The Fear of Exclusion: Individual Effort when Group Formation is Endogenous

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Abstract

To secure their membership in a popular group, individuals may contribute more to the group's local public good than they would if group formation were exogenous. Those in the most unpopular group do not have this incentive to contribute. Substantial differences in individual effort level between groups may be the result. The model thus provides one explanation for the existence of group-specific behavioral norms. A principal will prefer exogenous or endogenous group formation depending on whether he prefers high or low levels of the local public good. We analyze two stylized examples: Social interaction in schools, and multiple-task teamwork.

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JEL codes: C72, D11, D23, L24, Z13.

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1 Introduction

When interacting with others in a group, people care about who those others are and how they behave. Football players want their team-mates to be good players, team-workers want their colleagues to be efficient and reliable, and most people prefer to have attentive friends. To secure group relationships which are valuable to them, people may be willing to make substantial efforts: For example, athletes exercise more to keep their place on the team, and people keep appointments with their friends even when they really want to be somewhere else. In short, fear of exclusion from a popular group can make individuals strive to make themselves more attractive as group members. This requires, of course, that the individual's membership in the group can in fact be influenced by his behaviour. If group membership is exogenous to individuals, people may still fear exclusion, but since there is nothing they can do to prevent it, this fear may not affect their behaviour.

In this paper, we propose a model of group formation which may explain why norms for socially acceptable behavior vary between groups. Several economists have maintained that group norms can affect behavior in teams (e.g. Encinosa, Gaynor, and Rebitzer 1997, Knez and Simester 1999, Ichino and Maggi 2000, Hamilton et al. 2003, Akerlof and Kranton 2003). So far, however, few economists have focused on why different teams have different group norms[1]. In the present paper we demonstrate that when people are allowed to self-select into teams, group norms will depend on the comparative advantage of the group members. This has important implications for principal-agent theory. Indeed, a principal can use the choice of exogenous versus endogenous team formation as an instrument to influence agent behavior. This result adds to the recent strand of research integrating behavioral economics and principal-agent analysis (see e.g. Fehr et al. 1997, Benabou and Tirole 2003) demonstrating that social aspects of human interaction – as in our case, the existence of a social sanction mechanism within groups – can have substantial impact on agent behavior.

We study a population which is to be divided into two equally large groups (school classes, work teams). Each agent shares his time between producing a private good (academic achievement, sales activity, writing single-author papers) and contributing to a group-specific local

[1] One exception is Rob and Zemsky (2002), who show that when workers have reciprocal preferences and the workforce of each firm is fixed, optimal choice of incentives can lead to cultural differences between firms.

public good (social activity, helping co-workers, writing jointly authored papers). Agents have identical preferences for the private good, the local public good, and possibly their own contribution to the local public good (e.g. social activity may both be pleasant and provide benefits to other group members); but they differ with respect to their ability in both private and local public goods production. All else given, everyone prefers to be a member of the group with highest local public good provision. In order to secure their membership in this popular group, agents may be willing to contribute more to the local public good – and hence also produce less of the private good – than they would if group formation were exogenous. We analyze endogenous group formation in a non-cooperative game. In equilibrium, the popular group consists of those who have a comparative advantage in producing the local public good; and in this group, many members – though not necessarily all – contribute more to the local public good than they would if groups were formed exogenously.

Group formation has been studied extensively within club theory (see e.g. Tiebout's (1956) seminal paper on "voting with your feet", or the surveys of Schotchmer (2002) and Cornes and Sandler (1986)).[2] This literature focuses on competition for members between a large number of endogenously sized clubs, such as electorates offering different local public goods and tax levels. In the present analysis, there are no local authorities that can coordinate and enforce members' contributions; indeed, individual contributions cannot be enforced through formal contracts at all. However, contributions may be enforced through informal sanctioning within the group. Under these assumptions, we study how a non-cooperative group formation game can change individuals' behavior, compared to the case of exogenous group formation, and how knowledge of this can be useful to a principal wishing to influence agent behavior.

Our framework can be used to analyze a variety of phenomena, such as the formation of professional partnerships (see Landers et al., 1996), religious groups (Berman 2000), or "high society", where people throw excessively expensive parties to secure their position among the rich and famous. After presenting our general framework below, we will focus on two stylized applications. The first is a case of moral hazard in a multiple-task teamwork situation; the second concerns the relationship between social exclusion and students' efforts in schools.

[2] For a discussion of evolutionary aspects of group formation, see Bergstrom (2002).

2 A model of team formation

Consider a population that is to be divided into two equally sized groups[3]. Individuals are identical except for their abilities. Each individual i has to share his total available time (normalized to 1) between individual activities, r_i, and group activities, ℓ_i:

$$r_i + \ell_i = 1. \tag{1}$$

Time spent on individual activities produces a private good x_i,

$$x_i = w_i r_i, \tag{2}$$

where $w_i \geq 0$ denotes i's ability in production of the private good. Similarly, time spent on group activities produces a local public good, where the production function for individual i is given by

$$s_i = v_i \ell_i, \tag{3}$$

where $v_i \geq 1$ denotes i's ability in local public good production. Note that the assumption $v_i \geq 1$ implies that each person can produce at least one unit of the local public good.

