

When Good Incentives Go Bad: An Experimental Study of Institutions, Motivations and Crowding Out

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ABSTRACT

Many people voluntarily provide environmental goods and services. If supply is insufficient, a government may provide additional incentives. However, psychological studies indicate that incentives can crowd out the intrinsic motivations which prompt voluntary actions. We used experimental economics to examine these interactions, developing a scenario where people trade off private income against contributing to a public good. Our research found that formal institutions (regulation and competitive tender) crowded out voluntary contributions, with supply of public good increasing less than anticipated, or even decreasing. Crowding effects persisted even after an institution was revoked. Policy design should therefore tread carefully when incentives are combined with intrinsic motivations.

Introduction

Environmental goods and services often have public good characteristics, that is they are to some degree non-rival and non-excludable. Producing or maintaining many public goods is costly. Their non-excludable nature means that it is not possible to compel those who enjoy the benefits of a public good to recompense those who incur the cost of producing or maintaining it. Since there is little incentive for individuals to produce public goods, so they are likely to be supplied well below the socially optimal level. *Homo economicus*, the traditional narrowly-defined rational, self-interested agent, would not contribute towards the provision of a public good if the private costs of contributing exceed the private benefit from that extra contribution. Fortunately *Homo sapiens* is different. While undersupply (or overexploitation) of public goods is widespread, it is clear that many people are willing to make costly voluntary contributions. For instance people donate to charity, help strangers and spend time and money improving the environment.

Experimental economics examines how people respond to economic institutions. A consistent finding is that many people contribute to a public good even when faced with the opportunity to make more money by not doing so. In a typical public good experiment, each member of a small group is given a sum of money. They may keep this money for themselves or contribute some or all of it to a group fund.

Contributions to the fund are doubled, and are then split equally among all members of the group, regardless of who contributed. Total payouts will be maximised if everyone contributes all of their initial sum of money. However, each individual has an incentive to free ride as they only get back a fraction of the amount they contribute to the shared fund (for instance, if there are four players, the amount each contributes is doubled and divided by four, so each person receives only half of what they personally contribute, plus half of what everyone else contributes). The Nash equilibrium, that is the strategy that would be selected by rational, self-interested agents like Homo economicus, is for each player to contribute nothing. Experimental results do not uphold this prediction. Contributions typically average 40-60% (in one-off games and the early rounds of repeated games), albeit with considerable variation among individuals, with some contributing nothing while others contribute everything.

Voluntary contributions to public goods are therefore higher than would be feared based on economic theory. However even in these experiments it is clear that they are still substantially below the socially optimal level (and in repeated public good games, contributions tend to decline over time).

Why do people contribute voluntarily?

There are different reasons for people to make voluntary contributions to public goods. Some are likely to simply be miscalculating the payoffs; Andreoni (1995) estimates that around half of observed cooperation among experimental subjects is down to confusion rather than deliberate choice. Some may contribute out of pure altruism, seeking to benefit others whilst receiving no benefit themselves; such behaviour is rarely observed in experiments (Ostrom 1998). Voluntarily contributing to public goods may give people a “warm glow” (Andreoni 1990) – this is impure altruism as they are deriving some benefit themselves. In psychological terms, making voluntary contributions can improve a person’s self image – this was recognised as a motivating factor by Adam Smith (Benabou & Tirole 2004). Recent neurological studies suggest that cooperating with others can be inherently rewarding. MRI scans show that cooperation in prisoners’ dilemma games stimulates areas of the brain associated with reward processing (Rilling *et al.* 2002). Mutual cooperation appeared more stimulating than the more profitable outcome of defecting while the other player cooperated. This suggests there may be an underlying physiological basis to the warm glow hypothesis.

There is considerable experimental evidence that some people are motivated by a concern for fairness, being concerned not just by their own contributions and payoffs, but also those of others. They may value outcomes they perceive as fair, even if it involves them receiving less money than they otherwise might (eg Berg *et al.* 1995, Falk *et al.* 2003). People are also willing to punish actions by others which they perceive as unfair, even if such punishment is costly (Fehr & Gächter 2000). This sort of punishment can be considered altruistic because it creates strong incentives for individuals to cooperate (Fehr & Gächter 2002); the increased cooperation benefits all, while the costs of punishment are borne only by the punisher. Altruistic punishment has also been shown to stimulate reward areas of the brain (de Quervain *et al.* 2004), suggesting that satisfying social preferences such as a concern for fairness may be inherently rewarding, providing its own “warm glow”.

A desire for approval from others can also be important (Kopelman *et al.* 2002) – people have been shown to raise their contributions simply in response to others anonymously expressing ‘disapproval’ of their actions (Masclot *et al.* 2001). Gächter and Fehr (1999) found that social approval had little effect in increasing contributions among strangers, but if even weak social ties or group identity were formed approval incentives significantly reduced free riding. Social approval appears to be important in many public good decisions in life. People who have donated to good (or popular) causes often identify themselves with pins, T-shirts or certificates, while many charities publicly identify major donors. The lengths that most experimentalists go to ensure anonymity for their subjects suggests that social approval must be considered important (Andreoni & Petrie 2004). Indeed, identifying contributors, and the amounts they contribute, leads to significantly higher contributions in public good games (*ibid.*).

In a repeated interaction scenario, contributing to a public good can encourage others to contribute themselves, which in the long run may make the contributor (and everyone else) better off. When faced with unfamiliar situations, people will commonly look to imitate the actions of others. This means that norms of behaviour are pre-disposed to emerge, and individuals may be able to benefit from encouraging such norms to be cooperative rather than non-cooperative. Many people are ‘conditional cooperators’ in this type of scenario, that is they will cooperate providing others also make contributions. Making a voluntary contribution will encourage conditional cooperators to reciprocate, which may make contributing privately profitable. When there are repeated rounds of the public good experiment, cooperation typically declines over time; however the rate of decline is inversely related to the number of rounds (Ostrom 1998). If cooperation is intended as a signal to encourage others to cooperate in future rounds, then the incentives to send such a signal will decline through time (as there are fewer rounds remaining), which may account for the gradual decline in observed cooperation (Holt & Laury 2002).

People can also be motivated to contribute by more formal incentives. Payments may be used to subsidise contributions, or regulations to mandate a minimum contribution. Such incentives are extrinsic, that is they are dependent on external rewards or sanctions, as opposed to intrinsic incentives which are inherent to an individual (Deci 1971). The factors motivating contributions to a public good can be characterised according to the degree to which they are intrinsic or extrinsic (Figure 1). Altruism is entirely intrinsic, while payments are extrinsic. Encouraging reciprocity from others is largely extrinsic. “Warm glow” rewards are largely intrinsic, although they may be affected by external factors such as social norms. Desire for approval and concern for fairness are intermediate, as they are strongly influenced both by internal personal values and external social norms. These motivations can also be considered on a continuum of increasing social and institutional context. Pure altruism is largely self defined and based on personal values, while social preferences will depend on a combination of personal and societal values. Formal incentives such as regulations are entirely a product of society rather than the individual.

