Cooperation and Status in Organizations

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Abstract

We report the results of experiments designed to test the effect of social status on contributions to a public good, with and without punishment. The experiments are conducted in four-person groups in a "star" network, where one central player observes and is observed by the others. This imposes a social structure on the game, and gives the central player a leadership role in the group, simply by virtue of being commonly observed. We further manipulate status by allocating the central position to the person who earns the highest, or the lowest, score on a trivia quiz. These high-status and low-status treatments are compared, and we find that the effect of organizational structure—the existence of a central position—depends on the status of the central player. Higher status players are attended to and mimicked more systematically. Punishment has differential effects in the two treatments, and is least effective in the high-status case.

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1. Introduction and Motivation

Social status plays a complex role in human interaction. Previous work points to social status shifting prices in markets (Ball et al. 2001), boosting fundraising (Kumru and Vesterlund 2005) and solving coordination problems (Eckel and Wilson 2007). The provision of public goods is sometimes seen as a coordination problem, with participants willing to do their "fair share" if others also contribute (Sugden 1984). This manifests itself in "matching" behavior, where subjects are said to match others' contribution levels (Bardsley and Sausgruber 2005, Croson 2007). If agents have a strong preference to match others' contributions, the problem is transformed from a social dilemma to a coordination game (Harrison and Hirshleifer 1989, Mcelreath, Boyd, and Richerson 2003, Guillen, Fatas, and Brañas-Garza 2008). In this study, we ask whether social status serves as a useful mechanism for solving public goods problems. Status can act as a coordinating device, as it does in pure coordination games, with higher-status individuals more likely to be mimicked (followed) by others. In addition, in a setting with costly punishment, social status may enhance the effectiveness of punishment and reduce antisocial punishment, enhancing overall efficiency.

We present the results of laboratory experiments that explore the impact of social status on behavior in pubic goods games with a specific network structure. The network has a central player that is observed by a set of peripheral players who, in turn, observe only the central player. Status is awarded by the experimenter using scores on a general knowledge trivia quiz that is unrelated to the experimental game. The central position is given to either the high scorer (high-status treatment) or the low scorer (low-status treatment). Subjects play two games: a standard linear voluntary contribution mechanism (VCM) and a VCM with costly punishment. We find that higher-status central players are more likely to be "followed" in the key situation when the peripheral player is contributing less than the central player. We also find that high-status central players punish less, and peripheral players are more responsive to punishment by a higher-status central player.

2. Background and Hypotheses

Beginning with Becker's theoretical formalizations of discrimination (Becker 1971) and professional distinction (Becker 1974), economists have recognized the importance of status and status competition. Social status enters economic decision making in at least two respects. First, status is a motive in itself. Frank (1985) argues that the "quest for status" is as strong a motivation as the quest for monetary compensation, so that individuals engage in many activities in order to acquire and display status. Along the same lines, Veblen (1899) notes conspicuous consumption as a way of trying to signal status.[1]

[1]We distinguish status from earnings. Social status is often thought of merely as socioeconomic status, and formalized as relative earnings (Quint and Shubik 2001, Allgood 2006).

Second, high-status agents may have a strong influence on others, as others seek their company and guidance, affecting choices and decision making by lower-status individuals. Thus high-status individuals are more likely to be mimicked or deferred to (Ball et al. 2001, Kumru and Vesterlund 2005). Imitating or learning from higher-status exemplars can help solve coordination problems (Eckel and Wilson 2007); the behavior of the higher-status individual provides an example that is observed and can be followed by others. It is this second effect of status—the influence that high-status individuals have on the behavior of others—that we examine here.

Gil-White and Henrich (2001) argue that attending to and mimicking high-status individuals is a valuable strategy in a world where successful individuals may have superior information. Cultural transmission is enhanced when higher-status, successful individuals are copied by others. Copying successful individuals has evolutionary payoffs, so that humans may have evolved a preference for paying attention to and learning from high-status agents (see also Boyd and Richerson 2002, Boyd et al. 2003). Bala and Goyal (1998) capture the essence of the idea of attending to a high-status agent in a model where the presence of a commonly observed agent, which they term the "royal family," can have a significant impact on which among multiple equilibria is selected. Here high status consists of common observation alone, and the information provided by this observation can lead to a better outcome for the population of players. Our experiments include these two components of status: observability, and the manner in which the observable status is attained.

Experimental research confirms the tendency of individuals to mimic high-status agents. Eckel and Wilson (2001) show that a commonly observed agent can influence equilibrium selection in a coordination game. Because any commonly observed signal can act as a coordination device, we induce status differentials by allocating this role based on a score on a general knowledge trivia quiz. This allows us to distinguish whether our results are due to status or to a focal point (Schelling 1960). One treatment allocates the role to the high scorers, and the other to those who score the lowest on the quiz. Thus we manipulate the relative status of the commonly observed agent directly. These findings show that subjects are more likely to imitate a commonly observed agent who has high status than one that has low status, where status is determined by the experimenter in a domain that is unrelated to the game the subjects play. Imitation makes the population of subjects more likely to reach a Pareto-superior, but risk-dominated, equilibrium, an outcome that rarely occurs otherwise (Cooper et al. 1990). Kumru and Vesterlund (2005) show a related result, with high-status

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Experimental studies highlight the importance of relative earnings as a motivating factor (Bolton 1991). But status also can be based on rank with respect to other characteristics affecting the esteem of others, such as education, attractiveness, skill, etc., that may be only weakly correlated with earnings.

first-movers more likely to be mimicked in a two-person sequential voluntary contribution game. In their setting, high status enhances the ability of leaders to increase total contributions.[2]

Social psychologists have long noted the relationship between status and influence (see Webster and Foschi 1988, for an overview.) They have developed the concept of a "status characteristic"—an identifiable characteristic of a person that indicates higher status. A status characteristic implies knowledge or expertise, and is either *specific* or *diffuse*. Specific status characteristics are derived from specialization and expertise and are relevant to a specific domain. For example, having a PhD in political science implies specialized knowledge about politics. Status is conferred because of the credential, and others will defer to this person for topics having to do with politics (whether justified or not). Diffuse status characteristics are not related to credentials, but rather with aspects of individuals—such as ethnicity, sex, or attractiveness—that may be grounded in stereotypes and imply knowledge or expertise more generally. They are nevertheless influential.[3] In addition, status in one arena can spill over into another; a person with status in one arena may be influential in another, unrelated arena.

