'SOCIAL POKER'

A LABORATORY TEST OF PREDICTIONS FROM CLUB THEORY

Scott Crosson, John Orbell and Holly Arrow

ABSTRACT

The theory of clubs addresses the gap between purely private and purely public goods, being concerned with how groups ('clubs') form to provide themselves with goods that are available to their membership, but from which others (non-members) can be excluded. Despite 35 years of formal development, there have been virtually no laboratory studies of club formation. We develop the 'social poker' laboratory paradigm toward filling this gap, and test the predictions from club theory that populations will partition into a privately and socially optimal set of clubs. The experiment included three conditions: (1) 'Single shot' with one trial of club formation; (2) 'iterated' with a sequence of four trials; and (3) 'iterated dollar-guarantee', with four trials in which participants who were not included in clubs still earned a small amount of money. In all conditions, clubs were frequently larger than was privately or collectively optimal; in the second condition, clubs were increasingly likely to include unnecessary members across trials. After clubs formed, members had the opportunity to 'overclaim' – to take more than their agreed-upon share of the club good. Although the incidence of overclaiming was low, it was more common in larger clubs, further reducing the collective earnings of participants.

KEY WORDS • club goods • efficiency • inclusion • social dilemma

As first articulated by Buchanan (1965), a 'club' is a 'consumption ownership-membership arrangement' justified for its members by the economies of sharing production costs of a desirable good. The theory of clubs addresses the 'awesome Samuelson gap' (Buchanan 1965: 548) between purely private goods and purely public goods –

Rationality and Society Copyright © 2004 Sage Publications. Vol. 16(2): 225–248.
www.sagepublications.com DOI: 10.1177/1043463104039878

that is, between goods that are privately produced and for which individuals have exclusive use rights, and goods that are jointly produced and for which exclusion is not possible. Pure public goods allow *no* exclusion; pure private goods are *completely* exclusive. Buchanan was surely correct in recognizing that the space between pure public goods and pure private goods (from which all others are excludable) needed to be addressed.

A generation later, Cornes and Sandler (1996: 347) defined a club as 'a voluntary group of individuals who derive mutual benefit from sharing one or more of the following: Production costs, the members' characteristics, or a good characterized by excludable benefits'. As they and others have emphasized, club goods – what clubs produce – are like public goods in so far as, once produced, they are available to more than one individual. But they are like private goods in so far as explicit exclusion is possible. The American Sociological Association, for example, demands fees from those who reap the benefits it provides, just as those who swim in the Downtown Athletic Club's pool must pay the Club's membership fee or expect to be (politely?) asked to leave. In both cases, the resource is available to all members. Yet these clubs can and do restrict membership, either by keeping membership costs high (beyond the range of most residents) or through other explicit criteria (professional standing, for example). In short, the theory of clubs accommodates the fact that some goods can be simultaneously available to a defined and finite population *and* subject to explicit exclusion. This provides a solution to some of the more intractable and pervasive problems with public goods. Free-riding on the cost of producing club goods, for example, is prevented if membership fees are a condition of some unit of consumption.

Two implications of these special characteristics of clubs have been developed in the extensive formal literature since Buchanan.

First, a market for club goods can develop, with individuals in a wider population forming clubs or shopping around for existing clubs that satisfy their taste for quality and their willingness to pay for quality. Continuing the swimming pool example, some swimmers will be willing to pay the higher fees at the Downtown Athletic Club in order to have fewer swimmers per lane, while others will prefer the lower cost of the YMCA pool, with its more crowded lanes.

Second, just as a market for private goods enables buyers and sellers to sort themselves into a socially optimal set of binary exchanges, a market for club goods enables a population of people

to 'partition' themselves into clubs with particular clubs representing optimal consumption choices for their members (Pauly 1967, 1970), and with the set of clubs being an optimal partition for the population as a whole (Cornes and Sandler 1996). There are information problems, of course; people will seldom have complete information about the options available, but in the long run we can expect a socially optimal distribution of individuals among clubs by their tastes and by their willingness to pay. In a town with only a Downtown Athletic Club and a YMCA, for example, swimmers will eventually distribute themselves between those two clubs as a function of their willingness (and ability) to pay and their willingness to tolerate crowded lanes. Other outcomes are also possible. Swimmers may forgo joining either club and use the local swimming hole (which is freely available to all), or (if they are sufficiently wealthy) arrange for a private pool to be installed at their house. Similarly, should demand in the town exceed the capacity of those two clubs, resulting in prospective members being excluded due to excessive overcrowding, entrepreneurs (including, perhaps, disgruntled swimmers) may eventually open a third club, expanding the available choices.

While the laboratory study of behavior in markets for both private and public goods has flourished since the early 1970s, a review of relevant journals turned up only one laboratory study of behavior within a club framework (Battalio et al. 1986), and the participants in this study were not people, but rats. We attribute this lacuna to the lack of a laboratory paradigm adapted to studying club-related market behavior among humans and take a step toward filling it by introducing a new laboratory paradigm ('Social Poker') for studying club formation. We then report findings from a social poker study that tested the central prediction from club theory:

> Individuals who cannot realize their interests by private action but are free to seek out partners in a group effort will partition into a set of clubs that is both socially and privately optimal.

In this context, 'socially optimal' means that the resources distributed across members of the wider population are used efficiently to increase aggregate wealth – in the swimming pool case, to provide a set of pools that cater optimally to the distribution of tastes and willingness to pay. 'Privately optimal' means that individuals make the best possible use of the resources that they hold, given the distribution of tastes and resources within the population.

