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# When in Rome: conformity and the provision of public goods

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## Abstract

We ask whether conformity, copying the most observed behavior in a population, affects free riding. Our model suggests that, if sufficiently frequent at the start of a public goods game, conformity will increase the growth rate of free riding. We confirm this prediction in an experiment by showing that free riding grows faster when players have the information necessary to conform. As a stricter test, we econometrically estimate the dynamic on which the model is based and find that, controlling for the payoff incentive to free ride, players react significantly to the number of free riders in their groups.

*JEL classification:* C72; C92; H41

*Keywords:* Conformity; Public good; Social dilemma; Experiment; Replicator dynamic

## 1. Introduction

According to psychologists, *conformity*—the tendency to copy the most prevalent behavior in a population—is a particularly strong and robust predictor of human behavior (see the reviews of Moscovici, 1985; Cialdini and Trost, 1998). However, conformity is rarely accounted for in economic models of behavior which focus, mostly, on the pursuit of material well-being.[1] Obviously, the situations where conformity might improve economic predictions are limited to scenarios where behavior is public and people can observe what others do. However, isolating economically important situations where conformity may

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[1] Interesting exceptions include Bowles (1998) on the endogenous formation of preferences and Anderson and Holt (1997) on information cascades. Other exceptions include Akerlof (1997), Bernheim (1994), and Jones (1984).

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play a role is not as simple as identifying situations in which decisions are made publicly because we must also consider why people conform.

Traditionally, there are two reasons that people conform: (1) to avoid sanctions for deviating from norms, and (2) to take advantage of the information acquired and processed by others (Deutsch and Gerard, 1955).[2] Previous research suggests that when economic decisions generate externalities that either benefit or harm other people (i.e. social dilemmas), those who are affected are adept at figuring out the actions of others and at sanctioning those who make decisions that violate widely-held norms of cooperation.[3] In these situations people conform to evolved conventions to avoid being sanctioned.

People may also conform when they lack information about what the most beneficial action to take is or when they think they lack important information. In this case conformity is based on the perceived benefit of imitation. When presented with a new environment, the simple heuristic of copy the most prevalent behavior often pays off because copiers minimize the cognitive costs of gathering and analyzing information, while they benefit from the lessons learned by others (Tversky and Kahneman, 1974; Cialdini, 1993).

One economically important situation in which people might feel they lack important information and/or fear sanctions for making inappropriate decisions is the provision of a public good. While the incentives involved in the provision of public goods (see Bergstrom et al., 1986) appear straight-forward and assure that people will collectively contribute less that what would be socially optimal, to naïve decision makers it might not be obvious what the payoff maximizing contribution level is. For example, the fact that average contributions in many treatments of the linear public goods games start between 40 and 60% of the endowment (Ledyard, 1995) and the modal contribution in the first round is typically half the endowment is consistent with the hypothesis that participants are initially uncertain about what to do and simply try half-half to see what happens. Further, as demonstrated in Carpenter and Matthews (2002), Gintis (2000), and Sethi (1996), public goods games provide an environment in which the sanctioning of norm violators can and does evolve both in the lab and theoretically.

While the conforming effect of sanctions has been studied extensively and the role of being unfamiliar with the incentives of public goods has been examined to a lesser degree (Andreoni, 1988, 1995; Houser and Kurzban, 2002), there has been little economic research that isolates the non-punishment, or imitation, role of conformity in the provision of a public good.[4]

What follows is an empirical study of conformity in the standard public goods experiment, the *voluntary contribution mechanism* (VCM) (Isaac et al., 1984). We begin by creating a model of conformity. The model is important because it provides us with both a baseline prediction when no conformity is present and an alternative prediction that accounts for the imitative effect of conformity. We then discuss the results of an experiment. The first experimental condition is a traditional VCM which we use as a control. The treatment

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[2] People may also conform to be better liked (Hatfield et al., 1993) but this reason might just be a rationalization of norm compliance.

[3] Acheson (1988) is a fascinating and well documented example of lobster fishing in Maine. For laboratory evidence of punishing deviations from a norms see Fehr and Gaechter (2000b).

[4] There are, however, a few papers on the more general topic of conformity in social dilemmas in psychology (e.g. Parks et al., 2001; Schroeder et al., 1983).

modifies the standard VCM to allow, more explicitly, for the expression of conformity. We then estimate our model econometrically and find significantly more conformity in the treatment.

