A coalition is usually assumed to involve an agreement, explicit or implicit, among several actors (individuals or organizations) to cooperate in pursuit of a common interest. Typically members of a coalition regard such cooperation in their own individual interest only if others continue to cooperate. Thus violation of the agreement holding the coalition together by some members often instigates others to defect, and the process becomes self-reinforcing. The effect is demonstrated in an experiment with a Tragedy of the Commons type game, in which one of the players, a confederate of the experimenter, (the "stooge") grossly violates apparent expectations of the others. Measures of the amount of cooperation (or noncooperation) before and after the stooge's intervention are related to the presence or absence of preliminary discussion and to the number of players.

Experiments With Social Traps III

BREAKUP OF COALITIONS

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An important concept in the theory of *n*-person games is stability of coalitions, in particular of the grand coalition comprising all the players of an *n*-person cooperative game. Such a game is said to have a *core* if it is possible to allocate the joint payoff attained by the grand coalition in such a way that it does not pay for any subset of the *n* players to leave the grand coalition, for example, to form a coalition of their own. If a game has no core, the grand coalition is vulnerable to secessions, that is, can break up, which may entail a loss for everyone if the joint payoff to the grand coalition is greater than the sum of the payoffs accruing to any set of smaller coalitions or to individual independent players. The nuclear nonproliferation treaty may be an example.

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RATIONALITY AND SOCIETY, Vol. 7 No. 3, July 1995 328-337

ment of rights themselves. This will result in a Pareto improvement and will affect the allocation of resources in the presence of wealth effects. Thus in those cases where the authorities cannot determine the assignment of initial rights a priori, they should ensure that the agreements that are freely entered into are fully enforced and that the court system works efficiently for those parties who cannot reach an agreement privately.

NOTES

1. In fact, the term "theorem" was never used by Coase who made his argument through a series of examples.

2. Only if one of the parties is much richer than the other is it possible that the richer party can pay a sufficiently high compensation to obtain the child in the case that the rich party does not obtain custody.

3. For the wealth or welfare effect of the assignment of property rights to affect resource allocation, it is not sufficient that the effect be large. Additionally, the property right must be for an asset that is not available in a competitive market. In other words, the asset must have an intrinsic value for at least one of the parties. That is, the value to at least one of the parties involved must be higher than the market value. If the asset is available in a competitive market, then changes in the assignment of property rights will affect demand but will not affect value. In what sense are assets of intrinsic value in the examples above? In the first example, the child is worth more to the parents than to others. In the second case, the garden-sun combination has a unique value for me because I inherited the house and garden from my parents. In the mining case, the burial grounds have a special value for the indigenous tribe.

4. Parties may fail to reach an agreement if they have different perceptions of the probabilities of obtaining custody. I assume here that any existing informational asymmetry is between the legal system and the parties, not among the parties themselves. Informational asymmetry among the parties increases the probability that the issue will be resolved by the courts.

5. Several conditions must be satisfied for such compromise solutions to be Pareto superior. First, no other party can be adversely affected by the agreement reached by the parties involved. For instance, in the custody case, the out-of-court settlement might be best for the parents but not necessarily for the child. If both parents do not fully internalize their child's welfare in their decision, the arrangement will not be Pareto superior and the court may wish to intervene. Second, the out-of-court settlement must be voluntary. If one of the parties imposes a solution through coercive means, it will not be Pareto superior. Third, not all parties will necessarily gain in the case of strategic interaction between them.

6. The other implication is that in the case of externalities, governments need not use taxes or subsidies because the parties involved would be able to reach the optimal solution privately.

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Defections of even a small number of signatories may well doom the treaty and initiate a new nuclear arms race. The experiment to be described was designed to simulate a social trap of this type.

Some experimental results (cf. Rapoport 1988) suggest that attainment of cooperation in a Tragedy of the Commons type game in a laboratory situation is quite difficult but can be facilitated by emphasizing the players' collective interest in the instructions given to the subjects.

In the experiments to be described, a game called Draw From the Pot was played by groups of various sizes under conditions specified below. The experimental procedure is described in the following instructions handed out at the start of each session and read by the experimenter.

- You will be playing a game called Draw From the Pot.
- Initially the pot will contain a certain amount of money.
- The game will last at most 10 rounds.
- On each round each of you may claim any amount of money to be paid out to you from the pot. What happens depends on the total amount claimed.
- If the total amount claimed does not exceed the amount in the pot, then each will get the amount he or she claimed, and the amount left in the pot will increase by 50%. For instance, if $2.50 remains in the pot after the claims have been paid out, then on the next round the pot will contain $3.75.
- If the total amount claimed equals exactly the amount in the pot, the claims will be paid out and the game will be over.
- If the total amount claimed exceeds the amount in the pot, nothing will be paid out and the game will be over.