Consider the specific case of a VCM public good game. For a person to have influence, her action needs to be observable by others. In addition, others must attend to and mimic her actions. In a coordination-game setting, any strategy chosen by a commonly observed player can serve as a focal point for coordination (Schelling 1960); a commonly observed agent can serve a similar function in the public goods game if agents desire to reciprocate (or match) others' contributions (Croson 2007). That said, there is no guarantee that a commonly observed agent will lead a group to higher levels of public good production. Those who observe the central agent may ignore her example. If the mechanism for selecting the agent—that is, for conferring status—is unrelated to the task, then status is "diffuse," implying no specialized skills, and the agent may not be mimicked. Furthermore, the presence of an influential, commonly observed player could "lead" the outcome to any common level of donations to the public good. The commonly observed agent herself may not choose a strategy that, if copied, would lead to higher production levels of the public good. If the commonly observed agent is a high contributor we would expect contributions to be higher than in the absence of such an agent. If a high-status individual fails to contribute at high levels, that individual can still be imitated, but group contributions will not increase. This leads us to our main hypothesis:

[2]Chaudhuri, Graziano, and Maitra (2006) examine a different form of social learning in public goods games, intergenerational advice between rounds.

[3]See Ridgeway and Erickson (2000) for a rich discussion of the way in which status is created and spread.

H1. Peripheral players are more likely to mimic the behavior of higher-status central players.

There is a second feature to some public goods games where status may play a role: costly punishment. Punishment can be a useful mechanism for raising the levels of contributions in the VCM (Fehr and Gächter 2000). If subjects are allowed to observe one another's contributions and pay a fee to punish others, they will do so. This results in higher levels of contributions over time and an increase in group outcomes, though not necessarily an improvement in social welfare net of costly punishment. Costly punishment is a second-order public goods problem since individuals have to bear the cost to enforce a group norm (Boyd et al. 2003).

The presence of a high-status agent can interact with punishment in several ways. First, the leadership of a high-status, central agent may obviate the need for punishment, making the status of the leader a kind of substitute for punishment. Second, high status may enhance the effectiveness of punishment: punishment by a high-status player may have a greater impact on subsequent play merely because it comes from a source that is seen as more legitimate or respected. Third, other agents may be less likely to punish a higher-status group member, whether for prosocial reasons (punishing low contributions) or antisocial, retaliatory reasons (Herrmann, Thöni, and Gächter 2008). Taken together, these factors imply that making costly punishment available in the public goods context may not have the same effect when subjects differ in status. This leads us to our second hypothesis:

H2. Peripheral players will be more responsive to punishment by a higher-status central player, and high-status central players will receive less punishment.

We employ a star network structure in which there is a central player who is observed by all other group members, and these peripheral players are observed only by the central player (Fatas, Melendez, and Solaz 2010). Thus, by being observed, the central player inherently has high status: he is the "royal family" in the sense of Bala and Goyal (1998). We also vary the status of the central player. Following Ball et al. (2001) and Kumru and Vesterlund (2005), we allocate the central role based on scores on a general knowledge trivia quiz. As in Eckel and Wilson (2007), in one treatment the high-scoring subject is given the central role, and in another the low-scoring subject is allocated to the central position. This design allows us to compare the influence of the central agent for different status levels. It also allows us to distinguish between a pure coordination effect, resulting from the mere existence of any commonly observed strategy (Schelling 1960), and leadership, resulting from a situation where the identity (status) of the central player determines her influence.

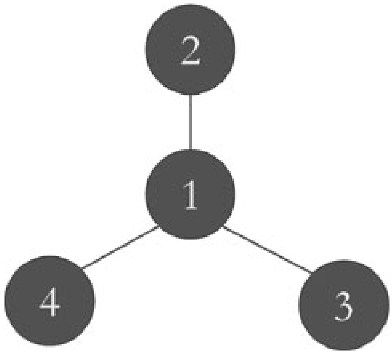

Figure 1: Star network: player 1 is the commonly observed player.

3. Design

The experiment is a repeated public goods game, conducted in a four-person "star" network with one central player and three peripheral players (see Figure 1). The network structure imposes an information structure on the game. One agent is observable by—and observes—all of the others. For consistency the commonly observed agent is referred to as the "central player" and the other agents as "peripheral players." In each round, subjects are endowed with 50 Experimental Currency Units (ECUs), and must decide (simultaneously) what portion of the endowment to contribute to a group account, c_i. Each ECU contributed to the group account yields a payoff of 0.5 ECU to each of the four members of the group. Each ECU not contributed by the subject is credited to the subject's private account. Therefore, in a particular round, individual i's earnings (in ECU) are given by the following equation:

$$\pi_i = (e - c_i) + b \sum_{i=1}^{n} c_i, \quad (1)$$

where the notation (e = endowment, c = contribution to the public good, b = marginal per capita return, n = group size) and parameter values (b = 0.5, $n = 4$) are standard. The MPCR of 0.5 makes the game easily computable for subjects. Group composition is randomly determined at the beginning of the session and remains unchanged throughout. Subjects interact via a computerized interface.

At the end of each round, each subject observes his own earnings and the decisions of those he is connected to. Thus the choices of the central player are observed by all other players in the group, and the central player observes the decisions of each of the other players, but the peripheral players do not directly observe each other. Average play can be inferred from payoff information, but the specific decisions of others cannot.

Table 1: Punishment cost structure

Punishment points (p_{ji}^{p})	0	1	2	3	4	5	6	7	8	9	10
Punishment cost (p_{ij}^{c})	0	2	4	8	12	18	24	32	40	50	60

The experiment is a 2 × 2 design, varying status (high and low) and game (VCM without and with punishment). Subjects are assigned to a high or low-status treatment, and within a session, subjects first play 20 rounds of a standard VCM. After a surprise restart in period 21, subjects are given the option to punish. A player can punish any agent who is connected to him—so again, the central player can punish anyone, but the other players can only punish the central player. Punishment is implemented as in Fehr and Gächter (2000), in a proportional way. Each punishment point received by a subject diminishes her profits by 10%.[4] The cost of punishment is presented in Table 1.

Following Fehr and Gächter (2000) and Fatas, Melendez, and Solaz (2010), if a central player received more than 10 punishment points from peripheral player in any given round, at most 100% of their earnings could be wiped out. A subject could achieve negative earnings for a round only by incurring punishment costs in excess of (net) earnings; thus losses could be avoided. Profits in the punishment game (PUN, thereafter) are calculated as

$$\pi_i = \left[(e - c_i) + b\sum_{i=1}^{n} c_i\right]\left[\frac{10 - \min\left(10, \sum_{j=1}^{n} p_{ji}^{p}\right)}{10}\right] - \sum_{j=i}^{n} p_{ij}^{c}, \qquad (2)$$

where p_{ij}^{c} is the punishment cost of the points sent by subject j to subject i, and p_{ji}^{p} is the number of punishment points received by subject i from subject j.[5] The punishment points received by subject i reduces her profits by 10% (up to a maximum of 100%, as explained) and the cost of the punishment points sent follow Table 1.