We assume that i's contribution to the public good s_i is observable by fellow group members, but not by any observer external to the group, such as a principal. We further assume that abilities w_i and v_i are known to i himself, but cannot be observed by others.[4]

Let the average local public good production in i's group (i.e. average s_i in the group) be denoted S_i. Each individual i benefits from his production of the private good, x_i, and average contribution to the local public good in his group, S_i. In addition, we allow that the individual derives utility from his own contribution to the local public good, s_i. Let the preferences of each individual be represented by the following utility function[5]:

$$u_i = x_i + \rho f(s_i) + \gamma g(S_i) \tag{4}$$

[3] This assumption is chosen for the purpose of simplification. Introducing more than two groups would not change the logic of the argument substantially, but allowing group size to vary endogenously would complicate our analysis considerably.

[4] This rules out inference of s_i via the individual's time budget. It also rules out direct allocation of group membership based on individual abilities, as well as any incentive mechanism requiring knowledge of individual abilities.

[5] Linear separability is assumed for the case of simplification.

where $\gamma > 0$, $\rho \in \{0,1\}$ and f and g are strictly increasing and strictly concave. While the notion that individuals have preferences for their own contributions may be unfamiliar to economists, the inclusion of $\rho f(s_i)$ in the utility function is motivated by our focus on informal social interaction and the idea that contributing in a social interaction could be conceived as pleasant or interesting in its own right (for example going to a party).[6] If $\rho = 0$, individuals do not have preferences for their own contribution.

Inserting (1) - (3) in (4) yields

$$u_i = w_i (1 - \ell_i) + \rho f(v_i \ell_i) + \gamma g(S_i) \tag{5}$$

If group membership were exogenous, so that i's membership were independent of s_i, the individual would simply maximize utility (5) with respect to ℓ_i. We assume that the population is a continuum, where each individual has no mass, hence the individual will treat S_i as fixed in this maximization. In the following, we will refer to i's *unconstrained contribution* as that contribution to the local public good i would make if group membership were exogenous.

If $\rho = 0$, (5) is maximized when i spends no time at all on group activities. If $\rho = 1$, maximization of (5) yields the following first order condition for an interior solution:

$$f'(s_i) = \frac{w_i}{v_i} \equiv \Omega_i \tag{6}$$

Note that the fraction $\frac{w_i}{v_i} \equiv \Omega_i$ denotes how many units of the private good the individual must give up to produce one more unit of the local public good. Thus, in the following Ω_i will be referred to as i's *opportunity cost.*

In the following, we will assume that when $\rho = 1$, parameters are such that (6) has an interior solution. This simplifies the notation considerably without affecting the main insight of the paper. We now have the following lemma:

Lemma 1 *Individual i's unconstrained contribution to the local public good, $\hat{s}(\Omega_i)$, is given by*

$$\hat{s}(\Omega_i) = \begin{cases} 0 & \text{if} \quad \rho = 0 \\ f'^{-1}(\Omega_i) & \text{if} \quad \rho = 1 \end{cases}. \tag{7}$$

[6]Note also that – although the context is different – this corresponds closely to Andreoni's (1990) "impure altruism".

We will now assume that the opportunity cost, Ω_i, is uniformly distributed $[m-h, m+h]$, where m is the opportunity cost for the median person, while $h < m$ measures the heterogeneity of the population. People may have different opportunity cost because they differ in abilities for private good production, in abilities for local public good production, or in both.

Assume now that the population is partitioned into a popular and an unpopular group through the following group formation game:

The Group Formation Game

- Each individual makes a commitment, c_i, of how much he will contribute to local public good production if accepted into the popular group.
- An initiator invites half the individuals to become members of the popular group[7]. The remaining individuals form the unpopular group.
- Each individual chooses s_i, how much to contribute to the local public good, subject to the constraint that $s_i = c_i$ if i is in the popular group. Payoff is then determined by (4).

In deriving our results, we will assume that there exists a mechanism making commitments c_i credible. The kind of mechanism we have in mind is that of social sanctions between group members.[8] For example, members of the popular group can turn their backs to a fellow member breaking his promise, simply ignoring him; a sanction which may be considered costless to the sanctioner, while still sufficiently severe to make it optimal to keep promises. Below, we will focus on equilibria where individuals choose to use these sanctions if promises are broken.[9] Moreover, we will assume that side payments in terms of individual production x_i are not possible[10].

[7] This is similar to Harstad (2005). Since the population is a continuum our analysis is independent of how the initiator is selected. However, it may be natural to think of the initiator as the individual who has given the highest commitment.

[8] See Kandel and Lazear (1992) for a formal discussion of such social sanctioning mechanisms.

[9] Assuming existence of such sanctioning mechanisms seems reasonable in light of the substantial recent experimental evidence of reciprocal preferences (see e.g. Fehr and Falk 2002) and strictly positive willingnesses to pay to punish norm violators (Fehr and Fischbacher 2004).

[10] In this model the individual will only allocates time between the use for private benefits and the group. To allow for side payments, the individual also has to allocate income between private use and the group. To

Since an individual's utility is increasing in the local public good, everyone prefers, *ceteris paribus,* to be in the group providing the highest S_i. Hence, the initiator will always invite the individuals with highest commitments to become members of the popular group. Let p denote the popular group and u the unpopular group, and let S^G denote the local public good supply in group $G \in \{p, u\}$. Then, $S^p \geq S^u$. This provides an incentive to commit more than one's unconstrained contribution $\hat{s}(\Omega_i)$ to be allowed into the popular group.