EXAMPLES

Suppose initially there is $0.50 in the pot, and suppose each of four players claims $0.10. Then $0.10 will remain in the pot, and the amount on the next round will increase to $0.15. On the other hand, suppose no one claims anything on rounds 1 through 9. Then on round 10 the pot will contain $19.35. If there are five players and each claims exactly one fifth of the pot, that is, $3.87, each will get what he or she claimed. The game will be over, but it would have been over anyway, because it will last at most 10 rounds.

The amount each player has claimed will be added to the fixed fee for participating in the experiment.

One can see that the players will get the most they can get *collectively* if they pass (claim nothing) on every round, letting the pot grow until the tenth round and if on the tenth round each claims the same portion of the pot. However, some players may get a different idea. Suppose, for example, the

pot contains $10 on round 9. One player may claim all of it. If no one else claims anything, he or she will get it, which is considerably more than an equal share of $15, which the pot would have contained on the tenth round if every one passed on the ninth. *But* if some one else gets the same idea, the pot will be overdrawn and no one will get anything. What you do is up to you.

At this point, someone always asks how much the pot will contain initially. The reply is that the amount will be announced as well as the amount left in the pot at the end of each round and the amount contained at the beginning of the next round.

The experiment was run under the following conditions:

1. *Stooge, no discussion (S).* In this condition, one of the supposed players was a confederate of the experimenter instructed to withdraw one half of the pot on round 5 and to refrain from withdrawing on any other round. The subjects were not permitted to communicate with each other.
2. *With discussion and stooge (DS).* In this condition, the experimenter left the room for 5 minutes before the game began, having informed the subjects that they were free to discuss anything they liked with each other. The stooge was instructed to be noncommittal, that is, neither to make promises nor to declare that he was bound by any agreement. As in condition S, the stooge was instructed to claim half the pot on round 5 and to refrain on any other round. An assistant of the experimenter who remained in the room reported that an agreement was reached by the bona fide subjects to refrain from withdrawing until the last round in every case. In one case it was agreed that a designated player would withdraw the entire pot on the last round and then split equally with the others. (Presumably the subjects anticipated the difficulty of dividing a four-digit number by four.)
3. *With discussion and no stooge (DN).* In this condition all subjects of a group were bona fide players.

Some of the subjects were students from various faculties at the University of Toronto. Men and women were represented approximately equally. All were in their early twenties. Other subjects were business and economics students from the University of Bern. About one third of them were women. Their average age was 23.

The groups of subjects playing Draw From the Pot will be designated by condition as follows:

- 2S: two-person groups in condition S
- nS: n-person groups in condition S with $n = 3, 4, 5$
- 2DS: two-person groups in condition DS
- nDS: n-person groups in condition DS
- 2DN: two-person groups in condition DN
- nDN: n-person groups in condition DN.

In Toronto, 10 2S and 30 *n*S groups were run, 10 each with *n*s = 3, 4, 5. Further, 2 2DS groups and 6 *n*DS groups were run with *n*s = 3, 4, 5. Finally, 2 2DN groups and 6 *n*DN groups were run with *n*s = 3, 4, 5.

In Bern, 20 2DS groups and 14 *n*DS groups were run, 11 with $n = 5$, one with $n = 3$, one with $n = 4$, and one with $n = 6$. It was intended to compare performances of 2-person and 5-person groups. Because of no-shows, two 5-person groups were short one or two subjects; the 6-person group was formed when all 5 and a stand-in showed up.

Because there was no intention of comparing the performances of subjects from the two universities, we conducted analyses on the combined data, namely

- 10 groups in the 2S condition
- 30 groups in the *n*S condition
- 22 groups in the 2DS condition
- 20 groups in the *n*DS condition
- 2 groups in the 2DN condition
- 6 groups in the *n*DN condition.

The independent variables of interest were condition (S, DS, DN), and group size (2-person vs. *n*-person groups [$n > 2$]).

The dependent variables of interest were indexes of the subjects' behavior: mean proportion of subjects making claims, mean number of claims per opportunity, and mean proportion of pot claimed.

In each case, our primary interest was in the effect of the stooge's provocation. We expected that a greater proportion of subjects would make claims on rounds 6-9 than on rounds 1-5 in conditions including the stooge. Similarly, we expected that the number of claims per opportunity would increase after the stooge's provocation. As for the proportion of the pot claimed, we conjectured that because the stooge would always claim one half of the pot, the mean proportion claimed after the provocation would increase, provided it was less than half in the early phase of the game. These three conjectures are embodied in Hypothesis 1.

