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SOME CONDITIONS AFFECTING THE CHOICE TO COOPERATE OR COMPETE[1]

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Three experiments investigated conditions affecting the choice to cooperate or compete. Experiment I compared the effects first of an individual activity, then of a competitive task as an alternative to cooperation. For both comparisons, subjects could earn more by cooperating. Choice of competition, but not individual activity, was found to depend on the task choice contingencies. Competition predominated when both subjects could compete if either or both chose competition. Previously competitive pairs cooperated when both subjects could cooperate if either or both chose cooperation. Experiment II investigated the effects of differences in magnitude of the reinforcers for cooperating or competing. Choice between the two alternatives was manipulated in all pairs by varying reinforcer difference. Competition was chosen over cooperation only within the limits within which competition was potentially profitable. Experiment III replicated the findings of Experiment II using triads. Subjects in triads, however, were more likely to withdraw from the experiment. Thus, the data for pairs and triads suggest an orderly relation between reinforcer difference for cooperating or competing and task choice. Motivation of subjects to maximize relative gain by competing can be overridden by moderate reinforcer differences favoring cooperation.

Key words: cooperation, competition, response choice, reinforcer magnitude, group size, college students

Under what conditions will persons choose to cooperate or compete? In social psychology, the basic vehicle for research on this question has been the Prisoner's Dilemma, in which two persons can choose between alternatives that are termed cooperative and competitive. In the typical Prisoner's Dilemma matrix shown on the left side of Figure 1, Person A's choice of C, which rewards both persons if also chosen by B, is termed "cooperative". Choice D, which provides Person A with his highest reward and Person B with his lowest reward if Person B chooses to cooperate, is termed "competitive". If both persons select choice D, each receives his next-to-lowest reward. In the Prisoner's Dilemma, the average of the possible outcomes from a competitive response exceeds that from a cooperative response, but with mutual choice of competition, payoffs are lower than with mutual choice of cooperation.

Despite the long-run profitability of cooperation, isolated subjects playing the Prisoner's Dilemma over multiple trials typically compete on a substantial proportion of their choices. For the values shown in Figure 1, for example, the proportion of competitive choices is generally greater than 0.50. A possible reason for this pattern is that size of earnings is not the only consequence affecting choice. Competition, whether profitable or not, maximizes relative gain—the difference between own and partner's earnings. Cooperation also minimizes joint gain. To reduce this ambiguity, a modified Prisoner's Dilemma (Maximizing Difference Game) shown on the right side of Figure 1 has been used. In this matrix, a cooperative choice (C) maximizes own as well as joint gain, and a competitive choice (D) maximizes relative gain only. Studies using the Maximizing Difference Game also indicate substantial competitive choice, thus suggesting the importance of relative gain in maintaining competition (McClintock and McNeel, 1966; McClintock and Nuttin, 1969).

There appear to be two limitations to this conclusion, however. The first is conceptual. The choice involved in the Prisoner's Dilemma

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		Person B: C	Person B: D
Person A	C	3,3 (X_1,X_1)	0,5 (X_2,X_3)
	D	5,0 (X_3,X_2)	1,1 (X_4,X_4)

Prisoner's Dilemma Matrix*

		Person B: C	Person B: D
Person A	C	6,6	0,5
	D	5,0	0,0

Maximizing Difference Matrix

*The Prisoner's Dilemma game is defined by the following payoff relations: $X_2 < X_4 < X_1 < X_3$; $2X_1 > X_2 + X_3$ (Rapoport and Chammah, 1965).

Fig. 1. Two 2 × 2 mixed-motive games.

is not a straightforward one between what we usually term cooperation and competition. As the concept has been most commonly conceived, persons are said to cooperate when all receive reinforcers for some group response (Marwell and Schmitt, 1975), or when each person's reinforcers are at least partially dependent on the responses of other persons (Hake and Vukelich, 1972). Persons are said to compete when reinforcers are obtained by fewer than all who respond. In the Prisoner's Dilemma, the problem lies with the definition of competition. Rather than being a potentially profitable, independent alternative to cooperation, competition is profitable only as defection from cooperation. Mutual choice of competition in the Prisoner's Dilemma results in mutual loss. By contrast, head-to-head competition in everyday situations typically results in reinforcement for one of the competitors—usually determined by some skill (or luck). If some persons choose not to compete, the reinforcers will go by default to one of the remaining competitors.