Subjects' scores on a trivia quiz determine who is assigned to the central player position.[6] There are two treatments. In one, the high-scoring player is

[4]We chose this punishment scheme to adhere as closely as possible to the original design by Fehr and Gächter (2000) and by Fatas, Melendez, and Solaz (2010). Given that the same punishment mechanism is implemented in all treatments, treatment effects should not be affected by this specific design choice.

[5]Note that only the central player can receive points from more than one other group member; peripheral players receive punishment only from the central player.

[6]The procedure and trivia quiz are adapted from Ball et al. (2001) and Eckel and Wilson (2007) to the Spanish subject pool. All 15 questions were relatively easy for college students: the average score was 9.78 (std. error 1.74, max 14 and min 4). Subjects

assigned to the role of the central player (high-status treatment, thereafter); in the second, the low-scoring player is assigned the role of the central player (low-status treatment).

All experimental sessions were conducted at LINEEX (Laboratory for Research in Experimental Economics), at the University of Valencia. We electronically recruited 80 subjects, mainly business and economics undergraduate students, all inexperienced in public good games experiments or network experiments. Specifically, 40 participated in each treatment, producing 10 independent groups for each. On average, a session lasted around 90 minutes, including initial instructions and payment of subjects, and the average payment was around $37. The experiment was computerized using *Z*-TREE (Fischbacher 2007).

4. Results

4.1. Aggregate Results

Table 2 reports aggregate results treating average behavior by an individual as an observation. In the VCM without punishment, subjects allocate on average between 22 and 25.6 out of a possible 50 tokens to the public account. There are no statistically significant differences in average donations across status treatments or position in the VCM. When punishment is introduced, contributions increase in both treatments. However, the increase is significant only in the low-status groups. While the standard errors are higher in the low-status treatment, the differences in variances are not statistically significant.

Figure 2 plots the mean contributions for the central and peripheral players for the VCM. The first row plots distributions for the peripheral players, and the second row for the central players, by game. These distributions illustrate the mean and the 95% confidence interval (standard error) across all periods, and show the higher variability of the low-status data. As is common in VCM studies, Figure 2 shows that the peripheral subjects begin by contributing about half of their tokens to the public good, and contributions deteriorate over time, with a more marked deterioration in the low-status treatment. Differences in contributions appear only in the final rounds, where contributions are sustained under the high-status treatment, while they drop considerably in the low-status treatment. The high-status central players have more stable contributions than low-status central players, which deteriorate in the last few periods of play.

Figure 3 shows that low-status contributions increase after punishment is instituted but not in the high-status treatment. However, the low-status distributions are more variable.

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were paid €.30 for each correct answer. No single question was related to the experiment, even indirectly. The quiz is available upon request from the authors.

Table 2: Average contributions by treatment (standard deviation in brackets)[a]

		Number of Subjects	VCM (Rounds 1–20)	VCM with Punishment (Rounds 21–40)
High status	Central players	10	23.90	25.62
			(10.00)	(13.24)
	Peripheral players	*30*	*25.63*	*26.28*
			(9.80)	*(12.88)*
	All players	40	25.20	26.12
			(9.75)	(12.80)
Low status	Central players	10	22.63	33.58
			(12.42)	(14.59)
	Peripheral players	*30*	*22.01*	*29.09*
			(11.86)	*(14.81)*
	All players	40	22.16	30.21
			(11.84)	(14.70)

[a]An average contribution was calculated for each subject, and we report here the standard deviation of that set of values. All statistical tests used these values.
The tests below report comparisons across means and in brackets is the reported p value for a ratio of variances test where the null hypothesis is that the variances are equivalent.
HS peripheral players v. LS peripheral players (periods 1–20): $t = 1.29$, $p = .20$, $df = 58$, [$p = .31$].
HS central player v. LS central player (periods 1–20): $t = 0.25$, $p = .80$, $df = 18$, [$p = .53$].
HS peripheral players v. LS peripheral players (periods 21–40): $t = 0.78$, $p = .44$, $df = 58$, [$p = .47$].
HS central player v. LS central player (periods 21–40): $t = 1.28$, $p = .21$, $df = 18$, [$p = .78$].
HS players (peripheral and central) v. LS players (periods 1–20): $t = 1.25$, $p = .21$, $df = 78$, [$p = .23$].
HS players (peripheral and central) v. LS players (periods 21–40): $t = 1.33$, $p = .19$, $df = 78$, [$p = .39$].
The following are within subject tests comparing no punishment and punishment games (periods 1–20 v. 21–40):
HS central players: $t = 0.47$, $p = .65$, $df = 19$, [$p = .42$].
HS peripheral players: $t = 0.33$, $p = .74$, $df = 29$, [$p = .15$].
LS central players: $t = 4.17$, $p = .002$, $df = 19$, [$p = .64$].
LS peripheral players: $t = 3.36$, $p = .002$, $df = 29$, [$p = .24$].
HS all players: $t = 0.54$, $p = .59$, $df = 39$, [$p = .27$].
LS all players: $t = 4.69$, $p = .00$, $df = 39$, [$p = .07$].

Recall that status can affect both the level of giving and punishment by the central player as well as his influence on the other players. Understanding these results requires a more detailed analysis that controls both for the behavior of the central player, and the response by the peripheral players, and explicitly models the dynamic interactions among the players.