An additional dependent variable was mean earnings per player. Note that because the initial amount in the pot is proportional to the size of the group, size per se should have no influence on the earnings per player. Any systemic difference can be attributed to the condition (S, DS, DN). Size could have an indirect effect, however, via the number of players making claims or the number or size of claims as intervening variables, because early claims even of modest size can seriously impair the growth of the pot.

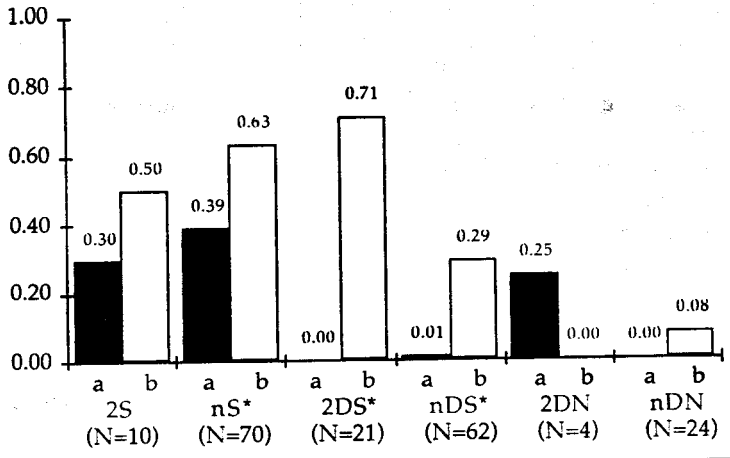

Figure 1: Comparison of mean proportion of players who made claims on rounds 1-5 (a) and 6-9 (b)

NOTE: Included only are groups that completed the game at least until round 10.
*Effect of stooge is significant according to chi-square test for $p < .01$.

Hypothesis 2 relates to the effect of discussion. We conjectured that discussion would enhance cooperation on the first five trials. Following the stooge's defection, however, we expected more defections in the DS conditions than in the S conditions, assuming that the defection would be seen as a breach of an agreement. (Recall that an agreement to allow the pot to grow to maximum size was always made in the DS condition.)

Hypothesis 3 relates to the effect of group size. It is commonly assumed that cooperation in situations involving the use of or contributions to a public good is more difficult to achieve in large groups than small ones (Chamberlin 1974; Hamburger, Guyer, and Fox 1975; Marwell and Ames 1979; see, however, Isaac and Walker 1988, where the marginal per capita return is an intervening variable in a public goods dilemma).

The results are shown in Figures 1-5.

DISCUSSION

From Figure 1 we surmise that our conjecture concerning the effect of the stooge's provocation is corroborated: The proportion of players making withdrawals in rounds 6-9 is greater in all groups with stooge. The difference

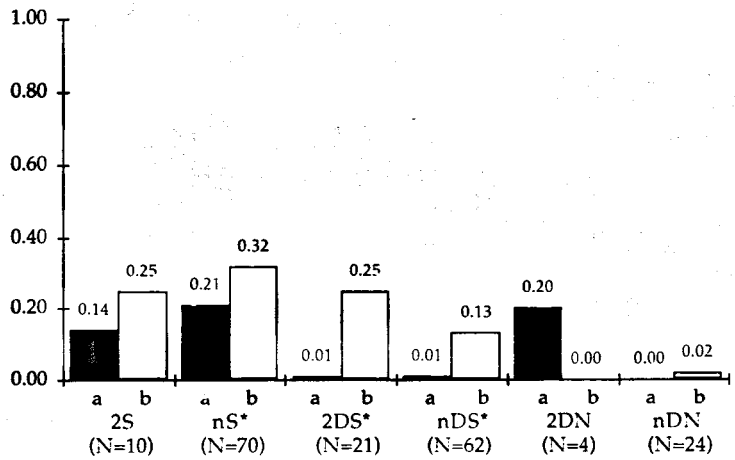

Figure 2: Mean number of claims per opportunity on rounds 1-5 (a) and 6-9 (b)
*Effect of stooge is significant according to t test for repeated measurement $p < .05$.