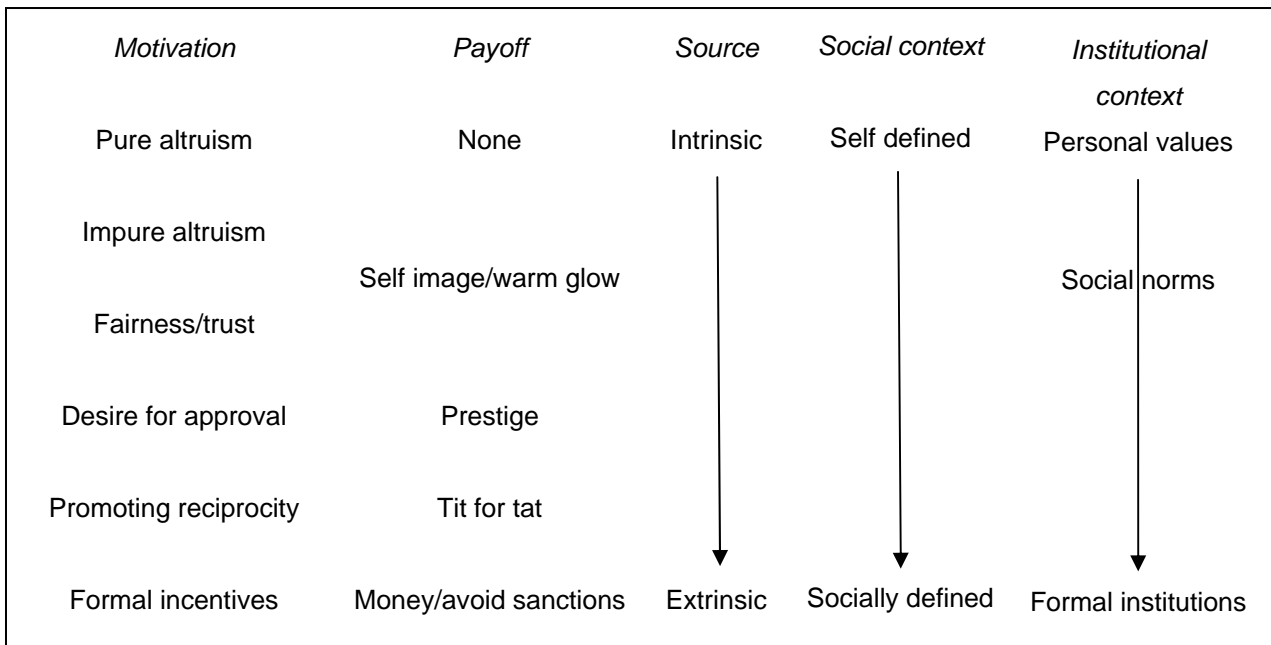


Figure 1: Motivations for contributing to a public good

Motivations meet incentives

In some cases, intrinsic motivations are sufficient to supply public goods at efficient levels. For instance in Australia people voluntarily supply sufficient blood donations despite the absence of any formal incentive. However many public goods are undersupplied, leading policymakers to look for ways to increase their provision. Introducing additional financial or regulatory incentives will, *ceteris paribus*, prompt people to contribute more to the public good. However there is increasing theoretical and empirical evidence to suggest that formal incentives have the potential to crowd out intrinsically motivated contributions toward a public good (Frey & Oberholzer-Gee 1997).

Cognitive evaluation theory suggests that intrinsic motivation consists of two elements (Deci & Ryan 1985). The most important is an individual's sense of autonomy; people are more satisfied if they perceive they are doing an activity for their own reasons rather than being controlled externally. The second element is a need to feel competent at an activity. Extrinsic rewards can be interpreted as controlling behaviour, reducing an individual's sense of autonomy, and therefore decreasing intrinsic motivation (Deci 1971). Monetary rewards are considered especially controlling (Frey 2001). However this may be offset to some extent if a reward is also seen as acknowledging competence at an activity. A meta-analysis of the psychology literature indicates that paying an external reward tends to reduce an individual's intrinsic motivation, while positive feedback (typically 'verbal rewards') increases it (Deci *et al.* 1999). This is motivational crowding – the intrinsic motivation has been crowded out by the extrinsic motivation.

Attributional approaches provide a different, although not necessarily mutually exclusive, psychological mechanism for motivational crowding. Where a reward is offered, people may attribute their behaviour to the reward, and come to believe that the task is not inherently worthwhile (Lepper *et al.* 1973). Individuals have a self-image which is shaped by their actions. Pro-social behaviour can lead to an improvement of an individual's self image. However if an extrinsic reward is introduced, it will no longer be clear whether the behaviour is being performed as a 'good deed' or for a reward. This removes the self-image enhancing value of the activity. An individual's desire for approval from others can be affected in a similar

way. Performing a pro-social activity without reward is clearly identifiable as altruism. However once a reward is attached this is no longer the case – more greedy individuals may become associated with the activity, reducing the reputational advantage gained by altruists (Benabou & Tirole 2004).

These theories suggest that formal institutions may be seen as controlling, reducing autonomy, and negating any ‘good deed’ aspect of contributing. Introducing a regulation or payment may lead to the perception that intrinsically motivated contributions are unacknowledged, or that contributions are only being made for personal benefit. Alternatively, a formal institution may enhance cooperation if it leads people to believe that others will also cooperate.

The potential negative effects of regulations were demonstrated in a field experiment in which a group of day care centres introduced a small fine for parents who arrived late to collect their children; as a result the incidence of late arrivals doubled (Gneezy & Rustichini 2000a). Initially, parents are likely to have been intrinsically motivated by social norms to avoid inconveniencing centre staff, but this appears to have been weakened by the introduction of the formal rule, and the small fine (cUS\$3) in itself provided only a weak incentive to arrive on time. Interestingly, even after the regulation was removed, the rate of late arrivals remained at the higher level, suggesting that the effects of crowding may be difficult to reverse (Gneezy & Rustichini 2000a).

There is also empirical evidence of intrinsic motivation being crowded out by monetary rewards. Paying a small financial incentive to volunteers collecting for charity reduced the collection rate compared to those with no financial incentive; offering a larger payment raised performance close to the levels with no cash incentives (Gneezy & Rustichini 2000b). An econometric analysis of volunteer work showed that individuals who are paid tend to contribute fewer hours than those who receive no financial reward, but among those who are paid, higher rewards are correlated with more effort (Frey & Goette 1999). These studies indicate that price does have an effect – those who are paid more work harder than those who are paid less. However they also indicate that small payments can have a negative overall effect on effort. This suggests that volunteers should either be paid properly, or not at all (Gneezy & Rustichini 2000b).

For activities where people are intrinsically motivated, the supply curve may be kinked, with small increases in price above zero resulting in a reduced supply (Figure 2). Paying any amount below x will result in an overall reduction in supply, achieved at significant cost. Even above x , the increase in supply will initially be very small, compared to the amount of money paid out. Unlike conventional supply curves, this effect may be unidirectional. Once a payment institution is in place, removing it may not necessarily increase intrinsic motivation.