The second limitation is methodological. Subjects in matrix-game research are generally studied for a single session entailing no more than several hundred trials (and usually fewer than 100). Presumed reinforcers are usually points or small amounts of money. Lengthier investigations using more substantial reinforcers may produce response patterns in which earnings are more often maximized.

In the present study, factors affecting the choice to cooperate or compete were investigated in a setting entailing an independent competitive alternative. The setting used the cooperative task and choice procedure developed by Schmitt and Marwell in previous studies of variables affecting the choice to cooperate or work alone (Marwell and Schmitt, 1975; Schmitt and Marwell, 1971). The following responses were included: a cooperative response, which required coordinated responses from each subject; a competitive response, which permitted subjects to win or lose; a choice response, which was distinct from the task responses. Thus, choice as well as task contingencies could be varied.

In addition, several aspects of the experimental procedures also differed from those commonly used in matrix-game research. First, intragroup comparison procedures were used to investigate treatment effects. Second, groups were studied over extended periods of time ranging from 4 to 16 hr (2 hr per day).

Three experiments investigated task, choice, and reinforcer characteristics that may affect the choice of persons to cooperate or compete. The experiments addressed the following questions. First, how does competition compare with a similarly paying noncompetitive individual activity as an alternative to cooperation? (Experiment I). Second, what are the effects of changes in the choice contingencies relating cooperation and competition? Do choices differ when cooperative contingencies are in effect when they are chosen by one person rather than by all? (Experiment I). Third, what are the consequences of differences in the size of the reinforcers for cooperating or competing? (Experiment II). Fourth, what are the effects of an increase in number of participants in a potentially cooperative group? (Ex-

periments II and III). Fifth, what are the consequences of differences among persons in competitive success? (Experiments I, II, and III).

EXPERIMENT I: EFFECTS OF AN INDIVIDUAL OR COMPETITIVE ALTERNATIVE TO COOPERATION

Although on theoretical grounds competition has been the alternative most often compared with cooperation, it is probably not the most ubiquitous one outside the laboratory. A more common alternative to cooperation is individual effort—working alone. To what extent does the type of alternative effect choice of cooperation?

Marwell, Schmitt and their associates conducted a series of experiments in which individual activity was the alternative to cooperation (Marwell and Schmitt, 1975; Marwell, Schmitt, and Bøyesen, 1973; Marwell, Schmitt, and Shotola, 1971; Schmitt and Marwell, 1971; Schmitt and Marwell, 1972). For most subjects, cooperation was chosen almost exclusively when it was favored by a small difference in earnings. When cooperation paid approximately \$2.40 per hour, compared with approximately \$1.80 for working individually, subjects typically cooperated on at least 95% of their responses. Most departures from cooperation occurred in the first several minutes when subjects explored the choices. Whatever effects boredom or random factors had on this behavior were not evident after relatively long periods of time.

The present experiment compared the effects first of individual activity, then of competition, as an alternative to cooperation. With either alternative, the average earnings were greater for cooperation. On the competitive task, one of the two subjects received twice what each obtained from the individual activity, thus equalizing *average* reinforcer magnitudes on the individual and competitive tasks. Within each of the task comparisons, the effects of two different sets of choice contingencies were investigated. In the first of these, the cooperative contingencies were in effect only when they were selected by both persons. If either person chose to work individually (or competitively), that contingency was in effect for both. These contingencies correspond to the conception of cooperation as a social behavior requiring mutual choice. One typically need not get another's agreement to work individually or to compete.

There are, however, instances in which the choice of cooperative contingencies by one person may restrict both to that alternative. Third parties may enforce such a rule, or one person may have the power to limit the other's choices, *e.g.*, in parent-child relations. The coerced party, though, may refuse to make the appropriate responses or he may make them in a desultory manner. The opportunity to enforce unilaterally the cooperative alternative constituted the second set of choice contingencies. The cooperative contingencies were in effect for both persons if either or both chose them. The alternative individual (or competitive) contingencies were in affect only if they were chosen by both.

METHOD

Subjects and Apparatus

Twenty college students (10 female and 10 male) volunteered to work as paid participants. Subjects worked in same-sex pairs.

