i>	-0.0022 (-0.22)	0.0015 (0.09)	0.0061 (0.32)	-0.0151 (-0.37)
<i>su</i>	0.0014 (0.28)	-0.0101 (-1.01)	-0.0142 (-1.07)	-0.0031 (-0.15)
<i>svo</i>	0.0037 (0.17)	-0.0469 (-0.44)	0.0465 (0.41)	-0.1351 (-0.86)
<i>trust</i>	-0.0013 (-0.31)	-0.0121 (-0.63)	0.0114 (0.71)	-0.0216 (-0.65)
<i>N</i>	1984	1984	1829	1457
<i>Subjects</i>	64	64	59	47
<i>df</i>	15	15	15	15
<i>Wald test <math>\chi^2</math></i>	22.55+	43.33***	66.00***	68.55***
<i>Lagrange multiplier test</i>	0.87	6.66**	0.0	0.52
$Pr(\hat{d} = 1 \mid d = 1)$	100.0%	99.9%	94.2%	81.0%
$Pr(\hat{d} = 0 \mid d = 0)$	0.0%	2.8%	62.5%	79.3%

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

Marginal effects are obtained by the delta method.  $\partial d/\partial x$  for factor levels is the discrete change from the base level.

The Lagrange multiplier test is obtained by doing a Wald test of zero coefficient for the added regressor  $(x'\hat{\beta})^2$ .

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table J.5: Determinants of the decision to take part in the public project, population-averaged regressions, by treatment.

<i>Dependent variable</i>	(1) TREATMENT 1 <i>d</i>	(2) TREATMENT 2 <i>d</i>	(3) TREATMENT 3 <i>d</i>	(4) TREATMENT 4 <i>d</i>
$d_{jt}^e$	0.3964 (0.13)	1.7871 (1.09)	-0.2949 (-0.18)	-1.6123 (-0.93)
$d_{jt}^e \times e_{jt}^e - x_l$	0.4939 (1.08)	0.0985 (0.29)	0.6992* (2.33)	0.8246* (2.44)
$sc_{it-1}$	0.4581+ (1.71)	0.4685** (3.21)	0.4078* (2.53)	0.2667+ (1.77)
$d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e)$	-0.0786 (-0.71)	-0.1575* (-2.18)	-0.1599+ (-1.88)	-0.1472* (-2.48)
<i>per</i>	-0.0782 (-1.00)	-0.0107 (-0.33)	-0.0727* (-2.56)	-0.1341*** (-4.60)
<i>phase 2</i>	0.7738 (1.07)	0.4837+ (1.94)	-0.1772 (-0.57)	0.3679 (1.35)
<i>phase 3</i>	0.4458 (0.45)	0.8006+ (1.81)	0.0653 (0.22)	-0.2502 (-0.79)
<i>v</i>	0.1830 (0.58)	-0.0760 (-0.57)	-0.1345 (-1.46)	-0.0195 (-0.22)
<i>female</i>	0.1996 (0.11)	-0.4646 (-0.32)	-0.5077 (-0.97)	0.0649 (0.14)
<i>age</i>	0.1929 (0.43)	0.1041 (0.61)	-0.0592 (-0.53)	0.0200 (0.28)
<i>economist</i>	-0.0135 (-0.01)	-0.0224 (-0.01)	-0.1001 (-0.15)	0.2355 (0.35)
<i>ra</i>	-0.2218 (-0.20)	0.0245 (0.08)	0.0559 (0.32)	-0.0981 (-0.37)
<i>su</i>	0.1385 (0.26)	-0.1697 (-1.07)	-0.1310 (-1.01)	-0.0203 (-0.15)
<i>svo</i>	0.3701 (0.17)	-0.7852 (-0.40)	0.4285 (0.41)	-0.8757 (-0.86)
<i>trust</i>	-0.1315 (-0.30)	-0.2020 (-0.69)	0.1048 (0.69)	-0.1402 (-0.65)
<i>constant</i>	-5.9209 (-0.77)	0.7646 (0.15)	5.7367+ (1.66)	3.6692 (1.20)
<i>N</i>	1984	1984	1829	1457
<i>Subjects</i>	64	64	59	47
<i>df</i>	15	15	15	15
<i>Wald test <math>\chi^2</math></i>	22.55+	43.33***	66.00***	68.55***
<i>Lagrange multiplier test</i>	0.87	6.66**	0.0	0.52
$Pr(\hat{d} = 1 \mid d = 1)$	100.0%	99.9%	94.2%	81.0%
$Pr(\hat{d} = 0 \mid d = 0)$	0.0%	2.8%	62.5%	79.3%

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

The Lagrange multiplier test is obtained by doing a Wald test of zero coefficient for the added regressor  $(x' \hat{\beta})^2$ .