## 2. Modeling the effect of conformity on the provision of a public good

Consider a large population of agents who are randomly repaired each period to play the following public goods game in groups of size $n$. Agents are "hard-wired" to either contribute to the public good or not and strategies survive (i.e. persist or grow in the population) to the extent that they return higher material benefits than that accruing to the strategy used by the average agent.[5] Agents are endowed with $e$ resource units that can either be all contributed to the public good or all kept. Each unit contributed returns benefits of $0 < m < 1$ to all the members of the group while kept units only benefit the free rider.[6] If we denote $p$ as the fraction of free riders in the population we can calculate the payoff for the two strategies: *contribute* and *free ride*. The payoffs to contributing, $\pi_{\mathrm{c}}$, and to free riding, $\pi_{\mathrm{fr}}$, when there are $p$ free riders in the population are:

$$\begin{aligned}\pi_{\mathrm{c}} &= \mathrm{em} + \mathrm{em}(n-1)(1-p)\\ \pi_{\mathrm{fr}} &= e + em(n-1)(1-p)\end{aligned}$$

Notice, both payoffs are decreasing in the number of free riders and the payoff to free riding dominates the payoff to contributing for any value of $p$. This defines the game as a standard linear public goods problem.

As we stated above, we will allow the population to evolve according to the standard replicator dynamic (Taylor and Jonker, 1978; Maynard Smith, 1982) under which the growth rate of a strategy depends on the differential benefit the strategy confers on agents when compared to the payoff received by the average agent. In discrete time, the growth of free riders in the population follows:

$$p_t = \frac{p_{t-1}(\pi_{\mathrm{fr}} - \bar{\pi})}{\bar{\pi}} + p_{t-1}$$

where $\bar{\pi} = p_{t-1}\pi_{\mathrm{fr}} + (1-p_{t-1})\pi_{\mathrm{c}}$ is the average payoff. Because the denominator does not determine the fixed points of the dynamic, we consider the simpler version

$$p_t = p_{t-1}(\pi_{\mathrm{fr}} - \bar{\pi}) + p_{t-1}$$

This sort of public goods game conducted in the experimental lab would, for example, allocate five persons to a group ($n = 5$), assign a marginal per capita return from the public good of three quarters of each contribution ($m = 0.75$), and give players an endowment of

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[5] A more complicated "social learning" story can be told based on agents who are not "hard-wired" but instead compare outcomes to aspiration levels and switch strategies when dissatisfied. However, as shown in Binmore et al. (1995), such a story is largely equivalent to the simpler, shorter, story that follows.

[6] This baseline model is very similar to Miller and Andreoni (1991) except Miller and Andreoni allow a larger strategy space (i.e. the contribution decision is not binary). As we will see, controlling for the return on the public good and the size of groups, our simpler binary choice game provides nearly identical time paths.

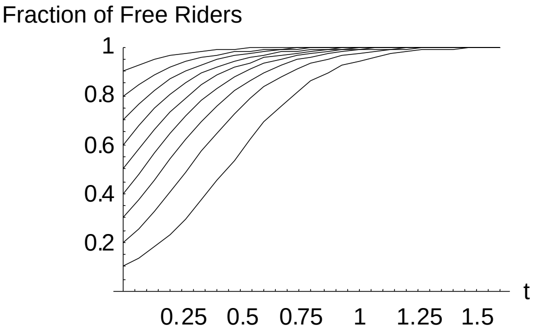

Fig. 1. The evolution of free riding according to the replicator dynamic.

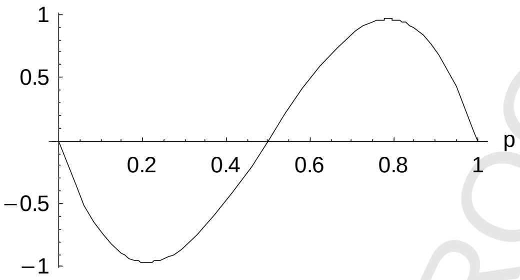

Fig. 2. A cubic conformist dynamic.

20 experimental monetary units (EMUs) ($e = 20$). Substituting these values into the payoffs to contributing and free riding, calculating the average payoff, and after some algebra we arrive at

$$p_t = p_{t-1}(1 - p_{t-1})(5) + p_{t-1}$$

The time paths of this dynamic mimic the standard increase in free riding we see in many VCM experiments (see Ledyard, 1995). Fig. 1 plots the time paths (in continuous time) from different initial conditions. Notice, as pointed out in Miller and Andreoni (1991), allowing strategies to evolve generates behavioral time paths that mimic the growth of free riding in actual laboratory experiments.

Now we ask what happens if people conform. While there are many functional forms that we could use to represent conformity, we will only consider what we call the class of "cubic" functions represented in Fig. 2.[7]

We limit our analysis to cubic conformity functions for two reasons. One, cubic functions can be constructed such that $\Delta p < 0$ when free riders represent less than half the population and $\Delta p < 0$ when free riders make up more than half the population. Second, to assure the

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[7] In related work, Henrich and Boyd (2001) use the linear conformity function, $p_t = p_{t-1} + 2(p_{t-1} - 1)$. For microfoundations for these and other conformity functions see Boyd and Richerson (1985).