Each of the subject rooms contained a table-mounted panel (23 by 46 cm) with a plunger, a switch for choosing between two tasks, stimulus lights, and two counters (Figure 2). All functions were labelled. The red light in the upper corner of the panel indicated when the tasks were operative. The white light in the lower corner was illuminated for 0.1 sec or for 3 sec whenever the other subject made a response. The blue light indicated when the other subject moved his switch to cooperate. The green lights next to the counters flashed for every reinforcement count registered. Each

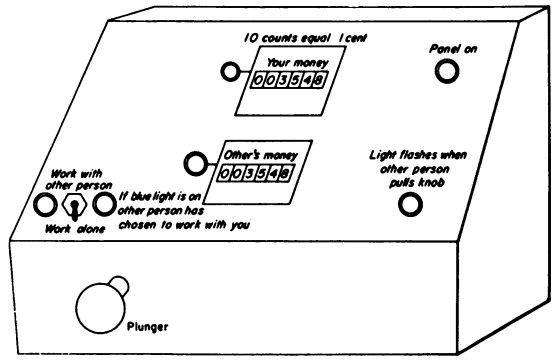

Fig. 2. Diagram of one subject's panel in two-person setting. (Experiments I and II).

count was worth 0.1 cent. One counter showed the subject's earnings during the current session; the other showed his partner's earnings. For all sessions after the first, both subjects' previous totals were posted on a blackboard on the wall directly behind the panel. A closed-circuit television receiver to the left of the panel showed the amount of money available to each subject for work on each of the tasks.

Procedure

Subjects reported to separate waiting rooms and were taken individually to the experimental rooms. Subjects did not meet one another during the experiment.

Table 1 shows the sequence of conditions. Subjects worked a total of four sessions over one to two weeks. Following a training session, four choice conditions were presented over three sessions. In the first two conditions, subjects could choose either to cooperate or to work individually. In the first condition (*individual preempting cooperation*), both subjects could work only individually if either (or both) chose the individual alternative. To cooperate, both subjects had to choose cooperation. In the second condition (*cooperation preempting individual*), both subjects could work only cooperatively if cooperation was chosen by either (or both). To work individually, both subjects had to choose the individual alternative. In the third and fourth conditions, subjects could choose either to cooperate or to compete. In the third condition (*competition preempting cooperation*), both subjects could work only competitively if either (or both) chose competition. In the fourth condition (*cooperation preempting competition*), both subjects could work only cooperatively if either (or both) chose cooperation.

Session 1 (training). Subjects were first shown how to make cooperative responses. Subjects pulled the knobs in response to instructions given by the experimenter over an intercom. Only coordinated knob pulls were reinforced. Either subject could pull first, thus illuminating the white response light on the other's panel for 3 sec. Reinforcement (a counter advance of five points for each subject) occurred whenever the second subject pulled his plunger in the 0.5-sec period after the response light went out; this response illuminated the response light on the other subject's panel for 0.1 sec. If the second subject pulled the knob before or more than 0.5 sec after the response light went off, no counter advance occurred. The next pull by either subject reinitiated the other's response light for 3 sec. If the subject responding first pulled more than once without a pull by the other

Table 1

Conditions Defining Experiment I

Segment	*Reinforcers (Counts)**	*Length of Segment*
Session 1		
1. Cooperation only	Cooperation: 5	335 Cooperative responses
2. Cooperation or individual responding with *individual preempting cooperation*	Cooperation: 1 Individual: 5	135 Individual responses
3. Cooperation or individual responding with *individual preempting cooperation*	Cooperation: 5 Individual: 1	135 Cooperative responses
4. Cooperation or individual responding with *individual preempting cooperation*	Cooperation: 4 Individual: 3	15 min
Session 2		
5. Cooperation or individual responding with *individual preempting cooperation*	Cooperation: 4 Individual: 3	60 min
6. Cooperation or individual responding with *cooperation preempting individual*	Cooperation: 4 Individual: 3	60 min
Session 3		
7. Competition only	Competition: 10	335 Competitive responses
8. Cooperation or competition with *competition preempting cooperation*	Cooperation: 4 Competition: 6	60 min
Session 4		
9. Cooperation or competition with *cooperation preempting competition*	Cooperation: 4 Competition: 6	60 min

*Each count was worth 0.1 cent.

subject, his additional pulls reinitiated the other's response light for 3 sec. Each reinforcement was followed by a 2-sec period during which the red panel light was turned off and cooperative responses were not reinforced. Subjects then made a total of 335 cooperative responses without further instruction (Segment 1).