Club theory recognizes that the quality of club goods can be degraded not only by crowding effects, but also by the misbehavior of individual members (Buchanan 1965; Cornes and Sandler 1996) – for example, by their inconsiderate behavior in swimming lanes. In club theory, the sanctions of expulsion or fees graduated according to an individual's pattern of use can be invoked to prevent members from damaging a club good. But that implies monitoring, and interest attaches to whether, absent appropriate monitoring, participants will, in fact, over-exploit such a resource. The basic finding from the extensive social dilemma laboratory tradition is that behavior does *not* match strong predictions from rational choice models; even in single-shot PD games without monitoring, some substantial incidence of cooperative behavior is a standard finding (e.g. Orbell et al. 1986, 1988).

Standard social dilemma laboratory paradigms do not, however, allow participants to form their own groups, as is envisioned within the club theoretical paradigm and implemented in the social poker laboratory paradigm to be described next (Arrow et al. 1999). There is also no formal basis for predicting that self-selection into clubs will alter the incidence of cooperative behavior. The incentive to exploit others remains despite self-selection. Nevertheless, we consider it plausible that the dynamics underlying cooperation and exploitation might be substantially modified if people are free to choose their membership groups, based on findings on partner choice in the psychological literature (e.g. Tziner and Eden 1985). Accordingly, we also report findings about the incidence of exploitative behavior in clubs.

The Laboratory Study of Clubs

In this section, we spell out the key elements of club theory that informed our study.

1. *A population of participants each hold resources that can be contributed toward the generation of a club good.* Club theory requires that the average per-person cost of producing the club good is lower than the cost of producing the same good privately. Otherwise, there is no reason for a club to form in the first place, and no incentive for individuals to join.

2. *Clubs must offer goods that potential members will value*. Buchanan (1968) proposed that a variety of clubs would form that would suit the 'tastes' of members for different types of benefits. In our laboratory paradigm, we wanted to ensure that the club goods would be something all participants would value. Money was the most convenient numeraire for this purpose.
3. *Participants are free to search for others with whom to form a club*. This follows from Cornes and Sandler's (1996: 347) definition of a club as 'a voluntary group'. Little theoretical attention in club theory has been directed to the mechanisms by which clubs form in the first place or to the motives of members for forming (as opposed to joining) a club. Thus our focus on the self-organization of members into clubs is consistent with, but not explicitly specified by, club theory. This feature is essential, however, to study our main question of interest – whether or not people in a defined population will actually partition themselves into a socially and privately optimal set of clubs.
4. *Allow more than one club to form within the population of participants*. The club paradigm requires that comparison shopping among clubs be possible, thus that there be more than one alternative club for individuals to choose among.
5. *The club good is subject to overcrowding and to overuse by particular members*. Quality can be eroded for members by overcrowding – too many swimmers per lane, for example. In response, club members can 'vote with their feet' (Tiebout 1956) by moving to a different club. Overuse of the resource by particular club members (exploitation) can also erode quality for other club members. A possible response is to expel these particular members from the club.
6. *Clubs have the power to determine their own membership*. As Buchanan stressed in his original formulation, a key distinction between club goods and public goods is excludability. Clearly, if clubs must accept all applicants for membership, regardless of qualifications or ability to pay, then the distinction between clubs and general public goods is lost. Hence clubs must have the power to reject prospective members to limit overcrowding, and the power to expel particular members who degrade the club good through overuse, failure to contribute, or other forms of exploitation.

The Social Poker Laboratory Paradigm

In this section we describe how these elements of club theory were implemented in the social poker paradigm. We then describe procedures and experimental conditions for the empirical study.

Participants and Resources In the standard game of poker, the player who forms the best hand of cards – or the best *bluffer* – captures the pot to which all have contributed. In social poker, each participant is also dealt some cards, but no player has enough cards to form a hand alone. Instead, players must seek out others with whom to pool their cards to form a hand and earn a collective payoff (the club good). A club can form only by the free agreement of all potential members. Individuals attempting to form a club are free to include *or reject* any other individual who indicates an interest in joining – fulfilling the 'possibility of exclusion' criterion.

Payoffs (the Club Goods) In the experiment reported here, acceptable hands were limited to three pairs or four of a kind. Either one earned the club $10. The distribution of cards was arranged so that it was possible for each player to form one of these hands by joining with two other players. No two players had the right cards to form a hand, ensuring that the minimum club size would be three.

Freedom to Choose Partners Social poker participants are free to search for others who hold complementary cards and form a club with them – subject, of course, to such individuals' willingness to accept *them*. A club is considered to be formed when all members agree on who is and who is not a member. Potential members are free to reject the offers of others, and emergent clubs are free to reject additional members once they have garnered the cards to form one of the specified hands.

More Than One Club Can Form Although laboratory paradigms for studying coalition formation give people resources that they are able to pool productively and include the freedom to choose partners (Komorita and Kravitz 1983; Murnighan and Roth 1980), only a single winning coalition can form at one time. In social poker, more than one club can form simultaneously, allowing for members to choose among clubs, and vice versa. All clubs that form successful hands receive the $10 payoff (just as multiple fitness

clubs can offer swimming pools as a member benefit). Although multiple clubs may be in competition for members, they can simultaneously produce useful club goods. Club formation is thus not a zero sum game.

Clubs are Subject to Overcrowding and Exploitation Although the card distribution ensures that at least three people are needed to form a successful hand, clubs are free to admit more members. If they do, club goods (the $10 earned) will be shared across more than three people. Participants make private claims on the resource once it has been produced, and have the opportunity to exploit the group by claiming more than their share. 'Overclaiming' erodes the value of group earnings, as explained in more detail in the next section. A larger number of members directly creates overcrowding (more claims on a fixed amount of club goods) and also logically increases the risk that at least one member will overclaim, further degrading the benefits of membership.

Experimental Design

Participants Three-hundred-and-sixty-six University of Oregon students (100 males, 266 females) participated. Of these, 267 were Caucasian, 40 were Asian, 14 were 'mixed', 9 were Hispanic, 5 were Native American, and 3 were African American; the remaining participants did not indicate ethnic background. The average age of participants was 20. Along with their earnings in the experiment, they received credit in a psychology course for their participation. The sign-up sheet directed people not to sign up for a session if they recognized the name of anyone who had already signed up.