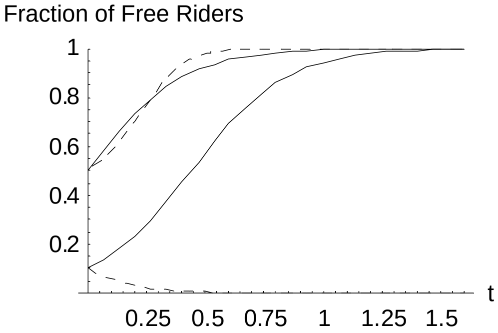

Fig. 3. Evolution under the conformist dynamic ($\alpha = 0.5$, dashed curves indicate conformity, solid curves are reproduced from Fig. 1).

dynamic never "runs off the strategy simplex," we also limit our choice to cubic functions which have rest points at $p = 0$ and $p = 1$. Let $c(p_{t-1})$ be one member of this class of conformity functions, in which case, we can combine the incentive to conform with the payoff incentive to free ride by assuming that the strength of conformity can be measured by the parameter, $0 \leq \alpha \leq 1$. Under this assumption the population now evolves according to

$$p_t = (1-\alpha)[p_{t-1}(\pi_{\text{fr}} - \bar{\pi})] + \alpha c(p_{t-1}) + p_{t-1}$$

Fig. 3 is drawn with $c(p_{t-1}) = 60p_{t-1}^2 - 20p_{t-1} - 40p_{t-1}^3$ and $\alpha = 0.5$.[8] As one can see, with sufficient conformity two important things happen to the time paths. First, as shown in the two lower curves, if the initial frequency of free riding is small, and if conformity is strong enough, a second fixed point arises in which all agents contribute. Second, and more important for our purposes, with conformity, the growth rate of free riding increases when there are sufficiently many free riders at the start of the game. Initially, the conformist dynamic causes free riding to grow slower near $p_{t-1} = 0.5$ because the effect of conformity at this population distribution is relatively low, but once there are sufficiently many free riders, the conformity effect exacerbates the payoff effect and free riding grows more rapidly than in the baseline model. Hence, our prior is: *if free riding is sufficiently common at the start of the game and conformity significantly affects contributions to a public good, we should see an increase in the growth rate of free riding as the game proceeds.*

## 3. Testing for conformity in the experimental lab

To test for conformity we ran a VCM experiment with 10 sessions. There were five sessions for each of two treatments and each session had either 15 or 20 participants. The 165 participants earned 16.14 dollars, on average, including a 5 dollar show-up fee.

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[8] Fig. 3 is robust to many variations in the conformity dynamic. For example, all else equal, the dynamics look the same when $\alpha$ is as low as 0.25 and when the conformity function is vertically compressed.

In each of 10 periods participants were randomly shuffled into groups of 5. This is the familiar *strangers* condition (Keser and van Winden, 2000; Croson, 1996; Andreoni, 1988). We used the strangers condition to control, as much as possible, for any strategic or conditionally cooperative reasons that may influence participant choices; doing so allows us to focus on conformity. We also used the strangers condition to match the conditions of the model, and the replicator dynamic, as closely as possible. The replicator dynamic is microfounded on a story which assumes agents are randomly drawn from a population to play a game for one period after which the groups are dissolved and new groups are formed at the beginning of the next period. This is precisely the strangers treatment.

As in our model, in the experiment each EMU that was contributed returned 0.75 EMUs for each of the five members of the group. With an endowment of 20 EMUs, the payoff function for the experiment was

$$\pi_i = (20 - x_i) + 0.75\sum_i x_i$$

where $\pi_i$ and $x_i$ are the payoff and contribution of the *i*th group member ($i = 1, 2, 3, 4, 5$), respectively. This payoff function, faced by our participants, provided exactly the same incentives as those faced by the agents of our model. Therefore, if the replicator dynamic is a good model of boundedly rational decision-making in the public goods experiment, we will see time paths from the experiment that are similar to Fig. 1. Specifically, the control condition should qualitatively match the standard dynamic and the treatment, explained in detail below, should match the dynamic augmented by conformity.

Again, this structure sets up a social dilemma. Differentiating $\pi_i$ with respect to $x_i$ illustrates that contributing nothing is the dominant strategy. However, differentiating with respect to $\sum_i x_i$ shows that the social optimum occurs when everyone contributes fully.

In the *control* treatment, participants were first asked to decide how to allocate their 20 EMU endowment between the public good and their own personal accounts. After everyone had made the allocation decision, each individual was shown three pieces of information: the individual's contribution, how much the individual's group contributed *in total*, and the individual's payoff for the period.[9] Hence, participants in the control only knew how much the group contributed in total—they did not know what the other group members had contributed individually. The *monitor* treatment proceeded identically to the control treatment except the information participants were shown after deciding on contribution levels was augmented by the individual contribution decisions of all the other current group members (however, individual identities were not revealed).