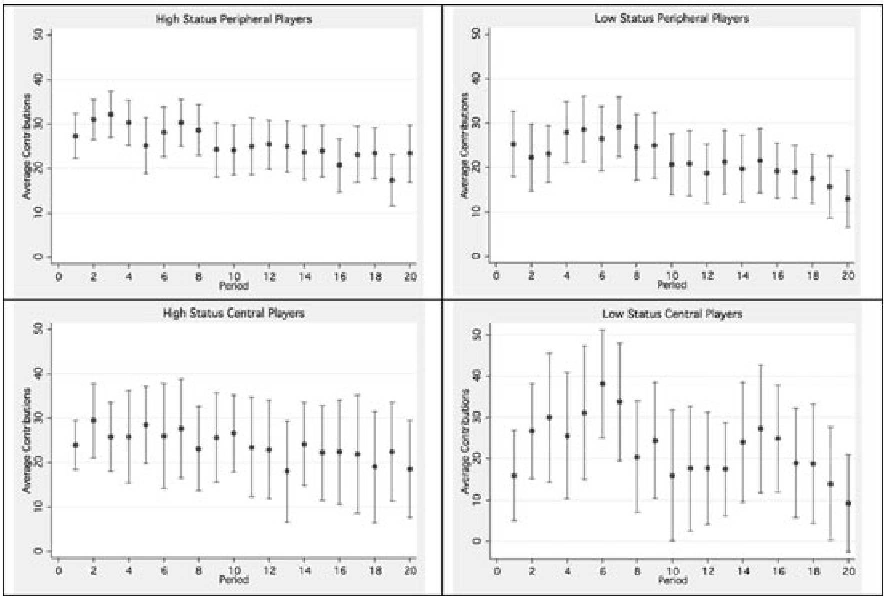

Figure 2: Plots of means and standard errors by period for contributions. The means are represented by dots while the standard error bars represent the 95% confidence interval around the mean. The top row represents the initial 20 periods with no punishment for the peripheral players. The left panel represents the high-status condition and the right panel represents the low-status condition. The bottom row represents the initial 20 periods with no punishment for the central players and the left and right panels display the high- and low-status conditions, respectively.

4.2. Contributions to the Public Good

Regression models are estimated for the individual contribution decisions in order to test whether the decisions by the central player affect the play of the peripheral players, and if those effects differ across status treatments. We employ tobit regressions with clustered standard errors.[7] Table 3 reports marginal effects for the peripheral players. The first includes only treatment dummy variables (high status, punishment, and their interaction, as well as a linear trend (period number) and a separate trend for periods 21–40. Two

[7]Using Stata's xttobit routine produced unstable estimates using random effects, which is not unusual for this finicky estimator (see Stata online documentation for a discussion). Fixed effects tobit regressions produced results similar to those here and are available on request. Clustering by subject roughly doubled the estimated standard errors, so we see this as a relatively conservative approach to the estimation. See Ashley, Ball, and Eckel (2010) for a more extensive discussion of the strengths and weaknesses of the random and fixed effects tobit estimations for repeated VCM data.

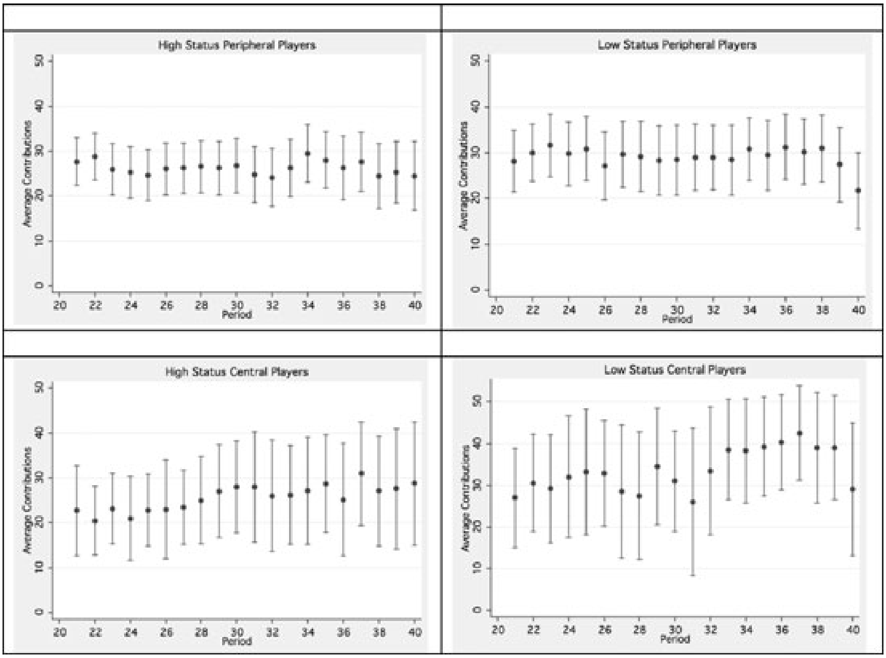

Figure 3: Plots of means and standard errors by period for contributions. The means are represented by dots while the standard error bars represent the 95% confidence interval around the mean. The top row represents the second 20 periods with punishment for the peripheral players. The left panel represents the high- status condition and the right panel represents the low-status condition. The bottom row represents the second 20 periods with punishment for the central players and the left and right panels display the high- and low-status conditions, respectively.

results are evident. First, punishment has a positive main effect, and this effect is offset for the high-status treatment as shown by the negative coefficient on the HS × PUN interaction. Second, contributions decline significantly over time, and this decline is again offset by the punishment period variable, indicating that no such decline occurs when there is punishment. This confirms the results in the graphs: there is no main effect of high status, and punishment only affects the low-status level of contributions.

However, our main hypothesis concerns the relationship between the central player's example and the peripheral player's behavior. To examine this we need to model the dynamic patterns in the data. Model 2 includes variables that capture the feedback that an individual subject receives on their computer screen during the game. This includes the subjects' contribution in the prior period, and two variables that capture the central player's action. Following Ashley, Ball, and Eckel (2010) we introduce two

Table 3: Tobit regression results (marginal effects). Dependent variable = peripheral player contributions in tokens. Standard errors clustered on the individual subject

	(1)	(2)	(3)
High status (HS)	3.613	−0.028	0.201
(1 = High Status, 0 = Low Status)	(2.739)	(1.466)	(1.446)
Punishment game (PUN)	13.360***	7.074***	7.430***
(1 = Yes, 0 = No)	(2.921)	(1.738)	(1.830)
HS × PUN	−7.164*	−2.465	−3.209#
	(2.860)	(1.491)	(1.642)
Period (1–40)	−0.561***	−0.253***	−0.251***
	(0.113)	(0.069)	(0.069)
Punishment period	0.496**	0.0001	−0.002
(1–20, beginning in period 21)	(0.186)	(0.110)	(0.110)
Lagged own contribution, $c_{i,t-1}$		0.959***	0.960***
		(0.055)	(0.056)
Lagged contribution above central player		−0.392***	−0.392***
$\lvert c_{i,t-1} - c_{*,t-1}\rvert$ if $c_{i,t-1} \geq c_{*,t-1}$, 0 otherwise		(0.050)	(0.050)
Lagged contribution below central player		0.071	0.091
$\lvert c_{i,t-1} - c_{*,t-1}\rvert$ if $c_{i,t-1} < c_{*,t-1}$, 0 otherwise		(0.097)	(0.084)
HS × Lagged cont. below central player		0.232#	0.200
(Interaction of HS and previous variable)		(0.132)	(0.123)
Lagged punishment received			−0.673
			(0.552)
HS × Lagged punishment received			1.643
			(1.448)
Observations	2400	2280	2280
Number of subjects	60	60	60
Pseudo R^2	0.006	0.099	0.099
Log likelihood	−8133.2	−6991.2	−6988.9