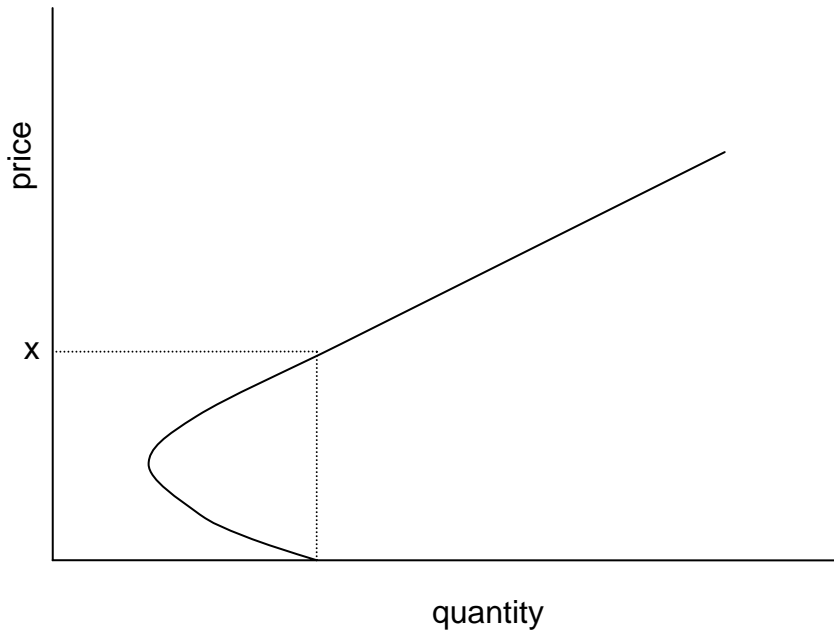


Figure 2: Supply curve for a good or service for which the supplier is intrinsically motivated (from Frey 2001).

Crowding out and environmental policy

Many environmental issues involve public goods dilemmas. Recent decades have seen the introduction of many formal institutions such as regulations and payments in an attempt to maintain the supply of environmental goods and services. For many environmental goods and services, people are willing to supply them to some degree even if the price is effectively zero. Such voluntary contributions must be largely intrinsically motivated. An apparently rational policy response to an undersupply of a public good is to increase the price by introducing a payment or sanction. However crowding out theory indicates that this may have less effect than anticipated, or even trigger a reduction in supply. This is particularly likely if payments are relatively small, or sanctions are weak, as is the case for many environmental incentive schemes.

Our experimental research is motivated by the need to better understand how people respond to incentives and other institutions, in order to better inform policies for natural resource governance. Experimental economics provides a powerful tool for examining how people make decisions. Responses to alternative institutions can be tested and compared under controlled conditions. This can both inform theory and act as a ‘wind tunnel’ for policy design. We applied experimental economic techniques to test how the introduction of alternative institutions impacts on intrinsically motivated voluntary contributions to a public good. In our first experiment, we looked at the effect of introducing a formal institution in the form of a regulation. A follow up study examined how people respond following the introduction of a market based instrument (a competitive tender) to a public goods dilemma.

Experimental scenario

Our experimental scenario consisted of a modified public goods game, in which participants trade off private income against contributing to shared income. This scenario is based on decisions faced by many landholders, who for instance trade off

stocking rates against biodiversity, or irrigation against contributing to groundwater salinity. It represents a dilemma as increasing private income leads to a greater reduction in group income. Participants have heterogeneous production functions, so there are potential benefits from applying a market approach.

In the absence of communication or formal institutions, it is most unlikely that participants will be able to completely solve the dilemma and maximise their collective income. However many individuals do make some level of voluntary contribution towards the public good in such situations, even at the expense of a reduced private income. Our interest was in how these voluntary contributions are affected by institutions. All experimental sessions ran for 12 periods. During the initial (periods one to four) and final (periods nine to twelve) stages there were no formal institutions. Formal institutions (regulation or competitive tender) were introduced during the middle stage (periods five to eight) of the experiment, and removed for the final stage (periods nine to twelve).

In each period, participants select one of five options. Each option is associated with a different level of ‘private income’ and ‘shared income’. ‘Private income’ is paid to the participant who selects that option. ‘Shared income’ is paid into a fund, and each participant receives 1/10 of the total amount. There were six different sets of options, with varying opportunity costs of contributing to shared income. The option sets are detailed in table one; figures represent actual payments in Australian cents. Each session had 12 participants, two for each option set. Subjects only see their own set of options. In each period participants select one of the five available options. Participants are paid for each period, in addition to a \$10 show-up fee.

	Private 1	Private 2	Private 3	Private 4	Private 5	Private 6	Shared
Option 1	0	0	0	0	0	0	200
Option 2	20	35	45	55	70	85	150
Option 3	35	55	80	95	115	140	100
Option 4	45	70	95	115	140	170	50
Option 5	48	72	98	118	143	173	0

Table 1: Private and shared income, in Australian cents, associated with each option. Each participant is assigned to one of the six private income sets. The shared income associated with each option is the same for all participants.

As private income increases, the associated contribution to shared income decreases. The Nash equilibrium is option four. Moving to option five increases private income by only 2-3 cents, while reducing shared income by 50 cents. Since each participant receives 1/10 of total shared income, option five is inferior to option four. The Pareto optimum is option one for sets one to four, and option two for sets five and six. (Since there were 12 participants, each receiving 1/10 of total shared income, public good contributions were effectively subject to a 20% bonus. Total shared income was divided by 10 rather than 12 to keep the calculations simple for the participants.)

Experiments were carried out using the Mwater software system at Griffith University in Brisbane. Participants were Griffith University students, all of whom had prior experience of economic experiments. They were randomly assigned to a computer, provided with a set of instructions in a powerpoint file, and asked to complete a quiz to ensure they understood the experiment. Once they had answered all the questions correctly, they received a password enabling them to access the experiment.

Computer screens show the five options available. At the beginning of each period a box appears, into which participants enter their chosen option. After 30 seconds the box disappears, and screens are updated to show the option selected, the private and shared income associated with it, the total shared income and the money earned by the participant in that period. There was also a running total of income earned. Information from previous periods remained visible throughout the experiment. There were 12 periods in total, which was not known to participants in advance.

Experiment one: Voluntary contributions, suasion and regulation

Our first experiment tested how voluntary contributions are affected by information and regulation. Does being reminded of the nature of the trade-off strengthen or weaken motivation to contribute? Does being regulated affect voluntary contributions? Based on the theoretical and empirical evidence for crowding, our hypothesis is that experience of a formal regulation will crowd out voluntary contributions to the public good.

In the control treatment, participants went through 12 periods of our public good dilemma uninterrupted. In common with previous studies, voluntary contributions were initially significantly higher than the Nash equilibrium, but declined towards it through the periods. Introducing moral suasion, simply by reminding participants that they would all be better off if they all contributed to the public good, significantly increased contributions in the short term, but this effect did not last.

Repeating the moral suasion prior to periods five and nine maintained voluntary contributions significantly above the Nash. We tested for the effects of a formal institution by repeating the moral suasion treatment with a regulation mandating a minimum contribution, unexpectedly introduced before period five and removed after period eight. Beginning both treatments with no formal institution provided an opportunity for social norms to develop. Our hypothesis is tested by comparing contributions in the final stage, after the regulation had been removed. In this stage neither treatment had any formal institution, so any observed differences in contributions can be traced to experience of the regulation in the previous periods.

As well as testing for evidence of institutional crowding, our experiments also examine how individuals respond to changing institutions. Following the introduction of a regulation, do subjects who were contributing more than the original minimum now contribute more than the regulated minimum contribution? Do those who were making large voluntary contributions continue to do so, or do they drop down to the regulated minimum? And what happens when the regulation is removed? Do people behave as they did prior to its introduction, or has their behaviour been changed as a result of experiencing the regulation?

Control Treatment

A baseline treatment was carried out in which participants were provided with basic instructions explaining the scenario, prior to running all 12 periods uninterrupted.