In the monitor treatment participants could see the distribution of contribution choices rather than just the group total contribution. Knowing the distribution gives players information that may allow conformity to play a stronger role. When players know only the group total contribution they cannot determine whether most people are gathered at a particular contribution level, or whether there is no consensus, and therefore, a lot of variation in behavior. However, when players are shown both the group total contribution and the individual behavior of the other members of their group, they can assess whether or not the rest of the group has gravitated towards one particular contribution level or not.

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[9] At the second stage of each period the information from all pervious periods was also listed.

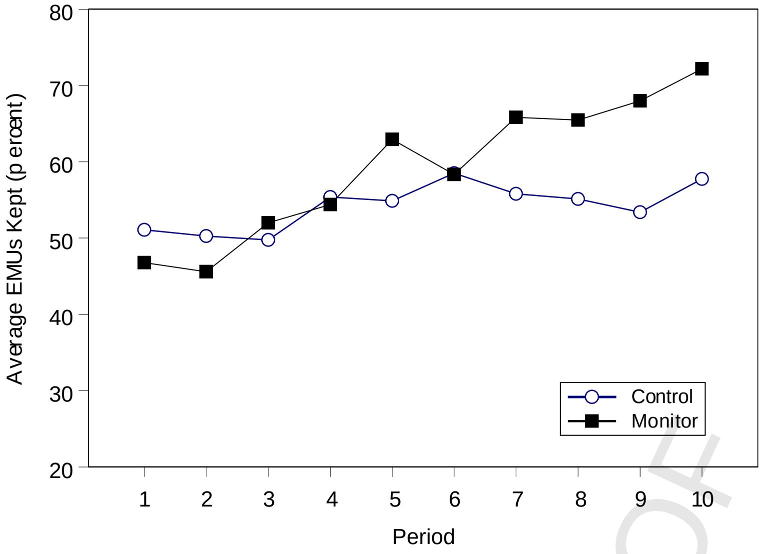

Fig. 4. Average free riding levels in the VCM experiment.

Three features of this experiment allow us to isolate conformity. Because groups are randomly reformed at the beginning of each round and this is stated clearly in the experimental instructions, the participants should not have been motivated by any strategic (e.g. pursuing a trigger strategy) or reciprocal (e.g. conditional cooperation) motivations. Second, given the participants are shown only their group's aggregate contribution in the control treatment, they are not given enough information for conformity to affect decisions. Third, the monitor treatment provides individual level contribution decisions which is the information necessary for conformity to be a factor. Moreover, the first and the third design features preclude other explanations for any changes in behavior between the treatments.

*What happens in this experiment*? Fig. 4 plots the average fraction of EMUs kept in the two treatments for each period of the experiment. In both treatments average contributions start at approximately 50% of the endowment. The control treatment replicates the results of other VCM experiments in which the marginal per capita return from the public good is 0.75 (Isaac et al., 1984); specifically, free riding increases, but slowly. Compared to the control, in the monitor treatment free riding grows faster. Overall, EMUs kept in the monitor treatment are distributed significantly higher than in the control. Defining an observation as the session average contribution in a period and testing for differences in central tendencies (Wilcoxon test) we get $z = 2.13$, $P = 0.03$. Testing for differences in the cumulative distributions (Kolmogorov–Smirnov test) we get $k_{\mathrm{s}} = 0.30$, $P = 0.02$. Further, as in the model (recall Fig. 3) the conformity treatment cuts the control treatment from below and then elicits more free riding faster. This result alone is evidence favoring a significant conformity effect.

Another way to test for conformity in our aggregate data is to check whether the variance in behavior declines over time and whether the variance declines faster in the monitor treatment. Table 1 presents the variance in individual behavior by period and treat-

Table 1
Does conformity exist?

| Period | Variance of EMUs kept (by treatment) | | |
|---|---|---|---|
| | Control | Monitor | *F*-statistic |
| 1 | 27.59 | 27.17 | 1.08 |
| 2 | 36.39 | 30.07 | 1.29* |
| 3 | 42.46 | 40.16 | 1.12 |
| 4 | 46.07 | 39.61 | 1.24 |
| 5 | 43.33 | 35.79 | 1.29* |
| 6 | 40.61 | 34.20 | 1.26 |
| 7 | 47.55 | 35.60 | 1.42* |
| 8 | 45.17 | 40.17 | 1.20 |
| 9 | 53.39 | 42.10 | 1.35* |
| 10 | 56.50 | 29.51 | 2.03* |
| *n* | 80 | 85 | |