Marginal effects; Standard errors in parentheses, $^{\#}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

variables to allow for an asymmetry in the response of the subject to the central player's example.[8] The first variable is the difference between own and central player contributions when the own contribution is above the central player contribution, and the second is the same difference, but when the own contribution is below the central player contribution. Both variables are defined as positive: Lagged Contribution Above is calculated as the subject's

[8]Ashley, Ball, and Eckel (2003, 2010) show that asymmetric responses to information are typical, so that it is important to specify models in this way.

own contribution in the previous period $c_{i,t-1}$ minus the central player's contribution $c_{*,t-1}$ when this difference is positive; the corresponding Lagged Contribution Below variable is the absolute value of the difference $|c_{i,t-1} - c_{*,t-1}|$ when own contributions are below the central player's. These variables allow us to test whether peripheral players pay attention to the central player. Note that if a player is strictly following the central player's lead, the coefficients on these two variables will be minus one for the first and one for the second.

Model 2 adds these two variables, as well as an interaction of Lagged Contribution Below with the high-status treatment. The interaction between high status and Lagged Contribution Above was near zero and insignificant in all specifications, and was dropped from the analysis. The result shows that when contributions exceed the central player's in the previous round, contributions fall by about 40% of the difference. But when contributions are below the central player's, there is no corresponding upward movement for the low-status treatment. Only when the interaction is also considered (the overall effect in the high-status treatment is the sum of the coefficients on the lagged-below variable and the interaction) is there a significant upward movement (likelihood ratio test, chi-square (2) = 12.06, $p = 0.0025$). We see that only the high-status central players are able to "lead" the peripheral players to actually increase their contributions, by about 30% of the difference.

Model 3 adds the punishment tokens received, and an interaction with the high-status treatment. Though the variables carry different signs, neither coefficient is different from zero. However, a likelihood ratio test indicates that they have some explanatory power (chi-square (2) = 4.33, $p = 0.097$), providing weak evidence that punishment by high-status central players is more effective. Thus the primary effect of the punishment treatment is due to the possibility of punishment, and not to the variable effectiveness of different levels of punishment.

Table 4 contains similar regressions for the central players. We again report marginal effects for tobit regressions with standard errors clustered on the individual. The variables are similar to those in Table 3. Model 1 includes only treatment variables and the period variables, as before. As in the previous table, the model shows that punishment increases giving, but only in the low-status treatment. Punishment again offsets the decline over time seen in the first 20 rounds.

Models 2 and 3 model the dynamics. In this regression we define Lagged Contribution Above Average as the central player's contribution $c_{*,t-1}$ minus the group average $\bar{c}_{t-1}$ when this is positive, and 0 otherwise. Symmetrically, Lagged Contribution Below Average is $|c_{*,t-1} - \bar{c}_{t-1} - |$ conditional on the central player's contribution being below group average. As before, we see considerable stickiness in play, with positive coefficients close to one on Lagged Own Contributions. When the central player is above the group average, he tends to lower his contributions, shown by the negative significant

Table 4: Tobit regression results (marginal effects). Dependent variable = central player contributions in tokens. Standard errors clustered on the individual subject

	(1)	(2)	(3)
High status (HS)	1.590	−1.105	−1.137
(1 = High Status, 0 = Low Status)	(4.630)	(1.889)	(1.841)
Punishment game (PUN)	11.530**	3.184	4.766
(1 = Yes, 0 = No)	(4.039)	(2.116)	(3.035)
HS × PUN	−10.200*	−2.805	−3.070
	(4.459)	(2.233)	(3.249)
Period (1–40)	−0.525**	−0.241*	−0.239*
	(0.194)	(0.119)	(0.120)
Punishment period	1.025***	0.505**	0.450*
(1–20, beginning in period 21)	(0.304)	(0.185)	(0.184)
Lagged own contribution, $c_{i,t-1}$		1.073***	1.068***
		(0.097)	(0.099)
Lagged contribution above average		−0.509*	−0.506*
$\lvert c_{*,t-1} - \bar{c}_{t-1} \rvert$ if $c_{*,t-1} \geq \bar{c}_{t-1}$, 0 otherwise		(0.218)	(0.219)
Lagged contribution below average		0.521**	0.546*
$\lvert c_{*,t-1} - \bar{c}_{t-1} \rvert$ if $c_{*,t-1} < \bar{c}_{t-1}$, 0 otherwise		(0.198)	(0.226)
HS × Lagged cont. below average		0.089	0.104
(Interaction of HS and previous variable)		(0.267)	(0.291)
Lagged punishment received			−0.432
			(0.529)
HS × Lagged punishment received			0.023
			(0.574)
Observations	800	760	760
Number of subjects	20	20	20
Pseudo R^2	0.013	0.112	0.113
Log likelihood	−2687.3	−2281.8	−2281.0

Marginal effects; Standard errors in parentheses.
(d) for discrete change of dummy variable from 0 to 1.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

coefficients on Lagged Contribution Above. When below average, the central player tends to increase contributions. The interaction term is insignificant, indicating that both high and low central players respond similarly to being above or below the average of their peripheral counterparts. Model 3 shows no additional effect of the punishment tokens received by the central player.

As noted above subjects in the high-status treatment seem to follow the central player more closely, especially when their own contributions are below the central player's. It appears that the reason the high-status treatment is not successful in increasing contributions over the low-status sessions is that central player chooses contribution levels that are no higher to start with, and so does not inspire higher contributions by the peripheral players. Part of this is due to the fact that high-status central players tend to contribute about half their tokens, and exhibit less variance than their low-status counterparts (see Figures 2 and 3).

These data point to the fact that while peripheral players will imitate high-status central players, those central players do not change their initial strategy to take advantage of peripheral players who are willing to follow.[9] Hypothesis 1 is correct in that peripheral players are taking their cues from high-status central players. Those central players, however, are not increasing their own contributions to the public good and as a consequence, neither are the peripheral players.

4.3. Punishment

We next turn to an analysis of punishment behavior by peripheral and central players. As shown in Table 5, punishment varies by player type and status. The low-status treatment exhibits highest average punishment behavior by both the central and peripheral players. Below Table 5 we report statistical tests of differences in average punishment behavior assuming one observation per subject (average punishment for all rounds). Using this measure, there are no significant differences in punishment sent or received by treatment, role, or game.