Procedure After giving informed consent, eight participants read an instruction sheet explaining the rules of social poker and took a quiz that tested their comprehension of the rules. Examples of both three- and four-person groups were given in the instruction sheet, so that it would be clear that they were allowed to form clubs larger than three if they wished. The experimenter then reviewed the rules, checked people's answers on the quizzes, and explained in more detail any points on which people were confused. The key rules were (1) two social poker hands, four of a kind or three pairs, were both worth $10; (2) to make a hand, players had to form groups (we did not use the word club) and pool their cards – trading

cards was not allowed; (3) each group could turn in only one hand; (4) after groups discussed the division of earnings, members would make private claims – which could be any even dollar amount between \$0 and \$10 – on the group earnings; and (5) if aggregate claims were \$10 or less, every member would receive what he or she claimed, but if aggregate claims exceeded \$10, each member would be penalized 50 cents for each dollar 'overclaimed' by the group. For example, if one member claimed \$10 and two claimed \$3 (for a total group claim of \$16), each would be fined \$3 (6×0.50), so one member would make \$7 while the other two would make nothing (if penalties exceeded claims, players earned nothing).

The instructions encouraged players to discuss the division of money before they made claims, but stressed that their actual claims would be strictly private. Players understood that they would be paid whatever they earned, but they would not be told what others members had claimed.

Once the experimenter was satisfied that everyone understood the game, each participant donned a runner's bib displaying their player number and received three playing cards and an information sheet that showed who had what cards – meaning that everyone played under full information about what cards each other player could contribute. After they had time to study the distribution and decide whom they would like to form a group with, players assembled in the middle of the room to seek out partners. Players forming groups were instructed to move to one of three tables located in the corners of the room.

After groups formed, they signaled to the experimenters that they had a hand, and the experimenter checked to be sure there was consensus about the membership of the group. Any people sitting at the table who were not included as group members were asked to go to another table at this time, and all the cards were collected. Group members were instructed to turn their chairs around so that they were facing away from the rest of the group, and they then completed a claim form and a questionnaire. Isolates (those not belonging to a group) received an alternative questionnaire. After claims were tallied, each group member was privately given a chit that indicated what he or she had earned for that trial. At the end of the experiment, participants completed a final questionnaire that asked whether they and other club members had 'promised' to abide by any agreement about the distribution of the \$10 club

good, with the definition of 'promised' being left to participants. Participants then went one by one to a debriefing area where they exchanged their chits for cash.

Experimental Conditions There were three experimental conditions. In the *single-shot* condition, participants played only one trial and knew in advance that only one trial would be completed. In the *iterated* condition, participants played four trials. They were told that they would play between 2 and 10 trials, so they knew at the outset that there would be multiple trials but did not know that the fourth trial was the last.[1] In a *dollar guarantee* condition, participants who did not get included in a club (some group members did not contribute any cards to the hand, but only people left out of groups got the $1 guarantee). This was clearly explained in the instructions, and any such 'isolates' were given a chit for $1 at the end of each group formation trial. Otherwise, procedures were identical to the standard iterated condition.

The single-shot condition is the simplest representation of the process of club formation, as it is not complicated by any expectation of future interaction among club members. The iterated condition, by incorporating multiple trials, allows us to investigate expected 'over time' effects such as responses to overcrowding. The dollar-guarantee condition adds the feature that individual resources that could be used as contributions to club goods would also be worth something privately (the $1 payoff). In some natural world club-formation situations, resources can only be used as contributions toward a club good; that is the case, for example, with skills used in team sports. But in many others the resources that people might contribute (such as membership fees) have alternative uses, and this condition recognizes that possibility.

In those conditions involving multiple trials, participants made private claims and received a chit for their earnings after each trial. They then returned to the middle of the room, received new cards, and repeated the club formation process. They were free to seek out either the same or different partners with whom they had formed a group in previous trials.

We ran 15 replications in each of the 3 conditions. Thus 30 clubs could form in the single-shot case, and 2(clubs) * 4(trials) * 15(replications) = 120 clubs could form in each of the two iterated conditions. In two cases (one in the single-shot condition, one in the standard iterated condition), only 7 people showed up for the

experiment. These cases are excluded from analyses of average club size.

Expected Results

In this section we describe the expected pattern of results for the three conditions on two outcomes: club size and the incidence of overclaiming.

Optimal Partitioning of People into Clubs

The primary prediction from club theory is that, in a relatively 'frictionless' environment in which there is complete information about clubs (and hence no transaction costs of seeking out this information), people will partition into a set of clubs that is both socially and privately optimal. For the single-shot and standard iterated conditions, the optimal result for the population of participants in a given trial would be to form two clubs (of any size between three and five members), each of which would earn \$10, extracting from the experimenters the maximum \$20. For the third condition, when isolates received \$1, the social optimum for the population of participants would be to partition into two minimally sized groups, with two isolates. Total wealth extraction would then be at the maximum of \$22. From the perspective of the individual, the best outcome in every condition is to be included in a minimally sized, three-person group; adding extra people increases the number of claims on the \$10 and also increases the risk of overclaiming. This leads to the primary 'optimal partition' prediction for club size:

1a. In all conditions, participants will reliably partition themselves into two clubs of size three

In the dollar-guarantee condition, the difference between payoffs for isolates and group members was reduced. Isolates received \$1, less than the \$3.33 expected value for members of minimally sized clubs, but more than the \$0 payoff for isolates in the other two conditions. Taken together, this suggests that, while the privately optimal club size is three in every condition, three-person clubs should be most commonly observed in the dollar-guarantee condition, the

only condition where it is also the collectively optimal solution for extracting wealth from the experimenters.