* Significant at the 0.10 level.

ment. Overall, we see that the variance in the control treatment increases rather than decreases over time because behavior bifurcates into those who contribute and those who free ride (the two clear modes in the control treatment in period 10 are to keep nothing or to keep 15 EMUs) while the variance in the monitor treatment is largely stable and then drops dramatically in period 10. In the monitor treatment the modal behavior in period 10 is to keep half the endowment as it is in period 1. Also notice that in each period the variance in behavior is lower in the monitor treatment and in half of the periods it is significantly lower. This evidence suggests that the norm of contributing half set in round one provides the anchor which others move towards in the monitor treatment, while without knowing the individual behavior of the rest of the group, players in the control treatment either become free riders or contributors (i.e. they do not even conform to the average).

## 4. Measuring the effect of conformity econometrically

As a more rigorous test of conformity we econometrically estimated our model to see if the key behavioral determinants, the differential benefit of free riding and the frequency of free riders, influenced the contribution choices of our participants. We also tested whether the monitor treatment elicited more conformity.

All the results we report are from regressing the number of EMUs a person kept in period $t$ on the frequency of free riders in the person's group in period $t-1$, on the differential payoff accruing to free riders in period $t-1$, and on the EMUs a person kept in period $t-1$. We measure the free rider's payoff differential as the average payoff received by a free rider minus the average payoff received by all players within each period and session. To test the robustness of our results, we measure free riding in three different ways: contributing 1/4 of the endowment or less, contributing 1/3 of the endowment or less, and contributing 1/2 the endowment or less. To prevent our results from being biased by the fact that contributions

Table 2
Does monitoring elicit more conformity?

| | Definition of free riding | | |
|---|---|---|---|
| | Contribute 1/4 or less | Contribute 1/3 or less | Contribute 1/2 or less |
| (Frequency of free riders)$_{t-1}$ | $4.27^{***}$ (1.07) | $4.75^{***}$ (1.03) | $4.39^{***}$ (1.25) |
| (Mean FR profit − mean overall profit)$_{s,t-1}$ | 0.13 (0.09) | $0.19^{**}$ (0.06) | $0.35^{***}$ (0.14) |
| (EMUs kept)$_{i,t-1}$ | $0.32^{***}$ (0.04) | $0.30^{***}$ (0.04) | $0.32^{***}$ (0.04) |
| (Frequency of free riders)$_{i,t-1}$ × monitor | $0.21^{*}$ (0.13) | $0.25^{**}$ (0.12) | $0.48^{***}$ (0.18) |
| (Mean FR profit – mean overall profit)$_{s,t-1}$ × monitor | 0.37 (1.55) | 0.16 (1.17) | 0.42 (1.68) |
| Monitor | −0.14 (1.11) | −0.22 (1.09) | −0.16 (1.43) |
| Constant | $6.43^{***}$ (0.83) | $5.98^{***}$ (0.82) | $4.78^{***}$ (1.12) |
| Wald $\chi^2$ | 123.24 | 136.45 | 128.38 |
| Probability > $\chi^2$ | <0.01 | <0.01 | <0.01 |

*Notes*: Standard errors in parentheses, $i$ is individual; $s$, session; and $t$ is period. Dependant variable = (number of EMUs kept)$_{i,t}$ (all results are tobit and include random effects).

$^{*}$ Significant at the 0.10 level.

$^{**}$ Significant at the 0.05 level.

$^{***}$ Significant at the 0.01 level.

are bound between 0 and 20, we use the tobit procedure. Lastly, to control for individual specific heterogeneity, we include random effects.

In Table 2 we ask, for each free riding definition, whether the key determinants of our conformity model, the payoff difference accruing to free riders and the number of free riders, have differential effects in the monitor treatment. Under none of the free riding definitions are participants significantly more responsive to the material incentive to free ride in the monitor treatment than in the control treatment (i.e. the free rider differential by monitor interaction is never significant). However, as hypothesized, conformity is stronger when participants are given the full distribution of what other players in their groups are doing (i.e. the frequency by monitor interaction is positive and significant in all cases).

The size and significance of the differential conformity effect depends on the definition of free riding. As the definition of free riding loosens, the differential effect of conformity in the monitoring treatment increases. This increase grows to the point where conformity is approximately 10% stronger in the monitor treatment when we use the contribute 1/2 or less definition of free riding.