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table J.6: Determinants of the decision to take part in the public project, fixed effect regressions, by treatment.

<i>Dependent variable</i>	(1) TREATMENT 1 <i>d</i>	(2) TREATMENT 2 <i>d</i>	(3) TREATMENT 3 <i>d</i>	(4) TREATMENT 4 <i>d</i>
$d_{jt}^e$	-7.5519 (-1.40)	-0.1535 (-0.10)	0.3924 (0.17)	-3.5034 (-1.43)
$d_{jt}^e \times e_{jt}^e - x_l$	1.9238+ (1.79)	0.7996* (2.10)	0.7770+ (1.70)	1.4792** (3.14)
$sc_{it-1}$	0.1676 (0.50)	0.4310* (2.37)	0.7556*** (3.68)	0.4380* (2.07)
$d_{it-1} \times d_{jt-1} \times (e_{it-1} - e_{jt-1}^e)$	-0.0735 (-0.67)	-0.1835* (-2.10)	-0.3052* (-2.27)	-0.1495 (-1.64)
<i>per</i>	-0.0545 (-0.65)	-0.0179 (-0.35)	-0.1027* (-2.56)	-0.1349*** (-3.42)
<i>phase 2</i>	0.7062 (0.68)	0.9703* (2.17)	-0.4861 (-1.05)	0.3252 (0.96)
<i>phase 3</i>	1.0916 (0.99)	1.5810* (2.45)	-0.0326 (-0.08)	-0.4172 (-1.13)
<i>N</i>	434	899	1271	1395
<i>Subjects</i>	14	29	41	45
<i>df</i>	7	7	7	7
<i>Wald test <math>\chi^2</math></i>	13.43+	49.99***	61.38***	114.99***
<i>Lagrange multiplier test</i>	0.11	0.08	3.85*	0.71

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

The Lagrange multiplier test is obtained by doing a Wald test of zero coefficient for the added regressor  $(x' \hat{\beta})^2$ .

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$



Table J.7: Tables of regression results for effort in common projects, fixed effect, with test for selection effect

<i>Dependent var.</i>	1. ALL <i>ec<sub>it</sub></i>	2. TREATMENT 0 <i>ec<sub>it</sub></i>	3. TREATMENT 1 <i>ec<sub>it</sub></i>	4. TREATMENT 2 <i>ec<sub>it</sub></i>	5. TREATMENT 3 <i>ec<sub>it</sub></i>	6. TREATMENT 4 <i>ec<sub>it</sub></i>
<i>ec<sub>jt</sub><sup>e</sup></i>	0.1433** (2.88)	0.2009** (2.95)	-0.0178 (-0.17)	0.2509* (2.54)	0.1113 (1.64)	0.0309 (0.35)
<i>sc<sub>it-1</sub></i>	-0.0482 (-1.41)	-0.0435 (-0.68)	-0.0253 (-0.38)	-0.0732 (-1.57)	-0.0826* (-2.13)	-0.0682 (-1.16)
$1 - d_{jt-1}$	0.0197 (0.17)	. (0.00)	-0.6218 (-1.55)	-0.0363 (-0.17)	0.3291+ (1.67)	-0.0059 (-0.04)
<i>per</i>	-0.0248** (-3.18)	-0.0267 (-1.46)	-0.0311* (-2.14)	-0.0232 (-1.51)	-0.0137 (-1.44)	-0.0203 (-1.44)
<i>phase 2</i>	-0.1345 (-1.58)	-0.0570 (-0.38)	-0.1828 (-1.05)	-0.2609 (-1.55)	-0.1348 (-0.79)	0.2836 (1.39)
<i>phase 3</i>	-0.1815+ (-1.79)	-0.1689 (-0.91)	-0.3064 (-1.51)	-0.2158 (-1.10)	-0.0278 (-0.14)	-0.0131 (-0.06)
<i>IMR</i>	0.1852+ (1.73)	. (0.00)	0.8133+ (1.71)	0.1855 (0.88)	0.0950 (0.48)	0.0679 (0.56)
<i>constant</i>	4.8122*** (16.76)	4.4802*** (9.03)	5.8796*** (10.38)	4.0996*** (7.07)	4.8634*** (8.78)	5.5693*** (10.62)
<i>N</i>	7353	1860	1942	1722	1251	578
<i>Subjects</i>	294	60	64	64	59	47
<i>df</i>	7	5	7	7	7	7
<i>Wald test</i> $\chi^2$	29.25***	15.19**	12.22+	22.18**	16.30+	6.70