Suasion Treatment

An additional page ('suasion page') was added at the end of the instructions, intended to promote voluntary contributions. It read:

If everyone selects the option which has the highest total (ie private + shared) income you will all make more money than if everyone selects the option which has the highest private income.

The research questions required changing the rules of the experiment during the session, which necessitated taking participants through an additional set of instructions. The suasion and regulation treatments were interrupted after period four, and participants were asked to read an additional set of instructions and complete another quiz. In the suasion treatment, this was simply a repeat of the 'suasion page'.

Regulation Treatment

In the regulation treatment, participants were told after period four:-

A rule will now be introduced in order to promote higher incomes for all players. From now on, you must contribute at least 100 cents of shared income in each round. You may, if you wish, select an option that contributes more than 100 cents of shared income. But you may not select an option that contributes less.

This was followed by a repeat of the suasion page. The experiment then continued as before, except that participants had to contribute at least 100c to shared income (ie choose only options 1-3). The software would not accept decisions that did not comply with the regulation.

The suasion and regulation treatments were again interrupted after period eight, and participants were asked to read another set of instructions. They were told that the regulation was being discontinued, and the experiment would continue in the same way as in the initial periods. They were again shown the suasion page. In the suasion treatment participants were shown the suasion page only. There was no quiz following any of these instructions. The experiment then resumed, under identical conditions for both treatments, and proceeded for another four periods.

	<i>Periods 1-4 (Stage 1)</i>	<i>Periods 5-8 (Stage 2)</i>	<i>Periods 9-12 (Stage 3)</i>
Control	No formal institution		
Suasion	No formal institution	No formal institution	No formal institution
Regulation	No formal institution	100c minimum contribution	No formal institution

Table 2: Timelines for the various experimental treatments. Extra information, along with any necessary instructions, were provided to all participants in the suasion and regulation treatments prior to periods five and nine.

Participants were paid their experimental earnings in cash, confidentially, at the end of the session. There were two replicates of the control and three each of the suasion and regulation treatments.

Results

Data were analysed using general linear models. Mean contributions across all 12 players were calculated for each period in each experimental session. Stage was included as a continuous variable (1=periods 1-4; 2=periods 5-8; 3=periods 9-12), as was period (1-4) within each stage.

In all treatments, contributions were initially higher than the Nash equilibrium would predict (Figures 3 & 4) (Nash is a 50c contribution to shared income per player, giving a total of 600c per period). However contributions tended to decline through time. In the control treatment, contributions to shared income declined significantly over the 12 periods ($t=-4.5$; $t\text{ pr}<0.001$). By period 11, contributions had dropped to the Nash equilibrium. Such a decline is commonly observed in repeated public goods games in the absence of any institutions (Ledyard 1995).

Introducing the ‘suasion’ page has a marked effect on contributions. In the first stage of the experiment, contributions were significantly higher in the suasion and regulation treatments than in the control ($t=3.88$; $t\text{ pr}<0.001$). In the suasion only treatment, contributions declined significantly over the four periods within each stage ($t=-5.66$; $t\text{ pr}<0.001$). However there was no evidence of differences in contributions between stages ($t=0.09$; $t\text{ pr} = 0.927$).

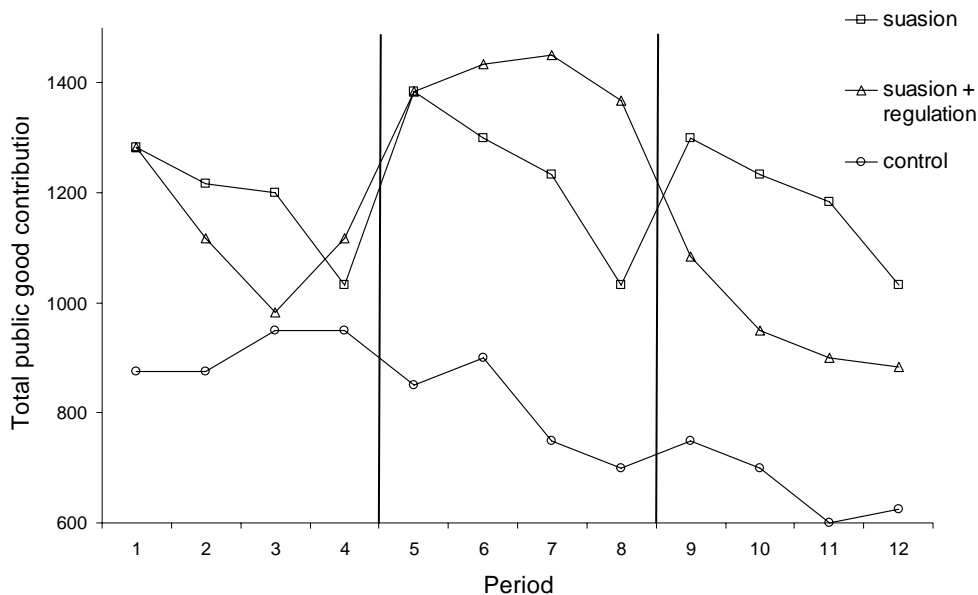


Figure 3: Mean total contributions to the public good in each period, by treatment. The suasion and regulation treatments were interrupted prior to periods five and nine and extra information was provided.

To analyse the regulation treatment, stage was considered as a discrete variable, since the regulation was present in the middle stage but not in the initial or final stage. Contributions again declined significantly between periods within a stage ($t=-2.37$; $t\text{ pr} = 0.024$). While the regulation was in place (during the middle stage) contributions were significantly higher than in the initial stage ($t=5.59$; $t\text{ pr} <0.001$). After the

regulation was removed contributions fell sharply, and were significantly lower than in the initial stage ($t=-3.37$; $t\text{ pr} = 0.002$).

Data from the final stages of treatments two and three were combined to test for differences between treatments. Contributions were significantly lower in the final stage of treatment three than in treatment two ($t=-4.96$; $t\text{ pr} < 0.001$). This indicates that experience of being regulated results in significantly lower voluntary contributions once the regulation is removed.

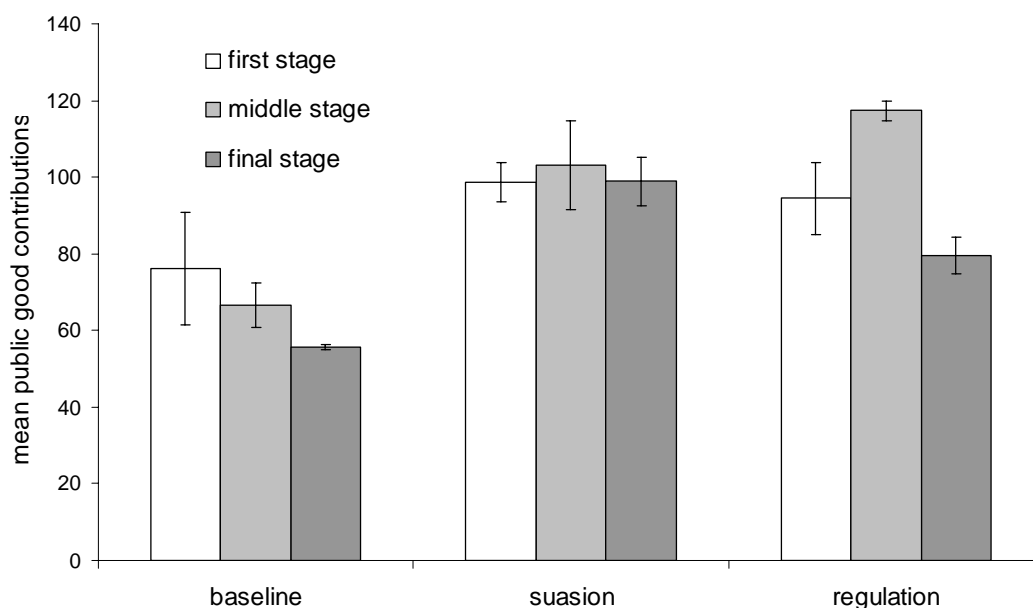


Figure 4: Mean individual public good contributions in each stage, by treatment. The regulation was in place during the middle stage only.