Further detail is provided by Figure 4, which shows histograms of punishment tokens sent. The top panel shows punishment by the central players, and it appears that there is considerably more punishment by the low-status than high-status central players, especially in the middle rounds. This is confirmed by a distribution test, comparing the distribution of punishment levels for all rounds for low and high-status central players (Kruskal-Wallis $\chi^2 = 48.17$, $df = 2$, $p < 0.001$). The bottom histogram shows punishment by peripheral players. Again, there appears to be more punishment by low-status players. A test comparing the distribution of punishment over all rounds sent by the high- and low-status peripheral players is again significant (Kruskal-Wallis, $\chi^2 = 83.78$, $p < 0.001$).

[9]Another question we might address is the relationship between the scores of the participants and their contributions. If high scoring individuals are more intelligent, for example, they might be more likely to "figure out" the game and so contribute less. While we see no evidence of this in the comparison of treatments—contributions by central players in the high-status treatment are not significantly lower than in the low-status treatment—we also estimated random-effects regressions including the test score. Interestingly, higher-scoring peripheral subjects contribute significantly larger amounts in the high-status case, where a high-scoring subject occupies the central position, but a higher score is associated with significantly lower giving by subjects in the low-status treatment. Among the high-scoring central players, a higher score is associated with lower giving. There is no effect of score on giving by low-status players.

Table 5: Punishment rates by status manipulation (standard deviation between brackets)

		Number of Subjects	Punishment Sent	Punishment Received
High status	Central players	10	1.10	1.79
			(1.77)	(1.56)
	Peripheral players	*30*	*0.59*	*0.37*
			(0.82)	*(0.60)*
Low status	Central players	10	1.91	2.32
			(2.21)	(1.10)
	Peripheral players	*30*	*0.77*	*0.64*
			(0.62)	*(1.19)*

Statistical tests assuming one observation per subject:
(i) Punishment sent and received by central subjects is NOT significantly different between High- and Low-Status treatments (p-value = .38 and .39, respectively).
(ii) Punishment sent and received by peripheral subjects is NOT significantly different between High- and Low-Status treatment. (p-value = .35 and .27 respectively).

Is there a systematic pattern to punishment? We first estimate the peripheral players' willingness to punish the central players using random-effects logit regression, as shown in Table 6. In this model, the dependent variable is 1 if the peripheral player chose to punish the central player. We include as independent variables dummy variables for status, the period to model a time trend, and an interaction of the time trend with high status. We also include by now familiar measures of the behavior of the central player that might inspire punishment by peripheral players. These measures are the difference between the central player's contribution and the group average, $|c_{*,t-1} - \bar{c}_{t-1}|$, conditional on whether the central player is higher or lower. We also include as a variable the punishment received in the previous period by the peripheral player to attempt to capture retaliatory punishment. The likelihood of punishment declines with period. In both treatments peripheral players are attentive to the central player and are more likely to punish if the central player's contribution is below the average. The major difference between the treatments is that peripheral players retaliate (at a significance level of $p < 0.1$ only) when they have been punished previously by a low-status central player. This is not true of high-status peripheral players, as shown by the negative coefficient on the interaction. (Though this interaction is not significant, it is enough to wipe out the marginal significance of the main effect.)

The second model is a random effects tobit regression of the number of punishment tokens sent by the peripheral players. Again we see that the peripheral players are attentive to the central player's behavior and punish below-average contributions. There is also clearer evidence of retaliatory punishment, again only for the low-status peripheral players.

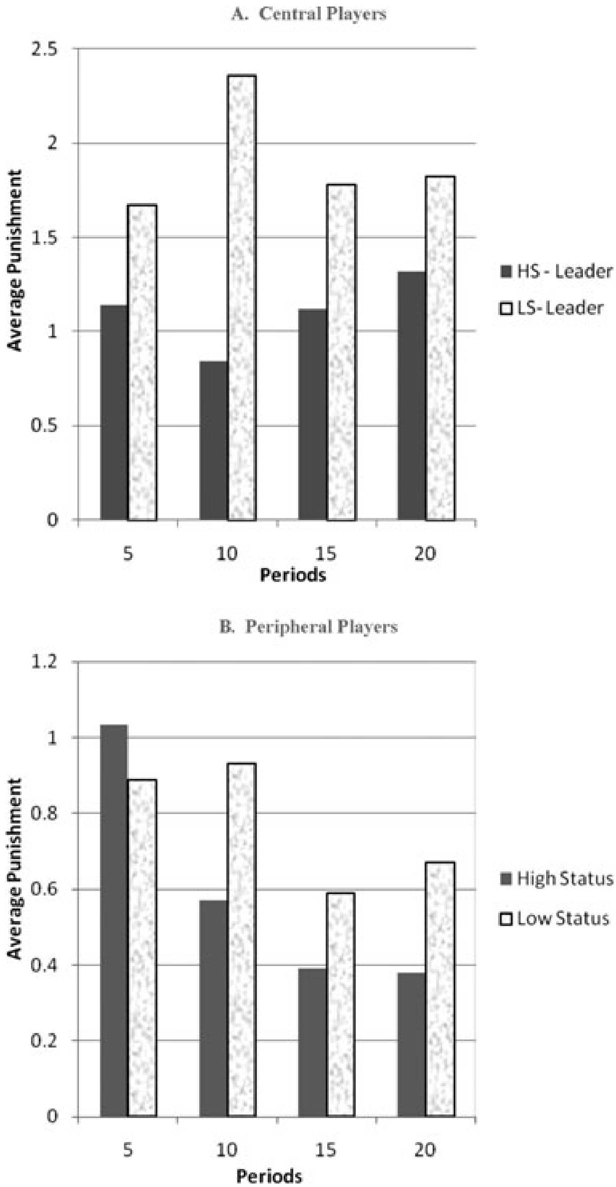

Figure 4: Histogram of average punishment tokens sent broken out by blocks of five periods. Panel A is for central players and represents the average number of tokens sent to all peripheral players (divide by 3 to get tokens per peripheral player). Panel B represents the average number of punishment tokens sent by peripheral players to the central player.