*z* statistics in parentheses, bootstrapped standard errors, 200 replications.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

### **K. Instructions for treatment 3, asymmetric payoffs, payoff=24**

Welcome and thank you for your participation! You can earn money in this experiment, how much depends on your decisions and on the decisions of the other participants. It is therefore very important that you read these instructions thoroughly and completely.

Please note that you are not allowed to talk with other participants during the entire experiment. If you have a question, please raise your hand and we will then come to you and answer your question. We ask that you do not express your question(s) aloud before we come to you, and that you ask your question in a low voice so others cannot hear you. We will have to exclude you from the experiment if you violate these rules.

PLEASE ENSURE THAT YOUR MOBILE PHONE IS TURNED OFF NOW!

#### **General procedure**

1. The experiment lasts about 110 minutes.
2. There will be three rounds in which you will keep performing the same tasks for a given number of periods.
3. In each of the 3 rounds you will be paired with a different participant in this session (your pair). This person will not have been paired with you or with anyone you were paired with in previous rounds.
4. Each round is divided into periods. The number of periods in each round is determined by a random process, so that the round ends with probability 5% after each period.
5. One period will be selected randomly at the end of the experiment and will determine your earnings. Your earnings will be calculated in ECU (Experimental Currency Units). 1 ECU corresponds to 0.50€. At the end of today's session, your ECU earnings will be converted into euros and will be paid to you in cash.
6. You will receive 10 ECU (equivalent to 5€) for participating. If you make losses in this experiment, those will be deducted from this payment. However, your total earnings are guaranteed never to be negative.
7. You will be asked to fill out a questionnaire before you receive your payment.
8. You will also be asked to take a few additional decisions unrelated to the main part of the experiment, for which you will be paid.

#### **Procedure in each period**

In each period you must make the decision whether to participate in project K or in project G1. Your pair is facing a choice as well whether to participate in project K or in project G2. These projects will be described in the following pages. After this

decision, you and your pair determine how much you wish to invest in the project you selected.

*Suppose you participate in project K and your pair participates in Project K as well:*

If both you and your pair participate in Project K, then the probability of success of project K depends both on the investment of your pair as well as on your investment. You and your pair may invest any sum between 0 and 10 ECU each. The probability the project is successful increases with the sum of your investments according to the following formula:

$$\text{Probability of success} = \sqrt{(\text{your investment} + \text{investment of your pair})} / \sqrt{22}$$

The resulting probabilities can be seen in the table below (investments are shown only for whole numbers in the table, but you can choose investments between whole numbers). For a given investment by yourself (in columns), you can see how the likelihood of success for the project varies as a function of your pair's investment (in rows).

		Your investment											
		0	1	2	3	4	5	6	7	8	9	10	
Investment of your pair	0	0%	21%	30%	37%	43%	48%	52%	56%	60%	64%	67%	
	1	21%	30%	37%	43%	48%	52%	56%	60%	64%	67%	71%	
	2	30%	37%	43%	48%	52%	56%	60%	64%	67%	71%	74%	
	3	37%	43%	48%	52%	56%	60%	64%	67%	71%	74%	77%	
	4	43%	48%	52%	56%	60%	64%	67%	71%	74%	77%	80%	
	5	48%	52%	56%	60%	64%	67%	71%	74%	77%	80%	83%	
	6	52%	56%	60%	64%	67%	71%	74%	77%	80%	83%	85%	
	7	56%	60%	64%	67%	71%	74%	77%	80%	83%	85%	88%	
	8	60%	64%	67%	71%	74%	77%	80%	83%	85%	88%	90%	
	9	64%	67%	71%	74%	77%	80%	83%	85%	88%	90%	93%	
	10	67%	71%	74%	77%	80%	83%	85%	88%	90%	93%	95%	

Each row correspond to a given investment by your pair, each column corresponds to a given investment by yourself. The probability of success of the project for a given combination of investment by you and your pair is shown at the intersection of the corresponding row and column.