Average contributions by individual participants were examined to check that individual behaviour showed the same pattern. A generalised linear model was run, analysing the responses by individual players in the final stage of the experiment (mean contribution in periods 9-12) against contributions in the initial stage (mean contribution in periods 1-4) and the relative opportunity cost of contributing. The model was initially blocked by replicate, but this proved non-significant. Contributions in the last stage were positively correlated with contributions in the initial stage ($t=8.03$, $p < 0.001$), indicating that individuals were showing consistent patterns of behaviour through the experiment. Again contributions in the final stage were significantly higher in the suasion treatment than in the regulation treatment, even after accounting for differences in initial contributions. Relative opportunity cost was negatively correlated with the contributions made by each player across all stages of the experiment ($t=-2.49$, $p=0.015$).

The effect of changing institutions on individual contributions was examined by dividing individual subjects into four groups based on their average contributions in the first stage of the experiment (prior to the introduction of any institution). The groups were defined by mean contributions: i) greater than 100c; ii) equal to 100c; iii) between 50c and 100c; iv) equal to or less than 50c. Figure 5 shows how contributions varied in subsequent stages. In the suasion treatment, mean contributions by members of each group remained relatively constant between stages (Figure 5a). The regulation

mandated a minimum contribution of 100c during the middle stage, forcing those who were initially below this to contribute more. Figure 5b shows that those who were contributing less than 100c in the initial stage contributed on average barely more than the minimum amount under the regulation. Those who had initially contributed 100c per period raised their contributions by an average of 19c under the regulation, while those who had contributed the most prior to the regulation did not raise their average contributions at all. When the regulation was removed in the final stage, all four groups reduced their average contributions. There was a particularly marked drop in contributions from those who contributed the most initially. In the final period they contributed an average of 97c, down from an average of 149c in the initial stage. Figure 5b suggests that institutional crowding is occurring as a result of those who were initially making the largest contributions subsequently contributing less. The effect is much less marked among those who were making smaller, but still greater than Nash, contributions (50-100c).

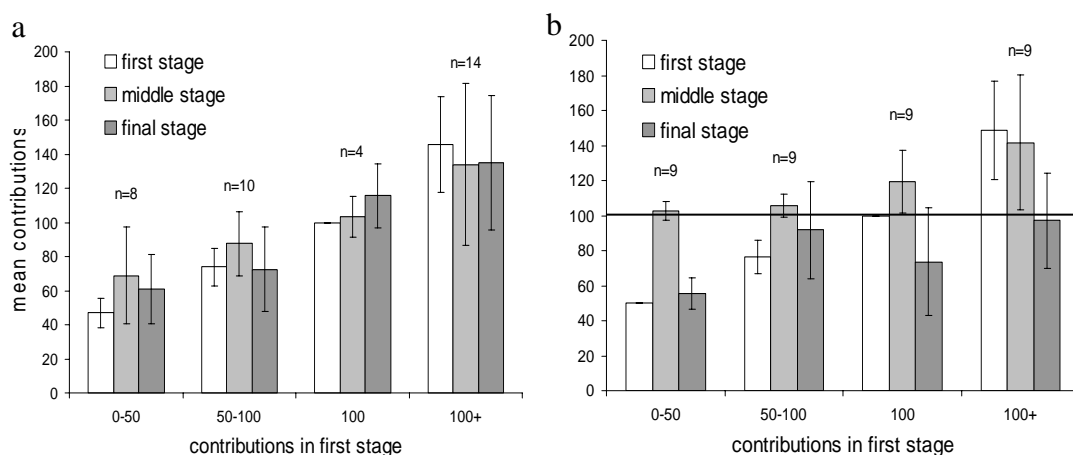


Figure 5: Contributions by individuals in each stage, grouped by contributions in the first stage in the suasion (left) and the regulation treatment (right).

Discussion

The results of this experiment demonstrate how simple institutional changes can have significant impacts on voluntary contributions to a public good. Contributions were consistently lowest in the control treatment. Beginning from a low base, contributions declined through the periods, reaching the level of the Nash equilibrium towards the end of the session. Unlike the other treatments, the control proceeded through all 12 periods without interruption, so there was no possibility of a restart effect – stopping, and then resuming a public goods game has been shown to result in a jump in voluntary contributions (Andreoni 1988).

The inclusion of a single sentence of moral suasion had a dramatic effect on voluntary contributions. This suasion page did not contain any new information, although it may have made the trade-off between private and public income clearer to some participants. Alternatively it may have served as a coordinating device by suggesting an initial level of contribution, or creating a social norm for higher contributions in the minds of some participants. The decline in contributions over the four periods within each stage is particularly notable in the suasion treatment, yet after the suasion page was repeated, contributions jumped back to the original level. It is curious that the effect appears to wear off so rapidly, yet is so easily reproduced. Each period lasted for less than two minutes, so participants hardly have time to forget the suasion

information. It is almost as though they pretend to forget that they should be contributing, but the reminder forces them to resume their contributions. Not contributing, when one knows one should, may be financially beneficial but detrimental to one's self image. Such a conflict could be avoided by 'forgetting' that it is right to contribute. This is analogous to finding a reason for crossing the street when a charity collector is spotted up ahead.

In terms of motivations, in the initial stage there were no formal incentives to contribute. Individuals who did so may have been motivated by reciprocity – by contributing themselves they may have encouraged others to contribute more, resulting in a higher payoff in subsequent periods. They may also have been motivated by social norms to make some level of contribution, or by a subconscious desire for approval. (While the experimental setting means decisions are anonymous, instinctively people may still feel subject to social pressures.) Another largely intrinsic motivation is self image, people wanting to do 'the right thing'. Some or all of these intrinsic motivations appear to have been crowded out by the formal institutions. Contributing to the public good because you are being compelled is unlikely to provide the same 'warm glow' or social approval as making entirely voluntary contributions.

These experiments provide support for the hypothesis that experience of a formal institution can crowd out voluntary contributions to a public good. Contributions in the final stage of the suasion only treatment were significantly higher than in the suasion plus regulation treatment, even though the regulation had been discontinued by that point. The effectiveness of an institution, in this case suasion only, depended on what had preceded it. Other studies also point to the importance of institutional sequencing. In an experimental comparison, a formal and informal incentive scheme had a similar effect when experienced in isolation, but substituting the formal in place of the informal had a strong negative effect on effort invested, while the opposite change had a strong positive effect (Büchner *et al.* 2004). Therefore experiments which consider only a single institution in isolation may be missing important aspects of how people respond as it is introduced.