We also see that (controlling for treatment differences) the effect of the material incentive to free ride becomes stronger and more significant as we loosen the definition of free riding. In fact, using either the contribute 1/3 or less or the contribute 1/2 or less definition the replicator dynamic fits our data rather well. The higher the material incentive to free ride last period, the more people free ride this period, and the more free riders there were last period, the more people free ride this period, the later effect being stronger when more information about free riding is provided.[10]

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[10] Note, one should expect a strong correlation between the free rider’s payoff differential and the frequency of

## 5. Concluding remarks

The model presented above and the experiment designed to test the model's predictions demonstrate that conformity may be an important economic phenomenon in social dilemma situations such as the provision of a public good. It is clear why people might conform in the standard public goods game. To many participants, their experience in the VCM is their first in a decision-making experiment where the incentives are explicit, but are conveyed without much context. It seems obvious that many players are simply confused at the beginning of the experiment and look for clues as to what they should do. In fact, Houser and Kurzban (2002) have recently shown that confusion accounts for more behavior in the VCM, than was previously thought. Their estimate is that more than half contributions (specifically 54%) can only be explained by confusion. In our control treatment, there are few clues for confused participants, while in the monitor treatment, participants can look to their group-mates for clues as to what strategy they should try.

Extrapolating our conformity results to social dilemmas in real life is not much of a stretch because, while context is provided in the real world, the incentives are often more complicated, and therefore, the incentive to conform may increase. For example, decision-making in reality is often cluttered by the addition of social influence (Cason and Mui, 1998) or recommendations (Croson and Marks, 2001). Because most models of bounded rationality predict people are more likely to conform or imitate when the decision environment becomes more complicated (e.g. Boyd and Richerson, 1985), our experiment should be viewed as a lower bound on the possible effect of conformity in social dilemma situations.

Conformity, in this context, is important because it helps sustain contributions when they start at sufficiently high levels. More importantly, however, as demonstrated by the current experiment, conformity is important because it can account for why cooperation might wane faster than standard theories based on boundedly rational agents (e.g. the replicator dynamic) would suggest. As the number of free riders increases, conformity provides an additional incentive (or excuse) to free ride. This also implies that when conformity is present, trying to initiate cooperation in a population of free riders will be even harder than first thought.

One might be concerned that the time scales of the model and the experiment are sufficiently different so that models based on evolutionary dynamics are inappropriate when generating hypotheses concerning the short run convergence of behavior in the experimental lab. However, there is evidence that suggests this concern is misplaced, especially when one thinks of evolutionary dynamics as mimicking the learning process of boundedly rational decision makers (Binmore et al., 1995 or Fudenberg and Levine, 1998) rather than the transference of genes in a population of zero-intelligence agents. Specifically, Friedman (1996) and Carpenter and Matthews (2001) show that evolutionary dynamics do predict laboratory outcomes reasonably well.

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free riders and that the resulting colinearity might cause the free rider's differential to predict poorly. However, because of how the free rider's differential is defined (i.e. expected free rider payoff minus the average payoff) we measured the free rider's differential at the session level while we measured the frequency of free riding at the group level. As a result, the correlation is never greater than $\rho = -0.33$. Further, dropping the frequency from the regressions in Table 1 does not substantially increase the size or significance of the free rider differential indicating that colinearity is not driving the result.

Both the current model and the experiment suggest a possible confound for explanations of the dynamics seen in public goods experiments based on the specific idea of conditional cooperation or, more generally, reciprocity. *Conditional cooperation* (Andreoni, 1995; Keser and van Winden, 2000; Fischbacher et al., 2001) hypothesizes that players are predisposed to contribute in social dilemmas, but become frustrated by free riders and punish them by withholding future contributions. Conditional cooperation predicts the type of gradual decline in contributions seen in many public goods experiments where players stay in the same group for the entire experiment (i.e. the *partners* protocol).

However, conditional cooperation makes little sense when groups are randomly reshuffled after each period (i.e. the current *strangers* protocol) because it is not clear why people would punish future group members who, in all likelihood, will be different from those who free rode in earlier periods. When players do not stay in the same group, there is no reason to punish future group members, and therefore, there are no forces reducing contributions in the conditional cooperation/reciprocity model. Yet, as seen in the current experiment and Fehr and Gaechter (2000a) free riding does grow in the strangers matching protocol, as it does under Fehr and Gaechter's *complete strangers* protocol, where players know they will never be in a group with the same people again.[11]

Conformity, on the other hand, predicts the growth of free riding equally well under any matching protocol. If naïve participants search for clues from their fellow group-mates and make decisions partially on the payoff benefit of a strategy and partially on trying to take advantage of what others have learned by imitating them, it matters little who is the group next period. If we review the data presented in Keser and van Winden (2000) and Fehr and Gaechter (2000a,b) through the lens of conformity (and the current model) rather than conditional cooperation we see a simpler explanation of the growth of free riding—riding grows faster when players are less likely to meet each other in the future because there is more initial free riding under these conditions.