1b. Trial 1 optimal partitions: Dollar-guarantee > Single-shot & Standard iterated

In market theory generally, predictions to socially optimal equilibria – for example, of supply and demand – are often recognized as predictions in the long run (e.g. Alchian 1950; Hayek 1979). Thus, if participants do not partition themselves into an optimal set of clubs on the first attempt, optimal partitions should become increasingly common through iterated sequences as individuals experience the costs of overcrowding and act to resolve the problem by excluding extra members.

1c. Optimal partitions over time, for iterated conditions: Later trials > earlier trials

Overclaiming

In all conditions, the private earnings for an individual are highest if he or she gains membership in a minimal (three-person) club and makes the maximum claim on the club good, while neither of the other members does so. Of course, if all individuals act thus in the hope that others will behave responsibly while they do not, the net result will be that claims total \$30, so that \$10 is subtracted from each person's claim and no one earns anything. In the dollar guarantee condition, participants whose analysis of the game leads them to expect this result should prefer the guaranteed \$1 payoff and decline to form or join a club.

If the club has more than three people making claims, the prospects for increasing one's earnings by overclaiming worsen, as even a more modest degree of overclaiming per member (an average \$7.50 claim) will suffice to reduce earnings to zero.

When one expects to interact repeatedly, however, the expectation of future interaction can provide some restraints on such misbehavior. Hence we predict the following:

2a. Trial 1 overclaiming: Single shot > Dollar-guarantee & Standard iterated

Even if more members behave cooperatively at first in the iterated conditions, they are unlikely to continue to do so if others are exploiting the group. Thus, even with the shadow of the future (Axelrod 1984) acting to constrain member behavior when there are multiple trials, we expect that some people will, indeed, overclaim, inspiring some formerly cooperative people to overclaim in turn, producing a negative spiral.

2b. Overclaiming over time, iterated conditions: Later trials > earlier trials

One empirically demonstrated solution to the problem of negative spirals of defection is promising. Universal promise-making is known to have a positive impact on cooperation in social dilemma experiments (Komorita 1996; Orbell et al. 1988, 1990, 1991; Ostrom et al. 1992). Because the logic of overclaiming in a social dilemma game is the same as the logic of overclaiming from a club good once provided, we make the following prediction for all conditions.

2c. Overclaiming: Universal promising < Absence of universal promising

Consideration of the expected pattern of overclaiming leads to a refinement of the predictions for club size. If the incentive to overclaim is indeed strongest in the single-shot condition, and the prospects for successful exploitation fall sharply when additional members are admitted, then this should further increase the incentive to ensure that clubs are as small as possible in order to achieve a privately optimal result. Hence we make the following adjustment to the club size predictions:

1d. Trial 1 optimal partitions: Single-shot > Standard iterated (& possibly < dollar-guarantee).

Findings

Club Size

Overall, the manner in which participants partitioned into clubs provided only modest support for the core prediction of club theory (1a) that people would reliably partition themselves into an optimal

arrangement of clubs. Across all 115 trials that included 8 participants, only 55 (48%) resulted in the optimal set of two 3-person clubs. The incidence of optimal partitions was highest in the single-shot (60%) and dollar-guarantee (52%) conditions, lowest (25%) in the standard iterated condition, in line with prediction 1d, and partially consistent with prediction 1b (dollar guarantee lower than standard iterated).

To confirm that people's behavior reliably departed from the predicted optimum of three-person clubs, we ran single-sample *t*-tests comparing mean club size with the predicted size of three. Departures were significant (0.05 level) in every trial. The strongest departures were in the standard iterated condition, with club size significantly higher than 3 in all trials ($p < 0.001$, $t[13]$ values ranged from 4.66 to 6.9). Club size for each condition is shown in Figure 1, and means and standard deviations are given in Table 1. A one-way analysis of variance comparing club size across conditions for trial 1 found no significant differences between conditions. Average club size, however, was significantly lower in the single-shot condition compared to the standard iterated condition when we collapsed across trials for the latter condition, $t(26) = 2.71$, $p < 0.02$, increasing our statistical power.

If we ask how many of the 30 sets of people in the two iterated conditions consistently partitioned themselves into optimal, minimally sized clubs across trials, the results are even less supportive

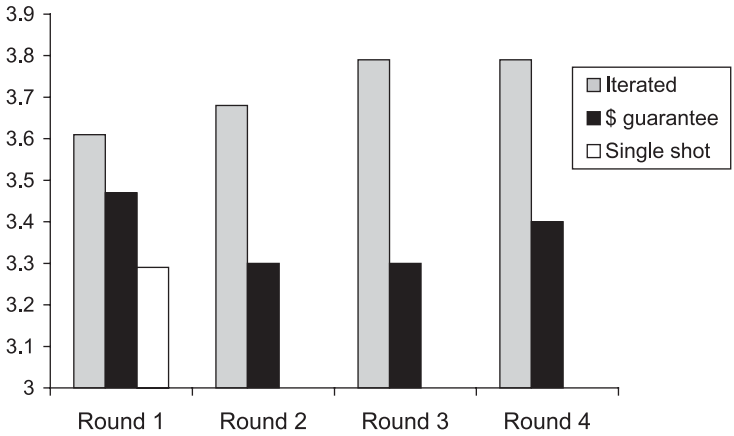

Figure 1. Average Club Size by Round and Condition

Table 1. Average Club Size, by Condition and Trial

	Trial 1	*Trial 2*	*Trial 3*	*Trial 4*	*All Trials*
Single shot ($N = 28$)	3.29 (0.46)*				
Standard iterated ($N = 28$ per trial)	3.61 (0.69)	3.68 (0.67)	3.79 (0.50)	3.79 (0.42)	3.71 (0.58) ($N = 112$)
Dollar guarantee ($N = 30$ per trial)	3.47 (0.69)	3.30 (0.60)	3.30 (0.54)	3.40 (0.62)	3.37 (0.61) ($N = 120$)
All conditions	3.45 (0.63)	3.48 (0.66)	3.53 (0.57)	3.59 (0.56)	