Table 6: Punishment of the central player by peripheral players. Marginal effects are reported. Model 1 is estimated using random effects logit (Stata's XTLOGIT estimator) and Model 2 is estimated using random effects Tobit (Stata's XTTOBIT)

Dependent Variable	(RE LOGIT) Peripheral Player Punished Central Player (1 = Yes, 0 = No)	(RE TOBIT) No. of Punishment Tokens Sent (0–10)
High status (HS)	−0.683	−0.190
(1 = High Status, 0 = Low Status)	(0.659)	(0.233)
Period (1–40)	−0.054*	−0.008
	(0.021)	(0.008)
HS × Period	−0.051	−0.018
	(0.034)	(0.012)
Central player contributions above group average	−0.024	−0.003
$\lvert c_{*,t-1} - \bar{c}_{t-1}\rvert$ if $c_{*,t-1} \geq \bar{c}_{t-1}$, 0 otherwise	(0.023)	(0.008)
HS × Previous variable	0.0052	−0.015
	(0.053)	(0.020)
Central player contributions below group average	0.088***	0.036***
$\lvert c_{*,t-1} - \bar{c}_{t-1}\rvert$ if $c_{*,t-1} < \bar{c}_{t-1}$, 0 otherwise	(0.019)	(0.007)
HS × Previous variable	0.052	0.027#
	(0.042)	(0.014)
Lagged number of punishment tokens received by the peripheral player	0.141#	0.061*
	(0.079)	(0.030)
Interaction HS × Previous variable	−0.088	−0.049
	(0.151)	(0.055)
Observations	1140	1140
Pseudo R^2	.10	.06
ll	−494.2	−1076.5

Marginal effects; Standard errors in parentheses.
(d) for discrete change of dummy variable from 0 to 1.
$^{\#}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

What about central players? Table 7 contains similar regressions for the central players. On the right-hand side we include the period and the peripheral player's deviation from the central player's contribution $|c_{i,t-1} - c_{*,t-1}|$, again divided into two variables depending on whether the peripheral player was above or below the central player. Finally, we include the extent to

Table 7: Punishment by the central player of peripheral players. Marginal effects reported. Model 1 is estimated using random effects logit (Stata's XTLOGIT estimator) and Model 2 is estimated using random effects Tobit (Stata's XTTOBIT)

	(1) Central Player Punished Peripheral Player? (1 = yes, 0 = no)	(2) No. of Punishment Tokens Sent (0–10)
High status (HS)	−0.055	0.062
(1 = High Status, 0 = Low Status)	(1.305)	(0.378)
Period (1–40)	−0.063*	−0.012#
	(0.025)	(0.007)
HS × Period	−0.014	−0.006
	(0.039)	(0.010)
Peripheral player's contribution	−0.016	−0.003
above central player	(0.014)	(0.004)
$\lvert c_{i,t-1} - c_{*,t-1} \rvert$ if $c_{i,t-1} \geq c_{*,t-1}$, 0 otherwise		
Interaction HS × Previous	−0.082**	−0.020*
variable	(0.031)	(0.009)
Peripheral player's contribution	0.113***	0.039***
below central player	(0.013)	(0.011)
$\lvert c_{i,t-1} - c_{*,t-1} \rvert$ if $c_{i,t-1} < c_{*,t-1}$, 0 otherwise		
Interaction HS × Previous	0.032	0.003
variable	(0.027)	(0.006)
Lagged number of punishment	0.063	0.017
tokens received	(0.090)	(0.022)
Interaction HS × Previous	0.137	0.038
variable	(0.157)	(0.035)
Observations	1140	1140
Pseudo R^2	.10	.08
ll	−380.1	−758.8

Marginal effects; Standard errors in parentheses, (d) for discrete change of dummy variable from 0 to 1.
$^{\#}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

which a particular peripheral player punished the central player in the previous period, which allows us to check for retaliatory punishment. Both the likelihood of punishment and the punishment tokens sent fall over time. When the peripheral player's contributions are above average, there is significantly less punishment sent to them by high-status central players, but not for low-status central players. When the peripheral players contributions are below there is more punishment by both high- and low-status central players. There is no evidence of retaliatory punishment. Taken as a whole, these findings are consistent with Hypothesis 2—peripheral players are responsive to high-status punishment and high-status central players use punishment sparingly.

4.4. Efficiency

Many experiments beginning with Fehr and Gächter (2000) find sanctioning mechanisms to increase public good provision. At the very least, the baseline trend of decay is substantially mitigated by punishment (see Page, Putterman, and Unel 2005, Carpenter 2007). This happens under a variety of conditions, even when punishment imposes no material harm, as in Masclet et al. (2003). (See also Yamagishi 1986, 1988). In this section, we provide two measures of efficiency. First, we measure the effectiveness of punishment as a contribution-enhancing mechanism in the different status conditions. Second, we extend the analysis to welfare. Given that punishment is costly for both punishers and punished individuals, welfare gains require that higher public good profits exceed the losses associated with punishing behavior.

We first compare donations in the first 20 periods with those in periods 21–40. Figure 5 plots the contribution gains associated with punishment. For every subject, we compute the difference between her individual contribution in every round of the punishment game and the same contribution in the same period of the earlier VCM. By inspection, and in line with our previous findings, contribution gains are significantly different from zero only in the low-status treatment.[10]

Studies vary widely in the efficiency of punishment.[11] In line with Sefton, Shupp, and Walker (2007) and Page, Putterman, and Unel (2005) our second analysis measures efficiency as actual group earnings as a percentage of maximum possible earnings. This measure ranges from 0 (if all subjects earn zero) to 100 (if all contribute 100% and do not punish.) Figure 6 plots the

[10]We run a Wilcoxon signed-rank test at the group level to compare contribution levels. Recall there are 10 independent group-level observations for each treatment and status condition. The test suggests that contribution in the second block is significantly larger than in the first one for the low-status treatment ($p = 0.035$), while no significant differences are found for high status ($p = .870$).

[11]See Carpenter (2007), Botelho et al. (2009), Fehr and Gächter (2002), Ostrom, Walker, and Gardner (1992), Sefton, Shupp, and Walker (2007), Carpenter and Matthews (2009), and Anderson and Putterman (2006) who find negative effects on earnings, and Bochet, Page, and Putterman (2006), Page, Putterman, and Unel (2005), Nikiforakis (2008) and van Soest and Vyrastekova (2007) who find no effect.