Your payment is calculated as follows:

- If project K is successful, then you receive 24 ECU and have to pay your investment. If project K is NOT successful, then you get 0 ECU and still have to pay your investment.
- If project K is successful, then you pair receives 16 ECU and has to pay their investment. If project K is NOT successful, then your pair gets 0 ECU and still has to pay their investment.

Note that your payment in case of success is different from that for your pair!

*Suppose you participate in project K and your pair participates in Project G2:*

If you participate in project K and your pair participates in project G2, then the probability of success of project K depends only on your investment. You can invest any amount between 0 and 10 ECU.

The probability of success of project K increases with your investment as per the following formula:

$$\text{Probability of success} = \sqrt{\text{your investment}} / \sqrt{22}$$

The resulting probabilities can be seen in the table below:

Your investment										
0	1	2	3	4	5	6	7	8	9	10
0%	21%	30%	37%	43%	48%	52%	56%	60%	64%	67%

The column headings in the table above refers to your investment, the percentages refer to the corresponding probability of success for the project.

Your payment is calculated as follows:

- In case of a success of project K, you receive 24 ECU minus your investment. Otherwise you get 0 ECU and still have to pay your investment.
- In case of a success of project G2, your pair receives 16 ECU minus their investment. Otherwise, your pair gets nothing and still has to pay their investment. Project G2 has the same characteristics as project G1, except your pair receives 16 ECU in case of success and project G2 can only be chosen by your pair. In the same way, your pair cannot choose project G1. Your payment is independent of the success of project G2.

*Suppose you participate in project G1:*

If you chose project G1, then the success of project G1 depends only on your investment. You can invest any amount between 0 and 10 ECU. The probability of success of project G1 increases with your investment as per the following formula:

$$\text{Probability of success} = \sqrt{\text{your investment}+2} / \sqrt{22}$$

The resulting probabilities can be seen in the table below:

Your investment										
0	1	2	3	4	5	6	7	8	9	10
30%	37%	43%	48%	52%	56%	60%	64%	67%	71%	74%

The column headings in the table above refers to your investment, the percentages refer to the corresponding probabilities of success for the project.

Your payment is calculated as follows:

- If project G1 is successful, you receive 24 ECU minus your investment, otherwise you get nothing and still have to pay your investment.
- The payment for your pair is independent of the success of project G1. It only depends on the success of the project selected by your pair in this period and on his investment in that project.

### **Overview of the choices to make**

In each period you have to:

- Choose either project K or project G1.
- Then choose how much you want to invest (between 0 ECU and 10 ECU) to the project you selected.

In each period you will be asked:

- How likely it is that your pair chooses project G2. If you guess your pair's decision exactly you receive 5 ECU extra. If your guess is off by  $x\%$  you get  $5-(x/10)$  ECU. If your guess is off by more than 50% then you get nothing from your guess.
- What investment you expect your pair to make in their selected project. If you guess the exact amount invested by your pair, you receive 5 ECU extra. If your guess is off by  $x$  ECU then you get  $5-x$  ECU. If your guess is off by more than 5 ECU then you get nothing from your guess.

Only one of the guesses (choice of project or investment) will be used to determine your earnings.

### **Earnings**

Your earnings will be the sum of

1. 10 ECU for participating,
2. PLUS 24 ECU or 0 ECU depending on if your chosen project in the period chosen for payment was successful or not,
3. MINUS your investment in your chosen project in the period chosen for payment,
4. PLUS a payment up to 5 ECU for your guess in either the choice of project or the investment of your pair in their chosen project in the period chosen for payment.
5. PLUS a payment for a few additional decisions unrelated to the main part of the experiment.

*Notes*

- You can invest any numbers of ECU between 0 and 10 ECU with a precision up to the second decimal place. You will be given the opportunity to calculate the resulting probabilities of success for your chosen project on your computer.
- You will be provided with information about your project choices and the choices of your pair, and whether your chosen project was successful, for each past period in a given round.
- Reminder: Your payment for a given period is the value of the project you selected in that period (either 24 ECU in case of success or 0 ECU in case of failure) MINUS your investment in that project.