Any individual will now consider whether the benefit of popular group membership is high enough for her to be willing to provide the minimum required contribution. Let s be a requirement to achieve popular group membership. If $s \leq \hat{s}(\Omega_i)$, individual i satisfies the requirement simply by committing to her unconstrained contribution $c_i = \hat{s}(\Omega_i)$. If $s > \hat{s}(\Omega_i)$, however, the individual will have to contribute something extra to gain membership in the popular group. Individual i's utility given that she chooses to become a member of the popular group can be written as follows (noting that $x_i = w_i(1 - \ell_i) = w_i - \Omega_i s_i$):

$$U_{i,p} = w_i - \Omega_i s + \rho f\left(s\right) + \gamma g\left(S^p\right) \tag{8}$$

If she instead seeks membership in the unpopular group, she will provide only her unconstrained contribution. This gives the following utility:

$$U_{i,u} = w_i - \Omega_i \hat{s}(\Omega_i) + \rho f\left(\hat{s}(\Omega_i)\right) + \gamma g\left(S^u\right) \tag{9}$$

Thus, for individuals with $\hat{s}(\Omega_i) < s$ the gain from being in the popular group is given by

$$\Delta U\left(\Omega_i; s\right) = -\Omega_i\left(s - \hat{s}(\Omega_i)\right) + \rho\left(f\left(s\right) - f\left(\hat{s}(\Omega_i)\right)\right) + \gamma\left(g\left(S^p\right) - g\left(S^u\right)\right) \tag{10}$$

Note that since $\Omega_i = f'(\hat{s}(\Omega_i))$ when $\rho = 1$, and $\hat{s}(\Omega_i) = 0$ when $\rho = 0$, it follows that

$$\frac{\partial \Delta U}{\partial \Omega_i} = -\left(s - \hat{s}(\Omega_i)\right) < 0 \tag{11}$$

Thus we have the following Lemma:

Lemma 2 *A person's net benefit of entering the popular group is decreasing in Ω_i, her opportunity cost of local public good production.*

keep the analysis simple we have avoided this two dimentional case, but at the end we briefly discuss a case where income and not time is allocated between private use and the group.

Note that this lemma holds irrespective of whether people have preferences for their own contributions ($\rho = 1$) or not ($\rho = 0$). Thus, if $S^p > S^u$ in equilibrium, it follows from Lemma 2 that those who have a comparative advantage in local public good production (i.e. $\Omega_i < m$) will be in the popular group, while those with a comparative advantage in private good production (i.e. $\Omega_i > m$) will be in the unpopular group.

Let the lowest contribution among the members of the popular group in equilibrium be denoted by $\bar{s}$. An individual's local public good production in equilibrium, $s^*(\Omega_i)$, is given by

$$s^*(\Omega_i) = \begin{cases} \hat{s}(\Omega_i) & \text{if } \Omega_i > m \\ \max\{\hat{s}(\Omega_i), \bar{s}\} & \text{if } \Omega_i \leq m \end{cases}. \tag{12}$$

Note that if $\rho = 0$, then $\hat{s}(\Omega_i) = 0$; hence $s^*(\Omega_i) = \bar{s}$ for all i such that $\Omega_i \leq m$.

If $S^p > S^u$ in equilibrium, then the average contribution in each group is given by

$$\begin{aligned} S^u &= \int_m^{m+h} s^*(\Omega_i)\, d\Omega_i \\ S^p &= \int_{m-h}^{m} s^*(\Omega_i)\, d\Omega_i \end{aligned} \tag{13}$$

In equilibrium, a marginal person ($\Omega_i = m$) must be indifferent between the two groups. Thus, the minimum contribution required to obtain membership in the popular group in equilibrium, $\bar{s}$, is determined by

$$\Delta U(m; \bar{s}) = 0 \tag{14}$$

Below, we will focus on Nash equilibria in which $\bar{s} \leq 1$, implying that membership in the popular group is feasible for everybody.[11]

The following Lemma is proven in the Appendix:

Lemma 3 *Assume that $\Delta U(m, 1) < 0$. Then, if $\rho = 1$ and/or $\gamma g'(0) > m$ then there must be at least one solution $\bar{s} \in (0, 1)$ to equation (14).*

Let $c(\Omega_i)$ denote the equilibrium commitment of person i. Clearly, if $\Omega_i \leq m$, then $c(\Omega_i) = s^*(\Omega_i) \geq \bar{s}$; while if $\Omega_i > m$, $c(\Omega_i) \leq \bar{s}$. Any member of the popular group

[11] This assumption simplifies the analysis, but is not essential. A discussion of the case when the minimum requirement may be unattainable to some individuals can be found in Brekke et al. (2005), Appendix B.

promising strictly more than her unconstrained contribution $\hat{s}(\Omega_i)$ would have preferred to lower her commitment, had she not by that lost her popular group membership. Thus, in equilibrium, some individuals in the unpopular group must have commitments arbitrarily close to the minimum requirement $\bar{s}$. Let $\bar{c}(\Omega_i)$ denote the commitment that makes person i indifferent between membership in the popular and the unpopular group, i.e the solution to $\Delta U(\Omega_i; \bar{c}) = 0$. Thus, $\bar{c}(\Omega_i)$ is i's maximum willingness to contribute. Then, individual i's commitment is given by

$$c(\Omega_i) = \begin{cases} s^*(\Omega_i) & \text{if } \Omega_i \le m \\ \bar{c}(\Omega_i) & \text{if } \Omega_i > m \end{cases} \tag{15}$$

Note that by definition $\bar{c}(m) = \bar{s}$. By continuity, $\bar{c}(\Omega_i) \to \bar{s}$ as $\Omega_i \downarrow m$. Thus, when every individual's commitment is as specified by equation (15), no-one has an incentive to change her commitment (recall that the commitment is conditional on being allowed into the popular group).