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## Appendix A. Participant instructions (monitor treatment)

You have been asked to participate in an economics experiment. For participating today and being on time you have been paid $5. You may earn an additional amount of money

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[11] In addition to the problem conditional cooperation has with explaining the growth of free riding in games with non-stable groupings, there is recent evidence indicating that it predicts poorly even with stable groupings. Houser and Kurzban (2002) state that they find "little evidence" of conditional cooperation in their VCM experiment and, in a different social dilemma, Carter and Castillo (2002) find no evidence of conditional cooperation in their sequential trust games.

depending on your decisions in the experiment. This money will be paid to you, in cash, at the end of the experiment. By clicking the begin button you will be asked for some personal information. After everyone enters this information we will start the instructions for the experiment.

During the experiment we will speak in terms of experimental monetary units, instead of Dollars. Your payoffs will be calculated in terms of EMUs and then translated at the end of the experiment into dollars at the following rate: 30 EMUs = 1 Dollar.

The experiment is divided into 10 different periods. In each period participants are divided into groups of 5. You will, therefore, be in a group with four other participants. The composition of the groups will change randomly at the beginning of each period. Therefore, in each period your group will consist of different participants.

Each period of the experiment consists of two stages. In the first stage you will decide how many EMUs you want to invest in each of two investment accounts. One account is a Private Account, which only you benefit from. The second account is a Public Account, the benefits of which are shared equally by all members of your group. In the second stage of the period you will be shown the investment behavior of the other members of your group.

Now we will explain the two stages in more depth.

### *A.1. Stage one*

At the beginning of every period each participant receives an endowment of 20 EMUs. You have to decide how much of this endowment you want to invest in each of the two accounts mentioned above. You are asked to invest in whole EMU amounts (i.e. an investment of 5 EMUs is alright, but 3.75 should be rounded up to 4).

To record your investment decision, you will type the amount of EMUs you want to invest in the Public and/or the Private account by typing in the appropriate text-input box which will be yellow. Once you have made your decision, there will be a green submit button that will record your investment decision.

After all the members of your group have made their decisions, each of you will be informed of your earnings for the period. Your earnings will consist of two parts:

(1) Your return on your Private Account. Your Private Account returns 1 EMU for each EMU invested. That is, for each EMU invested in the Private Account you get 1 EMU back.

(2) Your return from the Public Account. Your earnings (and everyone else's in your group) is equal to 0.75 times the total investment by all members of the group to the Public Account.

Your Earnings can be summarized as follows:

$$1 \times (\text{investment in Private Account}) + 0.75 \times (\text{group total investment in Public Account})$$

The income of each group member from the Public Account is calculated the same way. This means that each group member receives the same amount from the total investment in the Public Account. For example, consider the case of groups with five members, if the total investment in the Public Account is 75 EMUs (e.g. first group member invests 15 EMUs, the second 20, the third 10, and the fourth and fifth 15 each) then each group member will receive $0.75 \times 75 = 56.25$ EMUs. If the total investment was 30 EMUs then each group member would receive $0.75 \times 30 = 22.5$ EMUs.

For each EMU you invest in the Private Account you get 1 EMU back. Suppose, however, you invested this EMU in the Public Account instead. Your income from the Public Account would increase by $0.75 \times 1 = 0.75$ EMUs. At the same time the earnings of the other members of your group would also increase by 0.75 EMUs, so the total increase in the group's earnings would be 3.75 EMUs. Your investment in the Public Account, therefore, increases the earnings of the other group members. On the other hand your earnings increase for every EMU that the other members of your group invest in the Public Account. For each EMU invested by another group member you earn $0.75 \times 1 = 0.75$ EMUs.

### *A.2. Stage two*

In stage two you will be shown the investment decisions made by the other members of your group. You will be shown how much each member of your group invested in both the Public and Private Accounts. Your investment decision will also appear on the screen and will be labeled as 'YOU'. Please remember that the composition of your group will change at the beginning of each period, and therefore, you will not be looking at the same people all the time.

When you have finished viewing the decisions made by the other people in your group click the blue done button. When everyone is done, the experiment will proceed to the next period starting with stage one.

If you have any questions please raise your hand. Otherwise, click the red finished button when you are done reading.

This is the end of the instructions. Be patient while everyone finishes reading.

## References

Acheson, J., 1988. The Lobster Gangs of Maine. University Press of New England, Hanover.

Akerlof, G., 1997. Social distance and social decisions. Econometrica 65, 1005–1027.

Anderson, L., Holt, C., 1997. Information cascades in the laboratory. American Economic Review 87, 847–862.

Andreoni, J., 1988. Why free ride? Strategies and learning in public good experiments. Journal of Public Economics 37, 291–304.

Andreoni, J., 1995. Cooperation in public-goods experiments: kindness or confusion? American Economic Review 85, 891–904.

Bergstrom, T., Blume, L., Varian, H., 1986. On the private provision of public goods. Journal of Public Economics 29, 25–49.