Next, subjects were told (instructions over the intercom) how to make individual responses and use the task-selection switch. On the individual task, each pull of the plunger by a subject advanced his own counter (on both panels) and illuminated the response light on the other's panel for 0.1 sec. To equate the maximum frequency of reinforcement under the individual and cooperative task conditions, each individual response was followed by a 5-sec period during which the red panel light was turned off and responses were not reinforced. Each subject could choose to work on either the individual or cooperative task by operating the toggle switch on his panel. The switch could be operated at any time. The *individual preempting cooperation* contingencies were in effect first. The cooperative task could be performed only if both subjects chose to work together. Whenever a subject switched to "work with other person", a blue light on his partner's panel was illuminated. At first (Segment 2), the individual task paid at a higher rate (five counts *versus* one count); then (Segment 3), the cooperative task paid more (five counts *versus* one count).

In the final 15 min of Session 1 (Segment 4), the cooperative task paid four counts (approximately $2.40 per hour) and the individual task three counts (approximately $1.80 per hour).

Sessions 2 to 4. Session 2 began with a 60-min period with the *individual preempting cooperation* contingencies in effect (Segment 5). Subjects were then shown the *cooperation preempting individual* contingencies. Subjects operated their switches to show that if either chose to cooperate, both could cooperate only. A 60-min period with this condition (Segment 6) concluded Session 2.

Session 3 began with a demonstration of the competitive task contingencies. Before the session, the "work alone" label on the panel was replaced by a "compete" label. The competitive contingencies were similar to the individual ones, except that only one subject's response was reinforced. When the panel light was on, the first plunger pull by one subject was reinforced by a counter advance of 10 points. Each reinforcement was followed by a 5-sec period during which the red panel light was turned off on both panels and neither subject's responses were reinforced. The lights on both panels came on simultaneously after 5 sec. Then, the first response by one subject was again reinforced. Success on the competitive task thus depended upon the subjects' skill in responding quickly to the panel light, although pulling continuously at a high rate was also a successful strategy. Both strategies were used. Subjects made a total of 335 competitive responses (Segment 7).

Next, subjects were shown the task-selection procedure with the *competition preempting cooperation* contingencies in effect. Subjects operated their switches to show that if one subject chose to compete, both subjects could compete only. Subjects worked 60 min under this condition, where cooperation paid four counts and competition paid six counts (Segment 8). With only one subject able to earn money competitively every 5 sec, the *average* amount of money for both subjects on the competitive task (three counts per response) was less than the amount earned by cooperating (and identical to the amount for the earlier individual response).

At the beginning of Session 4, subjects were shown the *cooperation preempting competition* contingencies. If one subject chose to cooperate, both could cooperate only. Subjects worked 60 min under this condition (Segment 9).

Under each condition, the number of cooperative, individual, or competitive responses was recorded for each pair. With task responses distinct from task choice, subjects could choose a task (via switch position) and not make a task response. If the task chosen was cooperation, the failure of one person to respond meant that no cooperative response could be made. Nonresponding rarely occurred, however.

Results

Cooperative versus *individual choice.* Type of preempt contingency had little effect on the choice to cooperate or work individually. As the left half of Figure 3 shows, the one-count difference favoring cooperation led to a high proportion of cooperative responses in all

pairs regardless of preempt contingency. Nine of the 10 pairs cooperated on at least 95% of their responses under both conditions.

Cooperative versus *competitive choice.* Type of preempt contingency had a strong effect on the choice to cooperate or compete. As the right half of Figure 3 shows, competition was frequent when competitive choice was preemptive. With *competition preempting cooperation,* five of the 10 pairs (three female, two male) were cooperative on less than 16% of their responses. The mean percentage of cooperative responses for all pairs was 33%. The losing subject in one of the competitive pairs (female) withdrew from the experiment following the *competition preempting cooperation* condition.

The change from *competition preempting cooperation* to *cooperation preempting competition* almost eliminated the disruptive effects of competition. As Figure 3 shows, all pairs were cooperative on at least 78% of their responses under the latter condition. The mean percentage of cooperative responses for the nine pairs was 93%.