Thus, we have the following theorem:

Theorem 1 *Assume that $\Delta U(m, 1) < 0$, and that either $\rho = 1$ and/or $\gamma g'(0) > m$. Then there exists a Nash equilibrium in which individuals with a comparative advantage in local public good production (i.e. all i such that $\Omega_i < m$) are in the popular group, and those with a comparative advantage in private good production (i.e. all i such that $\Omega_i \ge m$) are in the unpopular group. Each person's actual contribution to local public good production is determined by equations (12) - (14). Each person's commitment is given by equation (15).*

The requirement that $\Delta U(m, 1) < 0$ ensures that $\bar{s} < 1$, so that the minimum requirement $\bar{s}$ is feasible even for individuals with low social abilities ($v_i = 1$).[12]

Note that when $\rho = 0$, i.e. people have no preference for their own contribution, then $\bar{s} = 0$ constitutes an equilibrium: In this case, $S^p = S^u = 0$, yielding no benefits of membership in one group as opposed to the other. However, the condition $\gamma g'(0) > m$ ensures that the local public good is sufficiently important to allow for another equilibrium, in which $\bar{s} > 0$.[13]

[12] See footnote 11.

[13] Note that for $\rho = 0$ there will be no production of the local public good in the unpopular group. In this case an alternative interpretation is that there is only one group, and that w_i an outside option available for those who do not join the group.

If people care for their own contribution ($\rho = 1$), then their unconstrained contributions will be strictly positive; this implies $S^p > S^u$, so popular group membership does secure a strictly higher level of the local public good. In this case, every equilibrium will sort individuals perfectly into groups based on their opportunity cost.

Hence, endogeneous group formation can be regarded as a screening device: Although neither absolute nor relative abilities are observable as such, the population is separated according to their relative ability, i.e. their opportunity cost, in equilibrium. One implication of Theorem 1 is thus that a principal external to the groups can use exogenous versus endogenous group formation as a tool to influence agents' behavior.

With endogenous group formation, marginal individuals will provide an effort strictly above their unconstrained supply, and by continuity the same applies to all near marginal individuals. Hence, endogenous group formation can induce some individuals to increase their local public good production. Conversely, disallowing endogenous group formation can decrease local public good production. From the principal's point of view, the optimal choice of group formation mechanism depends, of course, on whether increased production of the local public good is beneficial or detrimental to the principal's interests.

3 Teamwork

Our setting of our first application, which exemplifies how a principal can benefit from using endogenous team formation, is a firm where team members share their time between group tasks and individual tasks.

Holmstrom (1982) demonstrated that teamwork conditions may create a moral hazard problem with substantial free-riding. Further, Holmstrom and Milgrom (1991) showed that when agents have multiple tasks, and effort is not verifiable for some tasks, high-powered incentives may work badly, since it increases effort on observable tasks at the expense of the unobservable tasks. While much of the literature on these issues has focused on optimal payment schemes, we show that endogenous group formation can reduce the free-riding problem; moreover, we show that the potential improvement is increasing in the heterogeneity of workers' relative abilities.

Consider a firm in which individuals work together in one of two equally large teams, governed by a common principal. Each worker i has to choose how to share his time between two types of tasks. Let r_i denote the time spent by i on individual tasks, such as sales activities, writing single-authored papers, seeing patients or clients, while ℓ_i is the time spent on tasks increasing output for everyone on the team, such as marketing, working on co-authored papers, collection and dissemination of information, or taking part in group discussions (e.g. discussing others' difficult patient or client cases). Each individual produces a verifiable output y_i, which is increasing in private time r_i, in ability w_i, and in the average contribution to group tasks from members of his team, S_i:[14]

$$y_i = w_i r_i + \gamma g(S_i) \tag{16}$$

The worker's contribution to group tasks s_i, which we may think of as helping, is produced according to (3), i.e. $s_i = v_i \ell_i$. Contributions of help are observable to other team members, but cannot be verified by the principal. The principal, however, observes y_i, and rewards each person with an exogenously given fraction α of this individual production, keeping a profit per worker of $(1 - \alpha)y_i$. For specialized professions like physicians and lawyers, for example, individual output in terms of successful cases or treatments may be observable, but comments and suggestions from colleagues may be crucial to achieve this performance. Alternatively, and equivalently, we may assume that $x_i = w_i r_i$ and $g(S_i)$ are distinct, observable products, and that employees are paid by a share α of the former and a share $\gamma\alpha$ of the latter. For example, researchers may form a group of co-authors, where $g(S_i)$ is the published version of their co-authored paper, while x_i is co-author i's output of individual papers produced during the same time period.

To simplify the analysis, we assume that the individual cares *only* about his monetary payoff,[15] so that utility U_i can be written as

[14] The type of teamwork discussed here is thus slightly different from that in Holmstrom (1982), who assumes that individual production is not verifiable by the principal. Our focus is rather on the problem of allocating time between multiple tasks (as in Holmstrom and Milgrom 1991). Moreover, the solution to moral hazard in teams proposed by Holmstrom (1982) would not apply to our setting with continuous population.