* Values in parentheses are standard deviations.

of club theory. In the standard condition, only 3 of 15 (20%) and in the dollar guarantee condition, only 4 of 15 (27%) did so. They also showed no inclination to reduce overcrowding over time. To test the over-time prediction (1b) for the two iterated conditions, we conducted a repeated measures analysis of variance with trial and condition as the two factors and average club size as the outcome variable. Results indicated a significant difference in club size between the two iterated conditions, $F(1, 27) = 6.03$, $p < 0.03$ (standard iterated clubs were smaller) and a significant interaction between trial and condition, $F(3, 25) = 3.53$, $p < 0.03$. Closer examination of the interaction revealed a linear increasing trend in the standard iterated condition, $F(1, 13) = 3.46$, $p < 0.09$, and a quadratic U-shaped trend in the dollar-guarantee condition, $F(1, 14) = 3.86$, $p = 0.07$ (see Figure 1). The pattern for the standard condition thus showed a trend opposite to the one predicted.

Overclaiming

Contrary to prediction 2a, club members were not more likely to overclaim in the single-shot condition, with overclaiming occurring in 23% of single-shot clubs, compared with 40% of clubs in the standard iterated and 27% of clubs in the dollar-guarantee conditions for Trial 1. For that trial, the average claim in single-shot clubs ($10.73, SD = 2.8) was also lower than in the standard ($11.60, SD = 3.3) and dollar-guarantee ($10.90, SD = 2.6) iterated conditions. The difference in means is attributable to the different incidence of larger-than-optimal clubs in the different conditions (as shown in Figure 1); when club size is controlled for, condition

Table 2. Average Claims, by Club Size and Trial, Iterated Conditions Only

	Trial 1	*Trial 2*	*Trial 3*	*Trial 4*	*All Trials*
Size 3	\$10.97 (2.8)* ($N = 34$)	\$11.06 (2.6) ($N = 36$)	\$9.97 (0.72) ($N = 30$)	\$9.96 (1.4) ($N = 27$)	\$10.54 (2.2) ($N = 127$)
Size 4 or 5	\$11.62 (3.2) ($N = 26$)	\$11.33 (3.8) ($N = 24$)	\$11.90 (4.7) ($N = 30$)	\$11.24 (3.4) ($N = 33$)	\$11.52 (3.8) ($N = 113$)
All groups	\$11.29 (3.0)	\$11.19 (3.13)	\$10.93 (3.5)	\$10.63 (2.8)	

* Values in parentheses are standard deviations.

did not predict overclaiming. (Table 2 gives means and standard deviations for claims across club sizes and trials.)

Contrary to prediction 2b and to findings from studies of iterated social dilemmas that cooperation tends to decline over trials (e.g. Isaac et al. 1985), we found a significant linear trend toward *fewer* groups overclaiming over successive trials in iterated conditions of social poker, $\chi^2(1) = 4.08$, $n = 240$, $p < 0.05$. The Spearman's correlation was -0.13, again significant at 0.05 level. A further unexpected pattern was that many clubs *underclaimed*, submitting total claims (and hence realizing collective earnings) of less than the full \$10 (see Table 2). In fact, when all clubs in all conditions are considered, the incidence of underclaiming (20% of clubs formed) rivaled that of overclaiming (24% of clubs formed).

To further investigate patterns over time for the iterated conditions and to check our assumption about group size effects, we conducted an analysis of variance with trial and club size (optimal or larger) as the two factors and claims as the outcome variable (condition was excluded as a factor because it had no impact beyond group size). Results confirmed that clubs larger than three had a more serious overclaiming problem, $F(1, 232) = 6.69$, $p = 0.01$. No effect for trial and no interaction was evident.

Of course, the size effect need not indicate a greater propensity of members to overclaim in larger groups, since a fixed level of per-member overclaiming results in worse total overclaiming at the club level in larger groups – simply because there are more members involved. To investigate this issue, we re-ran the analysis with mean member overclaim ([club claim − 10]/club size) as the dependent variable. Larger clubs still had a worse problem, indicating that per-member overclaiming is exacerbated by club size, although the finding was not as strong, $F(1, 232) = 3.69$, $p < 0.06$. Inspection of

Table 3. Per-Member Overclaim, by Club Size and Trial

	Trial 1	*Trial 2*	*Trial 3*	*Trial 4*	*All Trials*
Size 3	\$.32 (0.93)* ($N = 34$)	0.35 (0.87) ($N = 36$)	−0.01 (0.24) ($N = 30$)	−0.01 (0.47) ($N = 27$)	0.18 (0.72) ($N = 127$)
Size 4 or 5	0.38 (0.76) ($N = 26$)	0.33 (0.96) ($N = 24$)	0.48 (1.2) ($N = 30$)	0.31 (0.85) ($N = 33$)	0.37 (0.95) ($N = 113$)
All groups	0.35 (0.86)	0.34 (0.90)	0.23 (0.88)	0.17 (0.72)	

* Values in parentheses are standard deviations.

the means (see Table 3) revealed a notable contrast between the first two and the last two rounds. The difference in per-member claiming between smaller and larger groups appears to develop in the last two rounds, when members of three-person groups *underclaim,* on average. This *post hoc* finding proved statistically reliable when the first two rounds were contrasted with the second two rounds for 3-person groups, $t(95) = 2.99$, $p < 0.005$ ($n = 127$, correction for unequal variance used). There was no over time difference for larger groups.