The change in choice contingencies was accompanied by a change in the proportion of time subjects spent switched to the competitive task. With *competition preempting cooperation,* subjects averaged 56% of their time switched to competition. For the more successful of the two competitors in each pair (excluding one totally cooperative pair), the average was 67%. For the less successful of the two competitors in each pair, the average was 58%. With *cooperation preempting competition,* subjects averaged 21% of their time switched to competition. For the more successful competitors in the previous condition, the average was 35%. For the less successful competitors, the average was 12%. Thus, subjects who had lost in competition typically forced their partners to cooperate when the choice contingencies enabled them to do so. With *cooperation preempting competition,* subjects whose initial choice to compete was preempted by a partner choosing to cooperate often switched to cooperation later in the segment.

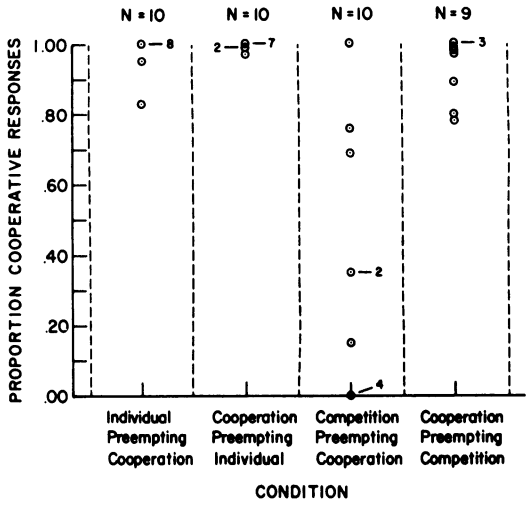

Fig. 3. Proportion of cooperative responses for each pair under the four choice conditions. Each circle represents the proportion of cooperative responses of one or more pairs during 60 min in each condition. The number to the right of a circle indicates more than one pair with the same value. One pair withdrew from the experiment following the third condition.

There is some evidence that the more a subject wins by competing, the more likely he is to compete. The relevant data are from the *competition preempting cooperation* condition, where a person who wanted to compete could do so. Differences in competitive success (difference in number of reinforced competitive responses made by subjects in a pair divided by the pair's total number of reinforced competitive responses) were correlated (Pearson's r) with proportion of competitive responses (pair's total number of reinforced competitive responses divided by the pair's total number of reinforced cooperative and competitive responses). One of the 10 pairs had fewer than 20 competitive responses and was excluded from the analysis. For the remaining nine pairs, the correlation between difference in competitive success and the likelihood of competition was 0.61.

For competition to be the most profitable strategy, a subject had to win often enough to overcome the reinforcer difference favoring the cooperative task. With the present reinforcer magnitudes, a subject would have to win more than 67% of the total competitive responses for competition to be more profitable than cooperation. This was the case for three of the four noncooperative pairs. In only two of the five pairs showing a mixed cooperative/competitive pattern did subjects benefit by competing.

Despite the comparatively large number of responses (approximately 600 under each condition), the behavior of some pairs raises a question as to the effects of time on the be-

havior patterns observed. When competition preempted cooperation, several pairs evidenced a mixed pattern of cooperation and competition throughout the 60 min of work. Would longer periods under the same condition lead to greater stability, with subjects opting for one response or the other? To answer this question, six additional pairs were studied for 4 hr (rather than 1 hr) under each of the two cooperation/competition choice conditions. Following a training session in which both the cooperative and competitive contingencies were demonstrated, pairs were studied with *competition preempting cooperation* for two 2-hr sessions, then with *cooperation preempting competition* for an equal period.

The results closely replicated those from the previous experiment and indicated that initial patterns are likely to persist. During the 4 hr with competition preempting cooperation, two of the six pairs competed on more than 95% of their responses, whereas one pair was totally cooperative. The remaining three pairs cooperated on 50%, 56%, and 77% of their responses respectively. In none of the six pairs did percentage of cooperative responses in the 2-hr sessions differ by more than 10%.

During the 4 hr with *cooperation preempting competition,* all pairs but one were predominately cooperative. Percentage of cooperative responses for the cooperative pairs ranged from 70% to 99%. Between-session differences were 10% or less. The exceptional pair (previously competitive) cooperated on 91% of its responses during the first 2-hr session, but on only 5% during the second 2-hr session. During both sessions, the subjects were nearly equal as competitors.

Thus, the stability of the behavior of these pairs over 4 hr and some 2300 responses in each condition (a duration equal to the total for conditions in Experiment I) makes it highly improbable that the condition-correlated behavior changes observed in Experiment I were a function simply of the passage of time. Rather, in both groups of subjects the changes in behavior were clearly related to the changes in choice contingencies.