[15] This is not crucial, but makes the example more transparent.

$$U_i = \alpha y_i. \tag{17}$$

Inserting (16) in (17), and using (2), yields an expression which is a monotone transformation of the utility function (4) of the general model presented above, with $\rho = 0$. Lemma 1 then implies that with exogenous group formation, no-one will contribute anything to group tasks: Without the threat of exclusion, each team member spends all his time on r_i, individual tasks. This is a standard public good problem; everybody would prefer a situation in which all team members contributed, but no-one has an individual incentive to do so.

Assume now that group formation is endogenous. Then, it follows from Theorem 1 (provided its conditions are satisfied) that there exists an equilibrium in which the popular group consists of those workers who have a comparative advantage in helping activities (i.e. $\Omega_i < m$), while the unpopular group consists of those with a comparative advantage in individual production[16]. In the popular group, people help each other by contributing $\bar{s}$ to group tasks. In the unpopular group, no help is provided to others.

The principal is interested in promoting the groups' total production, and thus prefers that workers share their time efficiently between the two tasks. However, since he cannot observe contributions, few instruments are available to reduce the free-rider problem discussed above. Nevertheless, the principal can use the fact that although *he himself* does not observe contributions, fellow teamworkers do: By allowing endogenous team formation, the principal can indirectly benefit from the the existence of an informal sanctioning mechanism among workers, and thus let the fear of exclusion from the popular team be the incentive to help others.

Since $\bar{s} > 0$, endogenous team formation will induce every individual in the popular group to contribute more to group tasks than he would with exogenous team formation, while the behavior of members of the unpopular group is unaffected. Note that $\bar{s}$ can be either higher or lower than that level of s which would have maximized total production in the popular group.

The productivity gain from endogenous group formation for an average worker in the

[16] There also exists an equilibrium with no production of the local public good, i.e. $S_p = S_u = \bar{s} = 0$.

popular group, as compared to the exogenous groups case, is in fact proportional to the level of heterogeneity in the population: Compared to the case with $s = 0$, the productivity gain of an average worker equals $\gamma g(\bar{s}) - (m - h/2)\bar{s} = h\bar{s}/2$, where the latter equality is derived from the equilibrium condition $\gamma g(\bar{s}) = m\,\bar{s}$, and where h is a measure of population heterogeneity as discussed above. While the gain from endogenous group formation can be substantial when workers have very different relative abilities, it can thus be negligible if workers are almost identical. The reason is that in the latter case, the competition to get into the popular group becomes so fierce as to produce inefficiently high contributions.

A principal might perhaps wonder whether S^p thus could become too large, i.e. whether the desire to be accepted in the popular team could induce workers to divert so much attention to group tasks, at the expense of individual tasks, that it would be more profitable to let team formation be exogenous after all. This can never be the case, however: The principal will always benefit from endogenous team formation. Endogenous team formation makes everybody in the popular group earn more (otherwise they would not have preferred the popular group); and since the payoff of workers in the unpopular group is unaffected, and the principal receives a fraction of every worker's payoff, the principal's payoff must be higher in the endogenous groups case.

With a slight reinterpretation of model variables, other ways to organize teamwork can be analyzed using our model. First, inserting (16) in (17), rearranging, and using that $r_i = 1 - \ell_i$, we find that (17) can be written as

$$U_i = \alpha\gamma g(S_i) - \alpha w_i \ell_i + \alpha w_i. \tag{18}$$

Now, let $\alpha\gamma g(S_i)$ be the team-worker's monetary payoff, proportional to team production $g(S_i)$, which is observable. Further, let w_i represent the individual's effort costs, where ℓ_i now represents individual effort. The term αw_i is fixed and will thus not affect behavior; consequently, (18) is behaviorally equivalent to $\tilde{U}_i = \alpha\gamma g(S_i) - \alpha w_i \ell_i$. The latter expression can be interpreted as the utility of a teamworker who is paid according to her team's total production, and whose utility consists of monetary payoff, $\alpha\gamma g(S_i)$, less her costs of effort $\alpha w_i \ell_i$. Note that it takes an effort $\ell_i = \bar{s}/v_i$ to attain membership in the popular group, and hence the cost of membership is $\alpha\bar{s}\Omega_i$. With this interpreation the model can also be applied for situations where workers are paid according to a group piece-rate only, while group productivity depends on individual efforts.

Hamilton et al. (2003) analyzed data from a garment factory that introduced voluntary team formation. Starting from a situation in which sewers worked independently, performing one specific task and being paid by individual piece-rate, the plant introduced module production, in which autonomous teams of six or seven workers would perform all sewing tasks. If working in teams, workers were sitting together in one room, making mutual monitoring effort easy, thus allowing for informal sanctions. Measurement of output from individual team members, however, was costly for managers. Thus, team members were paid a group piece rate. The researchers found that in spite of the opportunity to free-ride on others' effort, introduction of teams improved productivity by, on average, 18 percent. Further, the first teams to be formed yielded the highest gains. These results are consistent with our model[17]. Finally, in the garment plant case, all teams, even the latest to be formed, increased average productivity. This would be consistent with our model if workers have a preference for social interaction, i.e. $\rho = 1$. Our next example deals with a such case.

4 The unpopular nerds

In the above example, we demonstrated that endogeous group formation can be used as a policy tool for principals who want to influence non-verifiable effort in teams. Below, we will illustrate how our model can be used to understand the formation of group-specific social norms, using endogenous social group formation in schools as our example.