Promising

In their questionnaire reports, club members often did not agree about whether everyone in the group had promised to claim the agreed-upon amounts. Thus we sorted clubs into three categories, those with universal promising ($n = 84$), those with no promising ($n = 30$), and those in which promising was either incomplete or imperfectly recalled (i.e. member reports disagreed, $n = 154$), and ran a one-way ANOVA, which indicated that promising did have a significant effect on group claims, $F(2, 265) = 12.13$, $p < 0.001$. As expected on the basis of social dilemma laboratory findings, universal promising was quite effective in preventing overclaiming ($M = \$10.27$, $SD = 1.65$), but so was 'partial' promising ($M = \$10.88$, $SD = 2.64$). Both had significantly lower mean claims than clubs with no promising ($M = \$13.30$, $SD = 5.72$). To test for the combined effect of club size and promising, we followed up with a two-factor analysis of variance that included two levels of club size (optimal or larger) and three levels of promising (none, partial, and universal). Results indicated a significant interaction, $F(2, 262) = 8.78$, as well as significant main effects for club size,

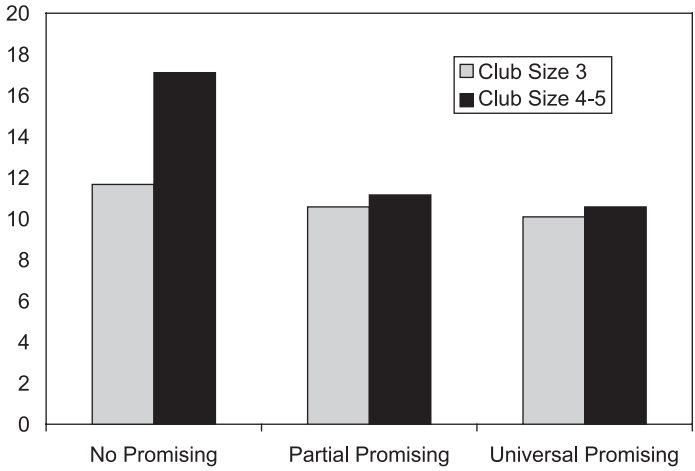

Figure 2. Total Claims by Club Size and Promising

$F(1, 262) = 23.2$, and promising, $F(2, 262) = 21.0$, all $p < 0.001$. The nature of the interaction is clearly evident in Figure 2: The impact of club size on overclaiming is most evident when club members make no promises to one another about what they will claim. These findings provide further evidence that overuse of a shared resource can be mitigated by group members 'discovering' the age-old institution of promising.

Discussion

Club theory proposes a decentralized, non-coercive process by which a population will partition into a set of clubs with (1) each producing club goods for consumption by its members – but not by non-members; with (2) different clubs offering a trade-off between price and quality that is optimal for each club's members; and with (3) the partition itself being optimal at the aggregate or population level. As sketched at the outset, Buchanan's (1965) critical insight was that the free-rider problem that bedevils the provision of *pure* public goods can be solved if exclusion is possible, by making an appropriately gauged contribution to the club a condition of access. 'Overcrowding', which degrades the quality of club goods, can still develop, but it can be addressed by limiting membership

or by excluding members who make excessive claims on club goods. The predicted outcome is that, generally, valued goods that cannot be produced by individuals acting alone (or that are prohibitively expensive for most individuals to provide privately) will be produced in a socially optimal manner.

Our main focus in this paper was to test this prediction using a laboratory paradigm that models the process of endogenous club formation. The experiment included conditions that model different types of resources – those that are only useful in producing a collective product and those that are 'fungible' – i.e. that can yield benefits outside of a club. We also included a 'single-shot' condition in which the actions of participants would not be affected by the expectation of future interaction.

Why Did Clubs Tolerate Overcrowding?

The primary prediction of club theory, that populations of people will partition themselves into clubs that are privately and socially optimal, was not reliably supported in this study. Instead, clubs frequently included more members than necessary to provide the club good. As expected, the incidence of optimal partitions did vary across conditions and trials. Although the pattern was not as predicted, these variations provide clues about the countervailing pressures that encourage club members to admit more than the minimally necessary number, reducing their individual benefits as a result. Optimal partitions were most common in the single-shot condition and were more common in the dollar-guarantee condition than in the standard iterated condition in which those not admitted into either club earned nothing. In the standard iterated condition, the propensity to include more people also tended to increase over time.

Together, these results suggests that potential club members will be more willing or able to hold the line against overcrowding when (1) those petitioning for entry beyond the socially optimal number are complete strangers – rather than people one has already encountered as fellow members of a different club; when (2) these petitioners will remain strangers – i.e. there is no expectation of future interaction once the petition has been rejected; and when (3) petitioners will not be left completely empty-handed if they are turned away – i.e. when the welfare of potential 'isolates' does not depend entirely on their sharing a successfully produced club good.

An anecdote from a real-life club may help illustrate the psychology that seems to be involved. Arrow has been serving as a consultant for a writer's group that is currently closed to new members. Ten people are on the waiting list, but no new members are currently being admitted, and most members agree that the group is already larger than optimal for the provision of club goods – in this case, critiques of stories by members. Despite the recognition that admitting more members will worsen the overcrowding and further degrade the payoffs for each member, many club members are unhappy with the continuing exclusion of the wait-listed members, and this is particularly true for members who know and like those waiting to be admitted. The pool of identified potential members for this club is considerably larger than in our laboratory experiments, a minimum of 35 counting current members plus the waitlist, compared with a pool of 8 in the social poker study. Yet we observe the tendency in both the laboratory and this natural world case to admit more members than what club members agree is the optimal number.[2]

The larger population involved in the writer's club suggest that our results are not necessarily applicable only to very small populations. The similarities, especially to our standard iterated condition, are also suggestive: (1) the membership decisions are made collectively by the club membership; (2) the club has, over time, continued to accept new people even after recognizing that the group was already too large; and (3) the petitions are typically made in person, to existing members of the group. While other writer's clubs do exist in the city, petitioners typically are not interested in these other clubs – they do not suit their tastes either because of how the clubs operate or the type of writing that is emphasized. Thus petitioners on the waitlist are out 'in the cold', so to speak, having no attractive alternatives – which makes the situation psychologically more like the standard iterated condition than our dollar-guarantee condition.