Discussion

Clearly, and not unexpectedly, individual responding and competition may produce very different patterns of response as alternatives to cooperation. What was unexpected was the almost complete dependence of the disruptiveness of competition on the choice contingencies. When the competitive choice could be enforced by either subject, competition was the predominant response. Pairs experiencing the most competition were ones in which one subject profited by competing. But considerable competition also occurred in pairs in which subjects were relatively equal as competitors, thus making competition less profitable than cooperation. When the choice contingencies were changed so that either subject in a pair could enforce the cooperative choice, cooperation predominated. In pairs with prior competition, this change gave at least one subject in each pair an opportunity to enforce the response that provided him with higher earnings.

The results thus illustrate the marked effects that different choice contingencies may have on work on identical tasks. This is a point often overlooked in comparing findings across different settings. Seemingly minor differences in choice procedures may have major consequences for behavior.

The effect of condition sequence was not investigated in this experiment. The competitive conditions followed several hours of cooperation with the individual alternative, during which subjects cooperated almost exclusively. The results, however, do not suggest that this experience produced a cooperative bias. Subsequent introduction of the competitive task produced considerable competition. In addition, very similar response patterns were obtained with the lengthened conditions in which no prior cooperation/individual conditions were included. The results also provide evidence against a competitive bias following periods of competition. Pairs that competed with *competition preempting cooperation* tended to be highly cooperative with *cooperation preempting competition.*

The finding that considerable competition occurred where cooperation paid more, on the average, than competition appears, initially, to be at variance with results from a study by Hake, Vukelich, and Olvera (1975), which also used a setting permitting separate cooperative and competitive responses. Each member of a pair had a matching-to-sample apparatus and a switch that could be used to give a matching-to-sample problem to his coactor or to take the problem for himself. One problem was

presented per trial, with the subject who operated his switch first determining who could work the problem. Correct problem solutions were reinforced with counter points backed up with money. Additional responses enabled subjects to communicate with each other. Cooperation was defined by a high correspondence in point totals, if it resulted from subjects giving each other approximately equal numbers of problems. A high correspondence in point totals produced through uncontested take responses was defined as sharing. Attempts by both subjects to take on the same trial were defined as competition. Competition in the match-to-sample setting was thus similar to competition in the present setting. With any differences in skill between competitors, competition would be the higher-paying alternative for one of the subjects. With these alternatives, most subjects received reinforcers via taking, but sharing, rather than competition, was the predominant mode of response. A likely explanation of the infrequency of competition is the opportunity to communicate in the match-to-sample setting. Studies by Marwell and Schmitt (1975) of cooperation and risk and various Prisoner's Dilemma studies (Vinacke, 1969; Wichman, 1970) have shown that the opportunity to communicate generally leads to a high proportion of cooperative choices. Hake *et al.* (1975) used short (20 min) sessions, which provided a number of separate occasions for a social relation to develop. Additional subjects exposed to massed sessions, and hence a shorter time period with fewer opportunities for communication, were far more competitive.

EXPERIMENT II: EFFECTS OF REINFORCER DIFFERENCES ON CHOICE BETWEEN COOPERATION AND COMPETITION IN DYADS

Where cooperation requires mutual choice, a 4:3 reinforcer ratio favoring cooperation over competition leads to frequent competition. The next question is the relation between reinforcer difference and task choice. For example, how great must the difference be before subjects choose consistently to cooperate? The answer should depend on the relative contribution of the two consequences of competition: relative gain and own gain. If relative gain is more important, choice should be little affected by reinforcer values. Subjects should compete even when it may be less profitable than cooperating. A different outcome would be expected if individual gain is more important. As the reinforcer for cooperating is increased, few subjects may so dominate their opponents that competition remains a profitable strategy. Thus, subjects maximizing own gain should choose to cooperate when earnings for cooperation exceed those possible by competing. In this experiment, the reinforcer difference between cooperation and competition was manipulated for each pair of subjects.

METHOD

Subjects and Apparatus

Thirty-four female college students volunteered to work as paid participants. The apparatus was the same one used in Experiment I.