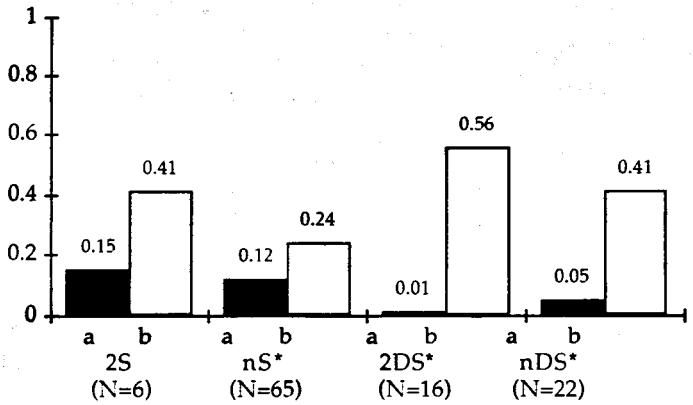

Figure 3: Mean proportion of pot claimed when claims were made on rounds 1-5 (a) and 6-9 (b)
NOTE: Included only are cases that drew at least once in rounds 1-5 and rounds 6-9 on resource.
*Effect of stooge is significant according to t test for repeated measurement $p < .01$.

is especially great in condition DS. Presumably, after reaching an agreement not to make claims until the last round, the bona fide subjects are disappointed

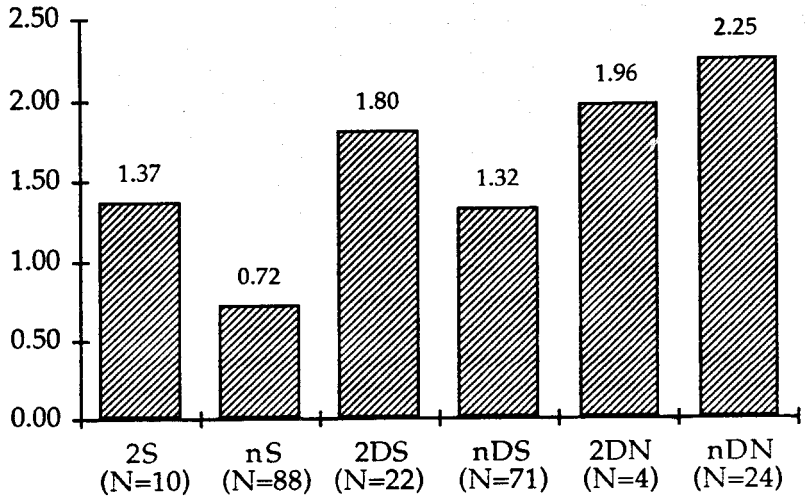

Figure 4: Mean earnings per player
NOTE: Differences are significant according to F test ($F = 5.997$, $df = 5$, $p < .01$).

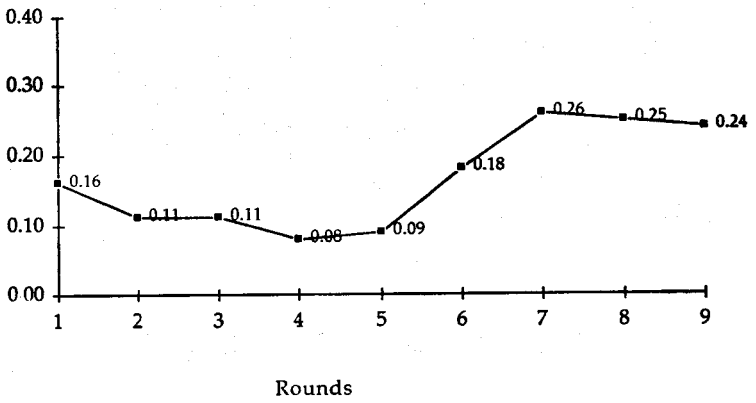

Figure 5: Proportion of subjects who made claims on successive rounds in S and DS conditions

in the stooge (who violates the supposed agreement) and retaliate especially vigorously.[1] We see also that in the absence of the stooge's provocation the agreement holds very well (condition DN).

Aside from the apparently prominent effect of the stooge's defection, the question remains whether, in the absence of discussion, there is a trend toward more withdrawals in successive rounds independent of the stooge's intervention. Figure 5 shows proportions of players withdrawing from the pot on successive rounds. Actually this proportion declines in the course of the first four rounds. The increase on round 5 cannot be ascribed to the stooge's intervention because it is discovered only on round 5. Still, the proportion of players making claims increases after round 5.

Figure 2 shows mean numbers of withdrawals per opportunity to withdraw before and after the stooge's intervention. The same picture emerges. In every category of groups playing under the S condition, the number of withdrawals per opportunity to withdraw is larger after the stooge's provocation. The same question arises, namely, whether the difference is due to a general trend independent of the provocation. The time course of the number of withdrawals per opportunity to withdraw is identical to the time course of the proportion of players withdrawing, because a "round" is actually an "opportunity to withdraw." Therefore the picture depicted in Figure 5 applies equally to the mean number of withdrawals per opportunity to withdraw.