Bernheim, B., 1994. A theory of conformity. Journal of Political Economy 102, 841–877.

Binmore, K., Gale, J., Samuelson, L., 1995. Learning to be imperfect: the ultimatum game. Games and Economic Behavior 8, 56–90.

Bowles, S., 1998. Endogenous preferences: the cultural consequences of markets and other economic institutions. Journal of Economic Literature 36, 75–111.

Boyd, R., Richerson, P., 1985. Culture and the Evolutionary Process. University of Chicago Press, Chicago.

Carpenter, J., Matthews, P., 2002. No switchbacks: rethinking aspiration-based dynamics in the miniature ultimatum game. Middlebury College Department of Economics Working Paper.

Carter, M., Castillo, M., 2002. The economic impacts of altruism, trust and reciprocity: an experimental approach to social capital. University of Wisconsin Working Paper.

Cason, T., Mui, V.-L., 1998. Social influence in the sequential dictator game. Journal of Mathematical Psychology 42, 248–265.

Cialdini, R., 1993. Influence: Science and Practice. Harper Collins, New York.

Cialdini, R., Trost, M., 1998. Social influence: social norms, conformity, and compliance. In: Gilbert, D., Fiske, S., Lindzey, G. (Eds.), The Handbook of Social Psychology. McGraw-Hill, Boston, pp. 151–192.

Croson, R., 1996. Partners and strangers revisited. Economics Letters 53, 25–32.

Croson, R., Marks, M., 2001. The effect of recommended contributions in the voluntary provision of public goods. Economic Inquiry 39, 238–249.

Deutsch, M., Gerard, H., 1955. A study of normative and informational social influences upon individual judgment. Journal of Abnormal and Social Psychology 51, 629–636.

Fehr, E., Gaechter, S., 2000a. Cooperation and punishment in public goods experiments. American Economic Review 90, 980–994.

Fehr, E., Gaechter, S., 2000. Fairness and retaliation: the economics of reciprocity. Journal of Economic Perspectives 14, 159–181.

Fischbacher, U., Gaechter, S., Fehr, E., 2001. Are people conditionally cooperative? Evidence from a public goods experiment. Economic Letters 71, 397–404.

Friedman, D., 1996. Equilibrium in evolutionary games: some experimental results. The Economic Journal 106, 1–25.

Fudenberg, D., Levine, D., 1998. The Theory of Learning in Games. The MIT Press, Cambridge.

Gintis, H., 2000. Strong reciprocity and human sociality. Journal of Theoretical Biology 206, 169–179.

Hatfield, E., Cacioppo, J., Rapson, R., 1993. Emotional Contagion. Cambridge University Press, New York.

Henrich, J., Boyd, R., 2001. Weak conformist transmission can stabilize costly enforcement of norms in cooperative dilemmas. Journal of Theoretical Biology 208, 79–89.

Houser, D., Kurzban, R., 2002. Revisiting kindness and confusion in public goods experiments. American Economic Review 92, 1062–1069.

Isaac, M., Walker, J., Thomas, S., 1984. Divergent evidence on free-riding: an experimental examination of possible explanations. Public Choice 43, 113–149.

Jones, S., 1984. The Economics of Conformism. B. Blackwell, New York.

Keser, C., van Winden, F., 2000. Conditional cooperation and voluntary contributions to public goods. Scandinavian Journal of Economics 102, 23–29.

Ledyard, J., 1995. Public goods: a survey of experimental research. In: Kagel, J., Roth, A. (Eds.), The Handbook of Experimental Economics. Princeton University Press, Princeton.

Maynard Smith, J., 1982. Evolution and the Theory of Games. Cambridge University Press, Cambridge.

Miller, J., Andreoni, J., 1991. Can evolutionary dynamics explain free riding in experiments? Economic Letters 36, 9–15.

Moscovici, S., 1985. Social influence and conformity. In: Gardner, L., Aronson, E. (Eds.), The Handbook of Social Psychology. Random House, New York.

Parks, C., Sanna, L., Berel, S., 2001. Actions of similar others as inducements to cooperate in social dilemmas. Personality and Social Psychology Bulletin 27, 345–354.

Schroeder, D., Jensen, T., Reed, A., Sullivan, D., Schwab, M., 1983. The actions of others as determinants of behavior in social trap situations. Journal of Experimental Social Psychology 19, 533–539.

Sethi, R., 1996. Evolutionary stability and social norms. Journal of Economic Behavior and Organization 29, 113–140.

Taylor, P., Jonker, L., 1978. Evolutionary stable strategies and game dynamics. Mathematical Biosciences 40, 145–156.

Tversky, A., Kahneman, D., 1974. Judgment under uncertainty: heuristics and biases. Science 185, 1124–1131.