One clear boundary condition for our findings, we believe, is the face-to-face interaction involved and the corresponding introduction of social motives and pressures, such as concern for the welfare of others, especially those with whom one has had some prior interaction. As Field (2001) has proposed, rationality-based predictions appear to be more successful in games against nature than in closely interpersonal circumstances, and club theory – like

market theory more generally – can be understood as substantially concerned with such games against nature.

Two different perspectives on club theory, and subsequent courses of action, are suggested by this analysis. One is to retreat from the study of people interacting face to face, which invariably evokes social influences that complicate the situation. Paradigms in which people make choices without interacting with others, for example, might effectively model such collectives as supermarket 'clubs', in which people pay a club fee and get a good price on goods bought in bulk. Such paradigms would not apply to fitness centers or writers' clubs, in which people interact, form attachments, and directly observe the behavior of others.

The second approach is to follow the lead of Cornes and Sandler (1996) in expanding the theory and study of self-organized club formation, acknowledging that the hoped-for benefits that inspire people to organize themselves into clubs, and the costs they pay in the process, can include benefits and costs of a 'social' nature. This leads us to question whether our definition of the 'optimal' partition for the social poker experiment is actually too narrow because it fails to account for costs and benefits that go beyond the money involved.

In a separate social poker experiment in which participants reported on the reasons behind their choice of partners and their satisfaction with the clubs they formed, it became apparent that people's 'tastes' for clubs were based on a balance between economic self-interest and equity motives (Arrow and Burns 2004). Some people were most satisfied in minimally sized groups; others expressed greatest satisfaction in larger groups. Judging the latter type of club as suboptimal hardly seems a satisfactory application of club theory if such arrangements provide the balance of benefits that its members prefer. Just as experimental results from laboratory studies of social dilemma behavior suggest that qualifications are in order about the importance of the free-rider problem, the results from our social poker experiments suggest that qualifications are in order about the optimality of a population's partitioning into a set of clubs. In both cases the qualifications appear to derive from humans' willingness to incorporate, to some extent at least, the welfare of others into their own decision-making processes.

Why Was Overclaiming So Low?

The potential of members to 'overuse' club goods, which is embedded in the social poker paradigm and also envisioned by club theory, is analogous to the public goods problems modeled by other social dilemma paradigms. Including this feature helped increase the costs of overcrowding – which we wanted to be steep enough to affect participant behaviour – and also allowed us to replicate and extend previous findings in the social dilemma literature that include the freedom to choose partners (e.g. Orbell and Dawes 1993; Yamagishi and Hayashi 1996).

As expected, we found that overclaiming is worse in larger groups, in part simply because there are more people who could misbehave, and in part because people are actually more likely to overclaim in larger groups. This is in line with the voluminous literature in social psychology indicating that problems such as free-riding and social-loafing are exacerbated by group size. While promise-making did not reduce the cost of sharing the fixed good among a larger number, it was effective in reducing overclaiming and had a particularly strong impact in larger groups. Promise-making, of course, is most likely to arise when people interact face-to-face, underlining the importance of this feature in our study design.

Although the logic of maximizing private self-interest suggested that members of single-shot clubs should be especially likely to attempt to exploit their fellow club members, participants were no more likely to overclaim in this condition, and in fact, overclaiming was both relatively infrequent and relatively mild when it did occur. Underclaiming, which maximizes no member's earnings, and in fact reduces the total income of the club, was almost as common. Invariably, this outcome occurred when club members agreed to make equal claims: \$3 each in a 3-person group or \$2 each in a 4-person group. Members of fully one-fifth of the clubs formed were willing to collectively forgo \$1 or \$2 in potential earnings in order to achieve equity among members. This surprising finding, like the popularity of 'overcrowded' clubs, strongly points to the importance of non-financial incentives in our participants' behavior.

NOTES

Research for this paper was funded by NSF SES-9729320 to Holly Arrow and John Orbell. We are grateful for help from K.L. Burns, Psychology, and Bill Harbaugh,

Economics, at the University of Oregon. Ruth Bennett contributed helpfully to the development of the social poker laboratory paradigm. We are also indebted to the undergraduate research assistants of the Small Groups Laboratory and to members of the weekly seminar of the Hill Center for Social Cognition and Decision Making of the Institute of Cognitive and Decision Sciences for helpful comments. Corresponding author: John Orbell, jorbell@uoregon.edu.

1. We chose to keep participants in the dark about how many trials they would play so that the four trials would be comparable in terms of anticipated future interaction. They would invariably differ, of course, based on the accumulated history of past interaction. Telling participants in advance how many trials there would be makes each trial 'unique' in a different sense, and might inspire special strategies based on calculations of the fourth trial being the last, the third trial being the penultimate trial, and so on.
2. The brief questionnaire that group members filled out privately after every trial of social poker asked whether they would like to be with the same group of people in the second round. An unpublished honor's thesis that analyzed the responses (Rivinis 2003) found that people in smaller clubs were significantly more likely to answer 'yes', indicating that the tendency to form larger clubs is not necessarily evidence that people privately prefer this outcome.

REFERENCES

Alchian, Armen. 1950. 'Uncertainty, Evolution and Economic Theory.' *Journal of Political Economy* 58: 211–21.

Arrow, Holly, Ruth Bennett, Scott Crosson and John Orbell. 1999. 'Social Poker: a Paradigm for Studying the Formation of Self-organized Groups.' Technical Report 99–01. Eugene, OR: Institute for Cognitive and Decision Sciences, University of Oregon.

Arrow, Holly and K. L. Burns. 2004. 'Self-organizing Culture: How Norms Emerge in Small Groups. In *The Psychological Foundations of Culture*, eds M. Schaller and C. Crandall, pp. 171–99. Mahwah, NJ: Lawrence Erlbaum Associates.