From Figure 3 we surmise that our conjecture concerning the proportion of the pot claimed (when claims are made) increases after the stooge's intervention.[2]

Figure 4 shows a comparison of earnings per player in each class of groups. The large earnings of players having the opportunity to discuss and not being provoked by the stooge speak for themselves.

We turn to the most prominent symptoms of the breakup of coalitions, tacit ones, as in the S condition, or explicit ones, as in the DS and DN conditions. These symptoms are the "take the money and run" stratagem (TMR) and "overdrawn pot" (OP). We found the following instances of those occurrences.

TAKE THE MONEY AND RUN AND OVERDRAWN POT

Of the 222 bona fide subjects, there were 15 instances of claiming about 80% of the pot and 7 of claiming 100%. The instances were too few to justify statistical analysis. It is interesting to note that the only defection in the 2DN condition (that is, by one of the four subjects in that condition) was a TRN.

The pot was overdrawn 10 times in the *n*S condition, 3 times in the 2DS condition, 4 times in the *n*DS condition, and 2 times in the *n*DN condition. Clearly, here too the number of cases was too small to warrant conjectures concerning the effects of the various conditions.

CONCLUSIONS

Two of our three hypotheses were corroborated. The stooge's provocation obviously stimulated defections. Specifically, the proportion of players defecting after round 5 increases, as well as the number of defections per opportunity and the magnitude of withdrawals.

The effect of discussion is clear-cut. Comparing the S and the DS conditions by proportion of players who made claims during rounds 1-9, individuals in the DS condition claimed significantly less than individuals in the S condition (chi-square = 16.33, $df = 1$, $p < .01$). This result is confirmed in Figure 2 ($F = 2.85$, $df = 189$, $p < .01$) and in Figure 3. However, in Figure 3 the difference is not significant. Inspection of Figure 1 shows that this effect is due to the low proportion of players who claim in rounds 1-5 in the DS condition. Inspection of Figures 2 and 3 confirms this result. Thus preliminary communication results in high cooperation before the stooge's intervention. Moreover, the increase in defection after the stooge's provocation is much stronger in the DS condition than in the S condition. Thus we actually have an interaction effect between stooge (or rounds) and communication.

The effect of group size at first seems ambiguous. In the S conditions, cooperation rates are higher in the small groups (see Figure 1, conditions 2S and *n*S), but in the DS conditions the largest defection rates occurred in the two-person groups after the stooge's intervention. It seems that the two-person group is a special case in the sense that the identity of the defector is certain, which stimulates retaliation; whereas in a large group, where the defector is protected by anonymity, retaliation appears indiscriminate and may be inhibited for that reason.

NOTES

1. The stooge effect displayed in Figure 1 is significant ($p < .01$) only in conditions *n*S, 2DS, and *n*DS according to chi-square. The test does not take into account that we are dealing with repeated measures when we compare claims on rounds 1-5 and 6-9. For cross-tab analysis we doubled the number of cases (pretending that we are dealing with two groups of subjects). However, the results conform to the *t* test (cf. Figures 2 and 3) in which a repeated measure design was used. Thus the correct statistical procedure on data represented in Figures 2 and 3 lead to the same conclusion. The number of cases differs in Figures 1-3, because, as noted, the analyses do not always apply to all cases.

2. In the 2DN condition in only one case withdrawals were made on rounds 1-5 and 6-9. In the *n*DN condition there were only two such cases. These cases were not included in the statistical analysis.

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The incentive and monitoring problems in Chinese collective farming are theoretically reformulated so that the uneasy position of collective managers concerning the adequate levels of work compensation and collective accumulation can be taken fully into account in determining the quantitative intensity of labor mobilization. It is argued that there was a motive for collective managers not to engage themselves in excessive mobilization of peasant labor if they were at all concerned about maintaining adequate wage levels, collective accumulation, and even their own income and positional benefits. The rationality of the managerial behavior on Chinese collective farms should thus be judged in view of the specific conditions imposed by the state on peasant interests.

Rationality and Socialist Collective Farming

A THEORETICAL REAPPRAISAL OF THE CHINESE EXPERIENCE

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1. INTRODUCTION

China's collective farming was once hailed as a model of genuinely successful Third World agricultural development (Gurley 1976; Wong 1979). From the late 1970s onward, however, its achievements were reevaluated by the newly incumbent, reformist leaders of the Communist Party of China (CPC), who needed a historical rationale for their new "development first"

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