## L. Additional tasks and questionnaire

### L.1. Aversion to risk and strategic uncertainty

The two following tasks are taken from [Heinemann et al. \(2009\)](#). In the risk task, subjects were presented with ten lottery comparisons, whereby lottery A offered a safe payoff ranging from 1 to 10 ECU and lottery B offered 0 ECU with probability half and 10 ECU with probability half. Measure  $ra$  of risk aversion is the number of times the subjects chose the safe payoff (lottery A), rather than lottery B. This does not impose the restriction that if A was chosen when it gave  $x$  ECU then it ought to be chosen when it gives any safe payoff  $y > x$ . Imposing such a restriction would make the choices expressed by 28 participants invalid.

In the strategic uncertainty task, subjects were put in groups of four and presented with ten lottery comparisons, whereby lottery A offered a safe payoff ranging from 1 to 10 ECU and lottery B offered 0 ECU if less than 3 group members chose lottery B as well in that choice instance, and 10 ECU if 3 or all group members chose lottery B in that choice instance. Measure  $su$  of risk aversion is the number of times the subjects chose the safe payoff (lottery A), rather than lottery B. Imposing the restriction that if A was chosen when it gave  $x$  ECU then it ought to be chosen when it gives any safe payoff  $y > x$  would make the choices expressed by 21 participants invalid.

### L.2. Social value orientation

Subjects were asked to allocate payoff between themselves and another participants in the session, while they did not know what role (Decider or Recipient) they would be assigned to. There were 6 vectors of allocations to choose from, each with 9 elements, whereby subjects were asked, for each vector, which of the 9 possible allocation they preferred. Vectors are shown in Table L.1.

		1	2	3	4	5	6	7	8	9
1	Payoff for me	5.0	5.4	5.9	6.3	6.8	7.2	7.6	8.1	8.5
	Payoff for other	10.0	8.9	7.9	6.8	5.8	4.7	3.6	2.6	1.5
2	Payoff for me	8.5	8.7	8.9	9.1	9.3	9.4	9.6	9.8	10.0
	Payoff for other	1.5	1.9	2.4	2.8	3.3	3.7	4.1	4.6	5.0
3	Payoff for me	5.0	5.4	5.9	6.3	6.8	7.2	7.6	8.1	8.5
	Payoff for other	10.0	9.8	9.6	9.4	9.3	9.1	8.9	8.7	8.5
4	Payoff for me	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
	Payoff for other	8.5	7.6	6.8	5.9	5.0	4.1	3.3	2.4	1.5
5	Payoff for me	10.0	9.4	8.8	8.1	7.5	6.9	6.3	5.6	5.0
	Payoff for other	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	10.0
6	Payoff for me	10.0	9.8	9.6	9.4	9.3	9.1	8.9	8.7	8.5
	Payoff for other	5.0	5.4	5.9	6.3	6.8	7.2	7.6	8.1	8.5

Table L.1: Allocation vectors



Choices made by the subjects were summarized in one measure as per [Murphy et al. \(2011\)](#) with

$$svo = \arctan\left(\frac{\text{mean}(\text{payoff for other}-5)}{\text{mean}(\text{payoff for me}-5)}\right) \quad (\text{L.1})$$

Higher *svo* indicates higher concern for others, up to perfect altruism (maximization of the payoff of the other). Lower *svo* indicates less altruistic behavior, up to perfectly competitive behavior (maximizing the difference between one's payoff and the one by the other). *svo* may take values between -0.28 and 1.07 given the range of choices provided.

### *L.3. Questionnaires on trustfulness*

The following questions are taken from the fairness, trust and helpfulness questions in the General Social Survey of the National Opinion Research Center at the University of Chicago.

1. Do you agree with the following three statements:
  - (a) In general, one can trust people.
  - (b) Nowadays, one can't rely on anybody.
  - (c) When dealing with strangers, it's better to be cautious before trusting them.

The possible answers on a four point rating scale are "disagree strongly", "disagree somewhat", "agree somewhat", or "agree strongly".
2. Would you say that most people...
  - (a) would try to take advantage of you if given the opportunity...
  - (b) or would try to be fair to you?
3. Would you say that most people...
  - (a) try to be helpful...
  - (b) or follow only their own interests?

We computed an index of trustfulness from the answer to those questions, using a single-factor measurement model whereby answers to questions 1a, 1b and 1c are modeled as ordered logit and answers to questions 2 and 3 are modeled as logit. The index ranged from -3.49 (least trustful) to 3.63 (most trustful).