Axelrod, Robert. 1984. *The Evolution of Cooperation*. New York: Basic Books.

Battalio, Raymond C., John H. Kagel and Owen R. Phillips. 1986. 'Optimal Prices and Animal Consumers in Congested Markets.' *Economic Inquiry* 24: 181–93.

Buchanan, James. 1965. 'An Economic Theory of Clubs.' *Econometrica* 32: 1–14.

Buchanan, James M. 1968. *The Demand and Supply of Public Goods*. Chicago, IL: Rand-McNally.

Cornes, Richard and Todd Sandler. 1996. *The Theory of Externalities, Public Goods and Club Goods*. New York: Cambridge University Press.

Field, Alexander J. 2001. *Altruistically Inclined? The Behavioral Sciences, Evolutionary Theory, and the Origins of Reciprocity*, ed. T. Kuran. Ann Arbor, MI: University of Michigan Press.

Hayek, F. A. 1979. *Law, Legislation and Liberty,* vol. 3: *The Political Order of a Free People*. Chicago, IL: University of Chicago Press.

Isaac, R. Mark, Kenneth F. McCue and Charles R. Plott. 1985. 'Public Goods Provision in an Experimental Environment.' *Journal of Public Economics* 26: 51–74.

Komorita, Samuel. 1996. 'Group Discussion and Cooperation in Social Dilemmas.' *Personality and Social Psychology Bulletin* 22: 1144–50.

Komorita, S. S. and D. A. Kravitz. 1983. 'Coalition Formation: A Social Psychological Approach.' In *Basic Group Processes*, ed. P. B. Paulus, pp. 145–51. Hillsdale, NJ: Erlbaum.

Murnighan, J. Keith and Alvin Roth. 1980. 'Effects of Group Size and Communication Availability on Coalition Bargaining in a Veto Game.' *Journal of Personality and Social Psychology* 39: 92–102.

Orbell, John and Robyn Dawes. 1993. 'Social Welfare, Cooperators' Advantage and the Option of Not Playing the Game.' *American Sociological Review* 58: 787–800.

Orbell, John, Robyn Dawes, Randy Simmons and Alphons van de Kragt. 1986. 'Organizing Groups for Collective Action.' *American Political Science Review* 80: 1171–85.

Orbell, John, Robyn Dawes and Alphons van de Kragt. 1988. 'Explaining Discussion-induced Cooperation.' *Journal of Personality and Social Psychology* 54: 811–19.

Orbell, John, Robyn Dawes and Alphons van de Kragt. 1990. 'The Uses of Multilateral Promising.' *Ethics* 100: 616–27.

Orbell, John M., Alphons J. van de Kragt and Robyn M. Dawes. 1991. 'Covenants Without the Sword: The Role of Promises in Social Dilemma Circumstances.' In *Social Norms & Economic Institutions*, eds K. J. Koford and J. B. Miller, pp. 117–34. Ann Arbor, MI: University of Michigan Press.

Ostrom, Elinor, James Walker and Roy Gardner. 1992. 'Covenants With and Without the Sword: Self- Governance is Possible.' *American Political Science Review* 86: 404–17.

Pauly, M. V. 1967. 'Clubs, Commonalities, and the Core: An Integration of Game Theory and the Theory of Public Goods.' *Economica* 34: 314–24.

Pauly, M. V. 1970. 'Optimality, "Public" Goods, and Local Governments: A General Theoretical Analysis.' *Journal of Political Economy* 78: 572–85.

Rivinis, Eve. 2003. 'Why Stay? Group Membership Preferences in Multiple Rounds of a Social Dilemma Experiment.' Unpublished Honors thesis, University of Oregon, Eugene OR.

Tiebout, C. M. 1956. 'A Pure Theory of Local Expenditures.' *Journal of Political Economy* 64: 416–24.

Tziner, A. and D. Eden. 1985. 'Effects of New Composition on Crew Performance: Does the Whole Equal the Sum of its Parts?' *Journal of Applied Psychology* 70: 85–93.

Yamagishi, Toshio and Nayoko Hayashi. 1996. 'Selective Play: Social Embeddedness of Social Dilemmas.' In *Frontiers in Social Dilemma Research*, eds W. B. G. Liebrand and D. M. Messick, pp. 363–84. Berlin: Springer-Verlag.

SCOTT CROSSON is an independent survey and trial consultant in Raleigh, North Carolina. He is particularly interested in the tensions that arise inside small groups during the decision-making process. He received his doctorate from the University of Oregon (2000), where he was a member of the Institute for Cognitive and Decision Sciences and the Political Science Department. The research in this paper was the basis of his dissertation.

ADDRESS: 4012 Grimstead Lane, Raleigh, NC 27613, USA [email: scrosson@mailsnare.net].

JOHN ORBELL is Emeritus Professor of Political Science and a member of the Institute for Cognitive and Decision Sciences at the University of Oregon. His interest is in Evolutionary Psychology, in particular in the evolutionary basis of cooperative behavior. Recent simulation work – with Morikawa, Hartwig, Hanley and Allen – shows how prior evolution of 'Machiavellian intelligence' could provide a basis for the evolution of cooperative dispositions in highly social species such as humans.

ADDRESS: Department of Political Science, University of Oregon, Eugene, OR 97403-1284, USA [email: jorbell@uoregon.edu].

HOLLY ARROW is a member of both the Psychology Department and the Institute for Cognitive and Decision Sciences at the University of Oregon, and is co-author, with Joseph McGrath and Jennifer Berdahl, of *Small Groups as Complex Systems; Formation, Coordination, Development, and Adaptation* published by Sage. She studies the emergence and transformation of structure, including norms, influence hierarchies, and the cognitive networks of members – in small groups.

ADDRESS: Psychology Department, University of Oregon, Eugene, OR 97403-1284, USA [email: harrow@uoregon. edu].