These results suggest that, once the warm glow or social approval is separated from an activity, it may be difficult to recover; crowding out was evident even after the formal institution was revoked. This lack of reversibility of institutional crowding has significant policy implications. Poorly designed policies may continue to cause problems even after they are removed. These data also suggest that the effects of crowding are most severe among those individuals who were initially making the largest voluntary contributions. In the regulation treatment, the group who were initially making the largest contributions continued to do so during the regulated stage, even though they were well above the minimum requirement. Therefore there is no evidence that the level at which the regulation is set immediately becomes a social norm. It was only after the regulation was removed that many in this group reduced their contributions significantly, perhaps in the expectation of similar reductions from others.

Experiment two: Competitive tender

Our second experiment examined how people responded when a market based instrument, in this case a competitive tender, was introduced to a public goods dilemma. The tender provides participants with the opportunity to bid for extra payments in return for contributing to shared income. The introduction of such a formal institution with extrinsic payments has the potential to crowd out intrinsic motivations. The voluntary nature of the tender may reduce the severity of the crowding, or alternatively its competitive nature may result in a greater degree of crowding out. This experimental setting also provided an opportunity to examine how different individuals respond to the tender process. Does it encourage those who previously were not contributing to make bids and subsequently contribute more? Or does it alienate those who were already contributing voluntarily? And how do people respond to failed bids?

As with the regulation in experiment one, the competitive tender was introduced midway through each session. After period four was completed, participants were asked to read an additional set of instructions which began:-

A mechanism will now be introduced in order to promote higher incomes for all players. Participants will have the opportunity to bid for extra money in return for contributing shared income.

This was followed by instructions detailing the tender mechanism. The tender used a discriminative price mechanism - successful bidders receive the price they requested, rather than a market clearing price - which is widespread in tenders for the provision of ecosystem services (eg Stoneham *et al.* 2003). In each period a fixed quantity of shared income was purchased. Most tenders have a fixed budget rather than a fixed quantity. In this case a fixed quantity was used due to software constraints; the key aspect for testing the research questions was to create a competitive environment, which was achieved equally well by purchasing a fixed quantity in each period.

<i>Periods 1-4</i>	<i>Periods 5-8</i>	<i>Periods 9-12</i>
No formal institution	Competitive tender	No formal institution

Table 3: Timelines for the experimental sessions.

The tender process was conducted at the beginning of periods 5,6, 7 and 8. Participation in the tender was voluntary. A bid represents an offer to contribute a certain amount of shared income in that period, in return for a payment. Participants could choose how much shared income to offer (in blocks of 25c, up to the maximum contribution of 200c) and how much extra payment they required in return. These payments were additional to the payments based on the option selected subsequently. Bids were funded exogenously, not from the shared income fund. Screens were updated after the bidding closed to show the results. Extra columns were added to the screen to indicate how much shared income had been ‘sold’, and how much extra payment would be received.

Participants then had to select an option, as in the previous periods. If their bid had been successful, a person was required to contribute at least that amount of shared income in their subsequent decision. For example, if someone successfully ‘sells’ 100c of shared income, they had to select an option that contributed at least 100c to

the shared income fund, so they could only choose from options 1-3 (the software blocked them from choosing options 4 or 5). If a bid was unsuccessful, a person could subsequently select any option. Bids were valid for the current period only. The bidding process was repeated at the beginning of each period during periods 5-8. Only one bid could be entered per person per period. Participants only knew the outcome of their own bids. They did not know the total quantity bought or extra money paid.

There were two treatments, in which different quantities of shared income were purchased to stimulate greater or lesser degrees of competition. In the higher budget treatment a total of 1000c was available for incentive payments in each period – in this treatment the majority (80-90%) of bids were successful. The lower budget treatment had a budget of 750c per period – only 50-60% of bids succeeded.

The session was interrupted again after period eight, and participants were asked to read another set of instructions. They were told that the tender was being discontinued, and the experiment would continue in the same way as in the initial periods. As in the previous experiment, the suasion page was included at the end of each set of instructions. There were three replicates of each treatment.

Results

Data were analysed in the same way as described for experiment one. In the first stage, public good contributions were not significantly different between the two treatments ($t=0.42$; $t\text{ pr}=0.677$), which is to be expected as there were no institutional differences at this point. In the second stage, contributions were significantly greater in the higher budget tender ($t=-6.07$; $t\text{ pr}<0.001$), while in the final stage there was no significant difference ($t=-1.01$; $t\text{ pr}=0.323$). For both treatments, contributions were significantly lower in the final stage after the tender had been revoked, compared to the initial stage before the tender was introduced ($t=-3.81$; $t\text{ pr}<0.001$).

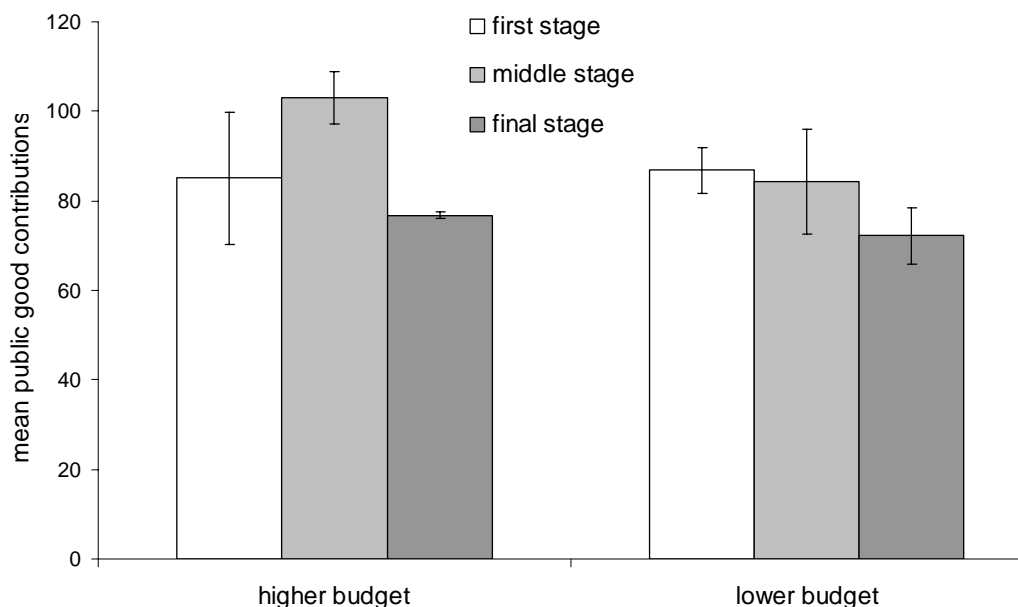


Figure 6: Mean individual public good contributions in each stage of the two tender treatments. The tender was in operation during the middle stage (periods 5-8) only.

Although bidding was voluntary, on only three occasions did participants not enter bids when given the opportunity. Only 6% of bids were below the opportunity cost (reduction in private income associated with contributing a given level of public income), suggesting that participants understood the tender mechanism. On average bids were priced 20 cents higher than the opportunity cost in the more competitive tender and 30c higher in the less competitive tender. Individuals who had been unsuccessful in the previous tender period lowered their prices by an average of 4.18 cents per block, while those who had succeeded raised their prices by an average of 0.94 cents.