Academic excellence – although frequently envied by others – is not necessarily a trait that makes a student popular among her peers (Eder and Kinney 1995). Sociologists have long been aware that in schools, students categorize themselves into social groups such as "nerds", "jocks" and "burnouts", each group with its separate requirements of appearance and behavior (Coleman 1961, Eckert 1989). The requirements of such social categories seem to

[17] One fifth of the increased producitivty could be explained by the fact that highly productive workers were more likely to join teams; the remaining 14 percent reflects a team effect. The former result is consitent with our model if v_i and w_i covariates such that v_i is increasing more than proportionally in w_i. This could be the case e.g. if return to human capital is higher in teamwork because skills can be taught to other team members.

affect students' school effort, and may hence also indirectly affect the productivity of resources allocated to schools.

Akerlof and Kranton (2003) argue that theories of identity may help explain student performance in school. They assume that different groups, like jocks, nerds, or burnouts, have different ideals for student behavior and performance, and that these ideals affect the behavior of students belonging to those groups. The ideals, however, are exogenous in their analysis. Below, we derive such group-specific ideals endogenously. Our analysis thus provides one possible explanation why devoting time and energy towards academic study in fact seems to make a student *less* socially popular, all else given (Bishop 1999, Lyng 2006)[18]. This can make some students reduce their learning efforts in order to become acceptable as members of a popular group.

To make the argument as transparent as possible, we will make several simplifying assumptions. Most notably, we will assume that students are identical in all respects except academic ability, disregarding differing preferences, wealth, and social ability. We will focus on the case of perfectly endogenous group formation, meaning that teachers do not intervene at all, and describe the equilibrium in this case.

Thus, let each student have preferences for private payoff achieved through school work, x_i, and for social quality, where the latter consists of benefits arising from one's own social activity ($f(s_i)$) and from the social activity of others ($\gamma g(S_i)$). This is as specified in equation (4) above, assuming that $\rho = 1$. Private benefits from studying are increasing in student ability w_i and time spent studying r_i, as specified in (2). Private benefits from studying can for example be future college entry, parent approval, or higher future earnings.[19] A low w_i may be caused either by low academic talent, or by factors external to the individual affecting the rewards he will obtain from his studies.[20] Moreover, assume that $v_i = 1$ for all i, i.e. every

[18] "The students in my study hold that there is a certain inverse connection between the positions of the two hierarchies: Those who want to be cool and hip care less about school, while those who are most committed to school work are not very popular" (Lyng 2006, p.17).

[19] Note that although private, none of these benefits can readily be used by students wishing to make side payments to increase their own popularity.

[20] For example, if i belongs to an ethnic or social minority subject to discrimination in the labor market, and j does not, then even if i and j have the same academic talent, the skills produced from j's effort may yield higher earnings than an equivalent effort from i, implying that $w_i < w_j$.

student is equally productive in contributing to the group's social activity. Referring to the model above, this implies that $s_i = \ell_i$, and $\Omega_i = w_i$.[21]

If students are allowed to form groups endogenously, those who contribute most to the group's social quality will be the preferred group members. This gives students an incentive to contribute more social time, and consequently study less, than they would have done if their group affiliation were exogenous. Theorem 1 above implies that in this (extremely simplified) case, there exists an equilibrium in which a student's popularity will depend on her opportunity cost $\Omega_i = w_i$. Students with low academic ability now have a comparative (although not absolute) advantage in socializing. They will thus be in the popular group, while the most able students will be in the unpopular group. Hence, in equilibrium, students will be perfectly separated according to their academic ability w_i, with the *least* able students being most popular. It follows that students' commitments and actual levels of social activity can be illustrated as in Figure 1.

[Figure 1 about here.]

The higher a student's academic ability, the lower her unconstrained supply of social time, since able students have a high opportunity cost in terms of foregone academic achievements. Further, some students with $w_i < m$ will make commitments which are substantially higher than their unconstrained supply. They do this because if they promised less, somebody else would take their place in the popular group. For those with very low ability, however, unconstrained social activity levels exceed the minimum requirement to become accepted. Hence, these students will contribute even more social time than required by the group – and their popularity is unthreatened. It is those whose ability level is in the middle range, but below the median, who will change their behavior in order to gain popularity. Note, however,

[21] If the teacher had perfect knowledge of w_i, the teacher could simply forbid social activity in school, or otherwise instruct each student how to share her time between studying and social activity; then inferring from each student's academic achievement and the time constraint whether she had kept to the rule. If abilities were observable for students, they would be able to enter explicit contracts with each other. Nevertheless, even in the case of perfect observability of w_i, the analysis of endogenous group formation would be unaffected as long as students cannot, for some reason, enter binding contracts with each other, and teachers allow endogenous group formation to take place.

that although more able students will end up as less popular, and with a lower social quality, their *utility*, including the benefits of academic achievement, will be higher than the utility of less able, but more popular students.[22]

The assumption that students are identical except from academic ability is obviously exceedingly simplistic. Since Theorem 1 allows v_i to vary, the above results can readily be generalized to hold for the case in which students also differ with respect to their social ability. The conclusion is still that those with a comparative advantage in production of social quality are in the popular group, while those with a comparative advantage in academic work are in the unpopular group; but in this case, students who are "good at everything" may, if they do indeed have their *comparative* advantage in social quality production, end up in the popular group. In general, thus, it is not academic ability as such which makes a student unpopular; it is the time and effort devoted to school work, time and effort that could, alternatively, have been spent producing social quality for the group. This conclusion accords well with sociological and pedagocical studies (e.g. Lyng 2004, 2006, Schreiner 2006, Bishop 1999).[23]

If the teacher's goal is to maximize students' academic achievements, and exogenous group formation were indeed possible, she would prefer to use it; because if students can self-select into groups, some of them will choose to spend less time studying in order to secure their membership in the popular group.[24] Here, however, the assumption that the teacher prefers

[22] In his essay "Why Nerds are Unpopular", Graham (2003) asks: "Why don't smart kids make themselves popular?" His answer is that nerds "wants to be popular, certainly, but they want even more to be smart. And popularity is not something you can do in your spare time".