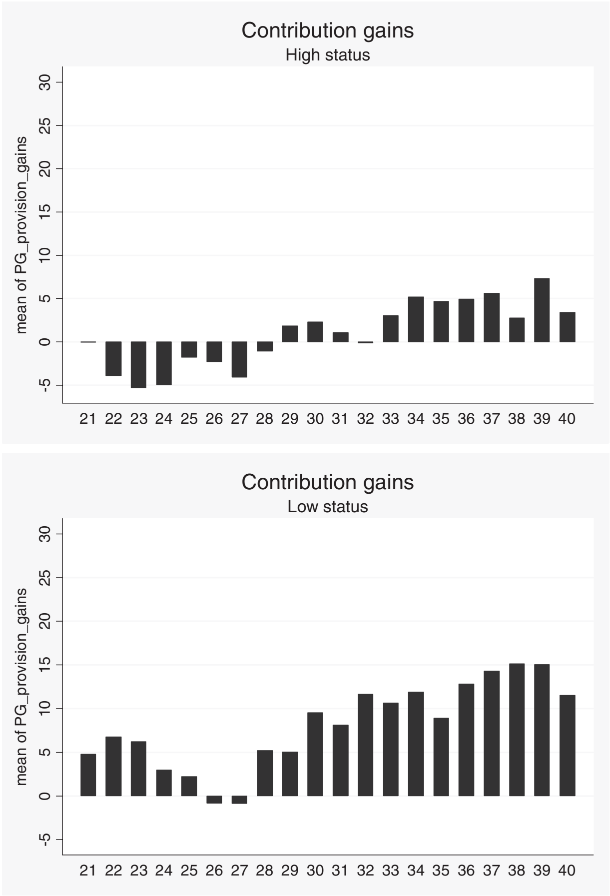

Figure 5: Provision gains
(Contribution in punishment treatment—contribution in no-punishment), by status.

average efficiency of the punishment game per round, by role and status. Clearly earnings are higher for peripheral players, and are similar for those players regardless of status. On the other hand, central players earn more in the high-status condition. For low-status central players, gains in contributions are more than offset by losses due to punishment. While Fehr and Gächter (2000) find that efficiency increases over 10 rounds, in line with Page, Putterman, and Unel (2005) we find that the dynamics of earnings are rather flat, and again mediated by status and roles. Players' performances do not improve over time, suggesting that efficiency is independent of the number of repetitions.

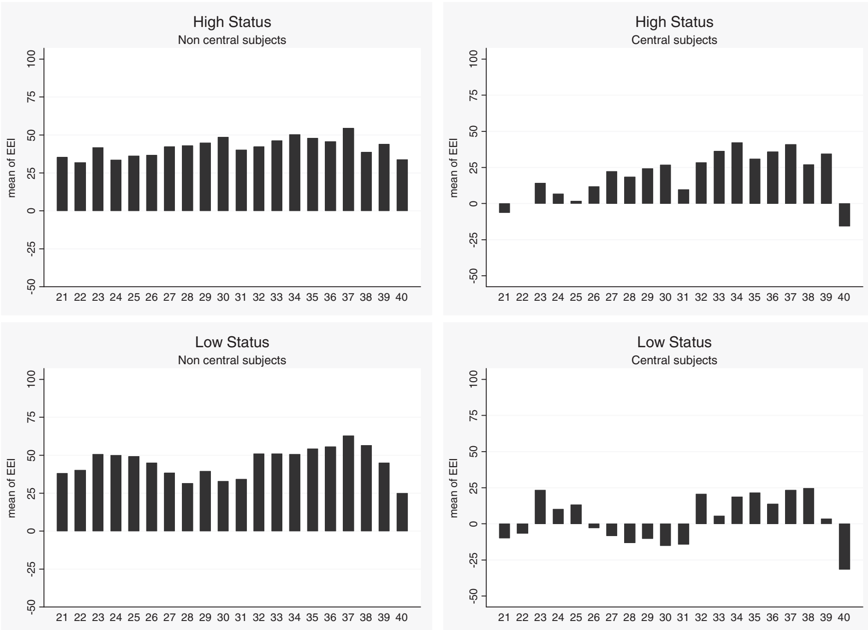

Figure 6: Earnings in the PUN game
(Includes public good provision less punishment costs).

5. Conclusion

Status matters. The decisions of a central, commonly observed player affect the decisions of peripheral players: central players serve a leadership role. Our results support our hypotheses, in the sense that peripheral players are more likely to mimic the behavior of high-status central players and high-status central players punish and are punished less. But our findings point out that higher status of a central player does not automatically lead to superior outcomes in the form of higher contributions. Our experiment analyzes to what extent the efficiency-enhancing role of status in other games is reproduced in a social dilemma. This game is played in fixed groups where the leading role of the central player is determined by a score on a trivia quiz. We believe that this relatively weak status-inducing mechanism generates a strong test for the role of status in repeated games. The score on the test is a kind of 'diffuse' status characteristic that influences how subjects play the game.

The role of the central players is reinforced by the network structure of the team (a star network). The central player alone has individual information about all the other group members. In our experiment, all subjects participated in two subsequent games: a linear public good game based on the voluntary contributions to the public good and a variant of this game in which subjects can punish at a cost, as in Fehr and Gächter (2000). This common sequence makes it simpler to understand the effect of status in two similar settings with very different behavioral patterns.

On average, induced status does not generate significant differences across treatments in the first game (VCM). At the individual level, however, we do observe that the peripheral players imitate high status more than low-status central players. High- and low-status leaders contribute the same (being a central player does not make a difference on average), but with greater variability among low-status central players. More interestingly, peripheral players always follow their leaders when those leaders contribute less than their own contributions. But they only follow the central players upwards (increasing their contribution) when the status of the leader is high.

These decisions are consistent with the existence of deferential behavior. Subjects are more attentive to high-status central players. Subjects are deferential only to high-status central players. Even though this weakly salient commonly observed signal should not matter in the repeated VCM, it does. This pattern fits with the results obtained in the punishment game.

Our results suggest that punishment, while important to enforcing cooperative norms in many social dilemmas, does not boost contributions in all instances. Punishment is used more readily by low-status groups, and increases overall contributions only among low-status groups. However, this seems to be primarily a main effect of the punishment institution, as there is little evidence that punishment tokens levied actually increase contributions in low-status groups; indeed there is weak evidence that the response to punishment is greater in high-status groups. Retaliatory punishment of central players is seen only in the low-status groups.

An unexpected consequence of these differences is that punishment is not efficiency-enhancing when the status of the central player is high. Costly punishment is used less in these groups, but contributions are not higher than without punishment. This generates a flat contribution pattern, and no differences between the VCM with and without punishment opportunities. At the other extreme, low-status central players punish and are heavily punished, and make significantly less money in the experiment than any other type of subject. But the reaction of low-status groups to the new environment generates a significant increase in the provision of the public good.

This research provides insight into leadership and the circumstances under which central players as role models can have a strong influence on aggregate play. In a team, the existence of a central role is not sufficient to create effective leadership: the status of the leader—the way in which the leader is chosen—clearly determines the extent to which the rest of the subjects follow. In teams with high-status central players, subjects are more likely to go along with the central player, but the leader does not necessarily set a good example. The main result of this work is surprising and novel. On the one hand, a high-status leader must be willing to risk making unilaterally high contributions to the public good, in the expectation that peripheral players will follow. On the other hand, low-status leaders need punishment in order to be effective, while their high-status counterparts do not.

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