Bid data were analysed by calculating the mean quantity and price bid by each player over the four periods during which the tender operated (periods 5-8). Generalised linear regression was used to compare this against their decisions in the first stage (periods 1-4), their decisions after the tender (periods 9-12) and their relative opportunity cost of contributing to the public good. The data was initially blocked by replicate, but this proved to be non-significant. The mean quantity offered by each player was positively correlated with contributions in the first stage ($t=5.02$, $p<0.001$) and negatively correlated with their relative opportunity cost of contributing ($t=-2.25$, $p=0.028$). Quantity offered was not related to price ($t=1.2$, $p=0.24$) and did not differ significantly between the two tender treatments ($t=-0.5$, $p=0.6$).

The mean price requested was not significantly related to the opportunity cost of contributing ($t=0.54$, $p=0.6$) or contributions in the first stage ($t=1.8$, $p=0.08$). Mean price was significantly lower in the more competitive tender treatment ($t=-2.28$, $p=0.026$). Profit seeking was calculated as the difference between the price of each bid and its opportunity cost (averaged for each participant over the four tender periods), and was analysed by generalised linear regression. Replicate was initially included in the model but found to be non-significant. Profit sought was significantly higher in the higher budget tender treatment ($t=2.78$, $p=0.007$). There was also a significant negative relationship with opportunity cost ($t=-4.49$, $p<0.001$), which is to be expected as those participants with lower opportunity costs had far greater opportunities for profit seeking. Those who initially made larger contributions tended to seek slightly less profit, although this was non-significant ($t=-1.91$, $p=0.06$).

In the higher budget tender treatment only 15% of bids were unsuccessful, compared to 36% of bids in the lower budget tender. Individual responses to success or failure in the tender were examined, considering only the data from the more competitive tender, ie the lower budget treatment. Each subject was given a score based on their success or failure over the four tenders (four failures =0, four successes=1, two successes =0.5 etc). Participants who had more of their bids accepted contributed significantly more to the public good during the tender stage ($t=3.6$, $p=0.001$); success was not a significant determinant of contributions in the stage after the tender (periods 9-12) ($t=1.7$, $p=0.1$). Examination of individual contributions following each tender period revealed that those who were successful contributed only slightly more than they had contributed on average in the initial stage (periods 1-4), while those who were unsuccessful reduced their contributions by a greater amount (Figure 7) (excluding bids on the margin which were partially successful, ie selling only a portion of the amount offered).

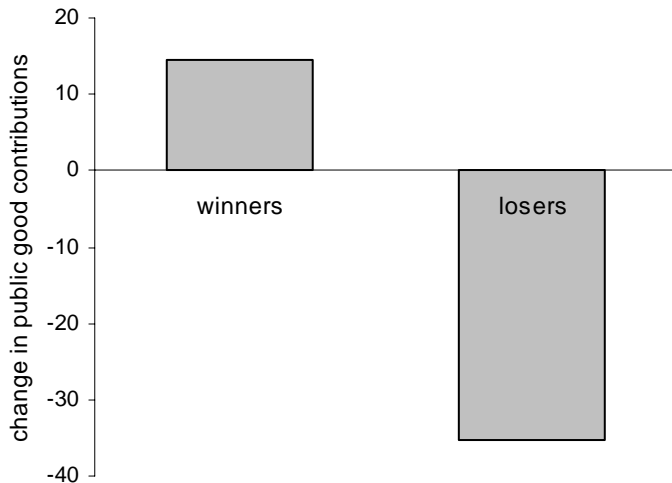


Figure 7: Mean changes in contributions to the public good following each round of the lower budget tender, compared to mean decisions made by the same participant in the initial stage of the experiment. Individuals who are successful in the tender on average contributed 15c more to the public good than they had in the initial stage prior to the tender. Individuals who were unsuccessful in the tender contributed 35c less on average than they were contributing prior to the introduction of the tender process.

The effect of changing institutions on individual contributions was examined by dividing individual subjects into four groups based on their average contributions in the first stage of the experiment (prior to the introduction of any institution). The groups were defined by mean contributions: a) greater than 100c; b) equal to 100c; c) between 50c and 100c; d) equal to or less than 50c. Figure 8 shows how contributions varied in subsequent stages. While in operation the higher budget tender succeeded in raising contributions from the groups who had initially contributed the least, but had little impact overall on those who were already making greater contributions. After its removal, contributions fell across all groups. As in the regulation treatment in experiment one, there was a marked decline in contributions from those who initially had been doing the most. In the lower budget tender this decline occurs during rather than after the institution (Figure 8b). The smaller amount of public good purchased in the tender was insufficient to raise contributions from the less cooperative participants, but triggered a decline in cooperation among the more cooperative ones. This decline was not reversed when the institution was revoked.

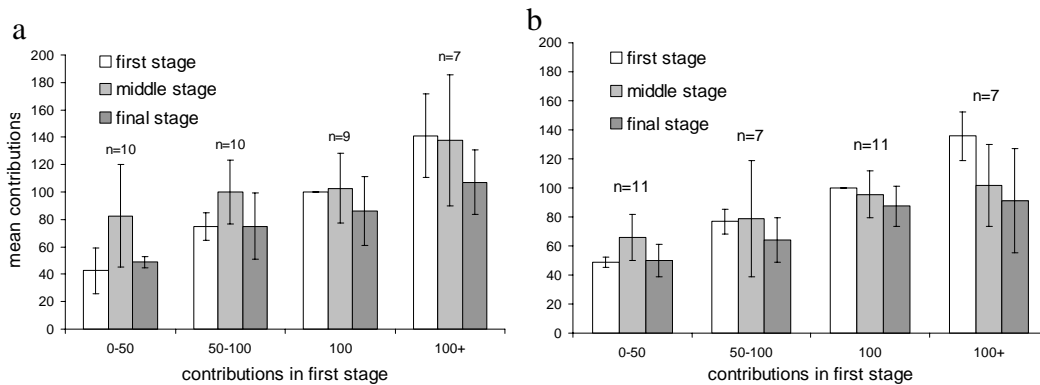


Figure 8: Contributions by individuals in each stage, grouped by contributions in the first stage in the higher budget tender (left) and lower budget tender (right).

Discussion

As in the previous experiment, there is evidence of crowding out – voluntary contributions after the tender was discontinued were significantly lower than prior to its introduction. However while in the regulation treatment, the effects of crowding out only became apparent after the institution was removed, in this experiment crowding out became apparent during the tender process itself. Individuals who were unsuccessful in any one round of the tender on average reduced their contributions considerably, compared to their contributions prior to the tender process. Having missed out on the chance of an extra payment, it is intuitively, if not theoretically, unsurprising that these individuals are subsequently less motivated to contribute, particularly as they know that others are getting paid for contributing. Typically unsuccessful bidders retreated to the Nash equilibrium in the following decision, even if they had been making larger contributions in the initial stage.

Examination of individual bidding behaviour indicated that, in the context of this experimental setting, the competitive tender institution was ineffective in terms of encouraging increased contributions to the public good. Overall most individuals made very conservative bids, offering to contribute only small amounts to the public good. The quantity offered was correlated with prior contributions, suggesting that those who were initially making larger voluntary contributions were now seeking the extra payments. Success in the tender was associated with a 15c increase in contributions, which is relatively small compared to the average voluntary contribution of 85c in the initial stage. Those who were unsuccessful contributed an average of 35c less than they had in the initial periods. The more competitive (lower budget) tender actually caused an overall reduction in contributions as the decrease in contributions from unsuccessful bidders outweighed the increases from those who were successful.