[23] Bishop (1999) quotes a study by Tannenbaum (1960), who provided students at a high school in New York with descriptions of eight fictious students, asking respondents to rate them. Their ratings were as follows: 1) Athlete: brilliant, nonstudious; 2) athlete: average, nonstudious; 3) athlete: average, studious; 4) athlete: brilliant, studious; 5) nonathlete: brilliant, non-studious; 6) nonathlete: average, nonstudious; 7) nonathlete: average, studious; 8) nonathlete: brilliant, studious. While accounting for athletic performance, which is an important deterinant for student popularity (Eder and Kinney, 1995), would require an extension of our model, the above is consistent with the idea that while academic *ability* may have ambiguous effects on popularity, being studious seems to be unambiguously negative.

[24] Note, however, that there will be conflicting interests among students concerning the group formation mechanism: In the present model, exogenous group formation amounts to drawing groups at random. For students whose unconstrained contribution exceeds $\bar{s}$, behavior is independent of the mechanism used; nevertheless, exogenous group formation reduces their social quality. A similar argument holds for the "nerds";

students to produce the private good, but not the public good, is crucial. In some contexts, the opposite may be true: The teacher may, to some extent, value students' social quality, or, alternatively, we may interpret the public good as the result of a group project (corresponding to the teamwork example above, but with $\rho = 1$). In such cases the teacher might prefer endogenous group formation.

Furthermore, our model is obviously a partial one, providing no comprehensive description of learning environments in schools. For example, peer effects in learning (e.g. Whitmore, 2005) have been disregarded, as well as any possible interaction effects between social quality and learning. Moreover, the same students may meet both *in* and *outside of* class (or school); implying that exogenous group formation *at school* may not fully remove the incentive to spend effort to make oneself popular. For these reasons, we do not want to push the policy conclusions concerning exogenous or endogenous group formation too hard. Nevertheless, we believe that our analysis contributes to the understanding of group-specific social norms; demonstrating, for example, why a nerd will not risk social exclusion by his peers if studying hard, while a marginally popular "cool" student will.

The above anlysis assumed that students have no other resources to spend than their time, and that the private good produced by studying, e.g. good grades, could not be used for side payments. However, if students differ with respect to monetary wealth, this may affect the sorting. For example, a wealthy student may make a monetary contribution, e.g. by throwing a party, to make herself popular. In fact, the model could easily be modified to describe situations where *wealth* is the main resource being used in the competition for popularity: If the marginal utility of income were decreasing in income levels, and individuals differed with respect to wealth, rather than abilities, our framework would imply that some individuals spend more money for the benefit of their group than they would have done with exogenous group formation, for example by throwing extravagant parties. Hence, our framework can also be used to analyze "high society".

The generalizable conclusion is that *those with the lowest opportunity cost of contributing to the group* will form the popular group. Similarly, if preferences vary between individuals,

their behavior is unaffected, but exogenous group formation will increase their social quality. These conflicting interests make unambiguous conclusions on welfare effects difficult to draw.

it is those with the lowest opportunity costs, valued by their marginal rate of substitution between the two goods, who will form the popular group.

5 Conclusions

Modern societies are socially highly structured. Rich mingle rich, intellectuals mingle each other. Different groups seem to endorse different behavioral norms. While social acceptance, in some groups, require helping others, or throwing extravagant parties, or abstaining from studying hard, the same does not hold for other groups. These structures and norms should not simply be regarded as arbitrary or fixed. To a large extent, social groups are formed endogenously and spontaneously; and the process through group formation takes place, may influence individual behavior in important ways.

Above, we have proposed a model of endogenous group formation. Within the logic of this model, we have shown that in a multi-task teamwork context, a principal can increase his profits by allowing endogenous team formation, exploiting the informal social control caused by the fear of being excluded from the most popular team. We have also shown that with endogenous group formation in schools, those who study hardest will, all else equal, become less socially popular, and that this will make some students study less hard than they would if social exclusion had not been a concern.

The impact on individual behavior of threats of exclusion may be an important consideration for teachers, firm managers and others who deal with teams. In general, whether a principal should choose endogenous or exogenous group formation varies from case to case. The key question in this respect is whether individual contributions to group-specific, local public goods is beneficial or harmful to the principal. In the case of schools, the teacher may want students to study hard, not spending too much time socializing with each other; the teacher's goal is then best served by giving students as little influence as possible on their group affiliations. In the teamwork case, however, the opposite result obtains: in that case, the principal wants team members to help each other, and if team formation is endogenous, some workers will contribute more to common tasks in order to keep their membership of a popular team.

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Appendix

Proof of Lemma 3

Proof. If $\Delta U(m, \varepsilon) > 0$ for some $\varepsilon > 0$, then, since $\Delta U(m, 1) \leq 0$ and $\Delta U(m, s)$ is continuous in s, it follows that there is an $\bar{s} \in (\varepsilon, 1]$ such that $\Delta U(m, \bar{s}) = 0$. We claim that with $\rho = 1$ or $\gamma g'(0) > m$ there does exist a (small) $\varepsilon \geq 0$ such $\Delta U\,(m; \varepsilon) > 0$.