Surprisingly, asking price was not related to the opportunity cost of making contributions. The participants in these experiments faced heterogeneous private production functions, meaning that in order to contribute to the public good, some had to forego larger amounts of private income than others. Theoretically, auctions are efficient because their competitive nature provides participants with an incentive to reveal their opportunity costs. Opportunity costs may be lower for those who are intrinsically motivated to contribute voluntarily, in which case price would be expected to be negatively correlated with prior contributions. However in these experiments there was no such relationship. Asking price appeared unrelated to costs, suggesting that participants were simply using the tender process to generate extra payments rather than as a means of subsidising contributions to the public good.

The vast majority of bid prices (94%) were greater than the participant's opportunity cost. This suggests both that participants had a good understanding of the tender and were using it as a rent seeking mechanism. People who had been making voluntary contributions in the initial stage were now seeking to profit from contributing. Participants did not appear to use the tender as a means of reducing their costs from making ongoing voluntary contributions, but rather as a means of profiting from contributing to the public good. The observation that many of those who had been successful in the previous tender period subsequently increased their asking price again suggests that participants are profit seeking, rather than simply offsetting the

costs of contributing. This behaviour will also tend to erode the surplus extracted from repeated discriminative price auctions.

Prices were significantly lower in the more competitive tender than in the less competitive tender, indicating that participants were modifying their bids based on previous experience. All participants continued to bid throughout the experimental tender, even though it was not compulsory to do so. This may be an artefact of the experimental design, as entering bids was costless. In reality there are costs, in terms of time and possibly professional advice, associated with submitting bids in such tenders. Incurring such costs may accentuate the negative motivational impact on unsuccessful bidders. In a costly bidding process, those who are unsuccessful may also stop participating in subsequent rounds. This could be explored in the laboratory by assigning a cost to submitting a bid.

The transition to the tender process appears to have significantly changed the way many participants make their decisions. While previously many incurred private costs in order to contribute to the public good, once the tender is in place they appear unwilling to do so. While the tender was in operation the vast majority of participants sought to profit from making contributions. It appears that introducing the market-like institution has triggered a 'market instinct' – people attempt to maximise their self interest, as they have learned to do in other markets. In many ways this is a good thing as markets have a proven ability to reveal information and allocate resources efficiently. However any pre-existing spirit of volunteerism is likely to be lost.

In our experimental scenario there was a clear case for establishing a baseline compulsory contribution, specifying 50c or 100c or even 150c contributions by each player. Without establishing such a minimum contribution, the tender budgets were clearly inadequate to deliver the efficient quantity of public good, but the institution did cause people to behave in a more self-interested manner. In the case of the lower budget treatment, this was sufficient to cause an overall decrease in the public good provided, even though additional funds were being paid out as incentives. It should be noted that funding for this tender was exogenous, rather than from shared funds. It would be interesting to see whether the same degree of rent seeking occurs if bids are funded from a group's own funds.

Institutions can change both an individual's motivations, and how they perceive the issue (ie is this a competitive or cooperative situation?). People build up a repertoire of behaviours relevant to different circumstances; institutions provide the cues for which behaviour is applied in any given situation. For instance behaviour that is considered acceptable when chasing a football is likely to be considered quite inappropriate when queuing for a bus. Experiments show that people are more likely to cooperate in the prisoners' dilemma if the game is framed in 'cooperative' rather than 'competitive' terms (Fehr & Fischbacher 2002). Similarly, in a study on a hypothetical social dilemma, people who considered it a 'business' issue were found less likely to cooperate than those who considered it an 'ethical' issue; an institution, in the form of a sanctioning system, increased the proportion of people who viewed it as a business decision, leading to an overall reduction in cooperation even though the material incentive to cooperate was greater (Tenbrunsel & Messick 1999).

Markets may have a particularly marked effect on social preferences as, unlike most other institutions, they support impersonal, ephemeral interactions (Bowles 1998). The competitive nature of markets may trigger people to behave in a self-interested way, rather than in the more cooperative or reciprocal ways in which they behave in other situations. The market does not make them more selfish, but it does make them more likely to apply self-regarding rather than social preferences from their behavioural repertoire (Bowles 1998). In the presence of selfish agents, there is little that non-selfish agents can do to affect the distribution of resources under a market institution (Sobel 2005). Expressing social preferences will still be costly, but there is much less chance of receiving reciprocal benefits than under other institutions. Where reciprocity is not possible, competition among agents leads to a greater degree of self interest than in the absence of competition (Roth *et al.* 1991; Fischbacher *et al.* 2001). However where contracts are incomplete, the importance of reciprocity is not diminished by increased competition (Fehr & Falk 1999).

In a market, there is a clear measure of success in the form of price. Paying too much, or selling for too little, triggers regret, even if the trade was profitable. Trading at a non-optimal price may be considered as a loss, which are weighted much more heavily than gains in the minds of most traders. Additionally, people have a psychological need to feel competent at an activity. In a market this is likely to be expressed by getting the best price possible. In contrast, in non-market situations people may feel competent by contributing to the public good if that is perceived as the 'right' thing to do. Therefore people are likely to learn to express mainly self-interested preferences under market-like institutions. Experimental evidence suggests that the more a situation resembles a competitive market with multiple anonymous buyers and sellers, the less other-regarding behaviour will be observed (Bowles 1998).

Conclusion

There is theoretical and empirical evidence to show that economic decisions are shaped by a range of motivations. Unfortunately for policymaking, these motivations are not always additive. These experiments demonstrate the potential for intrinsically motivated contributions to a public good to be crowded out by formal institutions. In situations where intrinsic motivations are low, and few voluntary contributions are being made, robust extrinsic incentives such as monetary payments can significantly increase supply of a public good. However where some people are already making voluntary contributions, motivated largely intrinsically, there is a significant danger that introducing extrinsic incentives will crowd out these voluntary contributions.

Environmental policy design might therefore benefit from a better understanding of existing voluntary behaviour and motivations. Good incentives can crowd in intrinsic motivation by recognising and acknowledging it (Frey 2001). Good policy may be able to strengthen existing intrinsic motivations among those already contributing while also providing attractive extrinsic incentives that will encourage others to contribute. The way in which information is presented may be crucial in framing motivations. The institutions applied in these experiments were deliberately harsh, in order to test our hypotheses. The negative effects of crowding may be mitigated, or even reversed, with greater consultation and information, for instance by providing greater feedback to unsuccessful bidders. Experimental economics provides a method for exploring and empirically analysing such effects.

The assumption that people are narrowly rational and self-interested neglects the fact the human nature has been shaped by evolution (Ben-Ner & Putterman 2000). The reality is that people are motivated by a range of social and psychological factors, and are pre-disposed to follow social norms. Institutions are crucial as they can both shape preferences and determine which social norm or behavioural paradigm is followed. For instance ‘friendly’ institutions are likely to enhance values for positive reciprocity, while hostile institutions will have the opposite effect. Our results suggest that in some circumstances it may be difficult to combine social preferences and norms with formal institutions. In particular, markets appear to trigger self-interested behaviour among participants. This need not be a bad thing, as it enables resources to be allocated efficiently among alternative uses. However if markets remain incomplete, as is the case with many environmental markets, there remains a need for institutions to promote pro-social behaviour. Experimental economics has the potential to build up our knowledge of the interactions between formal and informal institutions, ultimately leading to better policy design and environmental outcomes.

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