Consider first the case $\rho = 1$, and consider a minimum requirement $s = \varepsilon = 0$. In this case, $s^*(\Omega_i) = \hat{s}(\Omega_i)$, and since $\hat{s}(\Omega_i)$ is declining in Ω_i, it follows that $S^p > S^u$. Thus

$$\Delta U\,(m; 0) = \gamma\,(g\,(S^p) - g\,(S^u)) > 0.$$

Next, when $\rho = 0$, $\hat{s}(\Omega_i) = 0$ for all i. Hence $S^p = s$, while $S^u = 0$. Now

$$\Delta U\,(m; s)\,|_{s=0} = \gamma\,(g\,(S^p) - g\,(S^u)) = \gamma\,(g\,(0) - g\,(0)) = 0$$

Using (10), $S^p = s$ and $S^u = 0$,

$$\frac{\partial \Delta U\,(m; s)}{\partial s} = \gamma g'(s) - m > 0$$

Hence, there exists an $\varepsilon > 0$ such that $\Delta U\,(m; \varepsilon) > 0$. $\blacksquare$

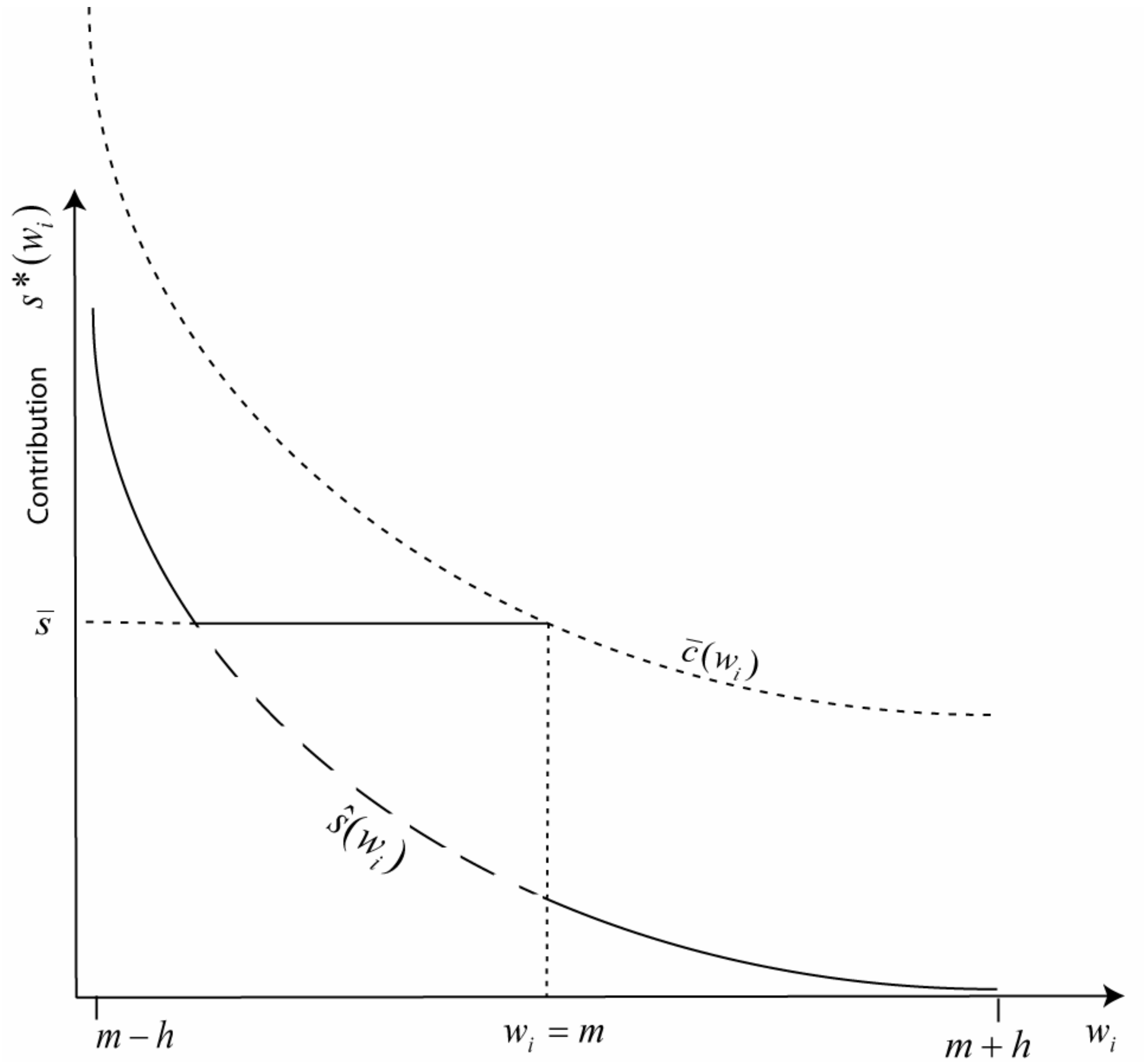

Figure 1: Contribution $s*(w_i)$ to the local public good (solid line). Note that $\Omega_i = w_i$. $\hat{s}(w_i)$ is the unconstrained contribution, $\bar{s}$ is the minimum requirement in equilibrium, and $\bar{c}(w_i)$ is the maximum willingness to contribute.