Procedure

Pairs were scheduled to work six 2-hr sessions, distributed over approximately two weeks. As in Experiment I, subjects in a pair did not meet each other during the experiment. Session 1 began with a demonstration of the cooperative contingencies (via instructions over the intercom) followed by 335 cooperative responses. Next, the individual task and task-selection procedures were demonstrated. Subjects then worked 30 min, with cooperation paying more than individual responding (four counts *versus* three counts). This period was included to assure that subjects opted for the more reinforcing task when the alternative was noncompetitive. Pairs that cooperated on at least 80% of their responses worked under these reinforcer values for the entire 30 min. Pairs that cooperated on less than 80% of their responses during the first 15 min earned five counts for cooperating and three for working individually during the second 15 min. Session 1 concluded with a demonstration of the competitive contingencies, followed by a total of 335 competitive responses.

In subsequent sessions, pairs worked under one of two reinforcer sequences. Seven of the 17 pairs worked under the *increasing reinforcer sequence,* in which the reinforcer for cooperation was initially less than the average reinforcer for competition. If competition re-

sulted, the reinforcer for cooperation was increased until the pair was cooperative. Finally, the reinforcer was reduced until the pair again was competitive. Except where noted, a given reinforcer value remained in effect during at least one 2-hr session. In order to determine when to change values, a pair's behavior during each session was categorized as follows: cooperative—when more than 75% of its responses were cooperative; competitive—when more than 75% of its responses were competitive; mixed cooperative/competitive—when neither of the above was obtained. If a pair reached the criterion for either cooperation or competition during a 2-hr session with a given reinforcer, the reinforcer was changed (either up or down, depending upon the stage of the sequence) for the next session. Pairs evidencing a mixed pattern when working for the first time with a given reinforcer (during the first part of the sequence), were studied a second 2-hr session with the same reinforcer to determine if one of the two responses would eventually predominate. If the mixed pattern continued, the reinforcer was increased during the next session. Pairs duplicating an earlier mixed pattern when a given reinforcer was reintroduced (during the latter part of the sequence) were not studied further under that reinforcer value. The reinforcer was reduced during the next session. Pairs began the reinforcer sequence in Session 2 with each subject receiving two counts for cooperating and six counts for competing (thus competition averaged three counts). The reinforcer for cooperation was increased or decreased in two-count steps.

Ten of the 17 pairs worked under a *decreasing reinforcer sequence* with the reinforcer for cooperation first raised to the point where subjects were cooperative (using the criterion given above). Then, the reinforcer was reduced until the pair was competitive. Finally, the reinforcer was increased until subjects were again cooperative. Pairs began the reinforcer sequence in Session 2 with each subject receiving six counts for cooperating and six counts for competing. The reinforcer for cooperation was increased or decreased in two-count steps.

Results

Increasing Reinforcer Sequence

All seven pairs chose to cooperate rather than work individually during Session 1. One pair (C-O) failed to cooperate at a high rate until the reinforcer for cooperation was raised to five counts.

Table 2

Proportion of cooperative responses of pairs under increasing reinforcer sequence. (Numbers in parentheses indicate hours worked.)

	Counts per Cooperative Response (Each Competitive Response Paid Six Counts)				
Pair	*2*	*4*	*6*	*4*	*2*
J-B	0.00 (2)	0.76 (4)			0.00 (2)
J-H	0.00 (2)	1.00 (2)			0.00 (2)
R-M	0.02 (2)	0.00 (2)	1.00 (2)	0.00 (2)	
S-S	0.14 (2)	0.10 (2)	0.99 (2)	1.00 (2)	0.00 (2)
D-J	0.00 (2)	0.50 (4)	1.00 (2)	0.75 (2)	0.05 (2)
C-O*	0.06 (2)	0.10 (2)	0.95 (2)	0.87 (2)	0.00 (2)
H-H	0.00 (2)	0.00 (2)	1.00 (2)	1.00 (2)	0.00 (2)
Mean	0.07	0.35	0.99	0.72	0.01

*Cooperated in Session 1 only when cooperation paid five counts and individual responding paid three counts.

With the opportunity to cooperate or compete, all pairs' responses were a function of the size of the reinforcer for cooperation. Table 2 shows the proportion of cooperative responses made by each pair under the various reinforcer values. Note that with each competitive response paying six counts, the average for each subject was three counts. Thus, average earnings for cooperation exceeded those for competition when cooperation paid four counts or more. All seven pairs competed on more than 85% of their responses during the initial condition where cooperation paid two counts and competition paid six counts. Two of these pairs were cooperative on more than 75% of their responses when the reinforcer for cooperation was increased to four counts. The remaining five pairs all cooperated when the reinforcer was further increased to six counts. When the reinforcer for cooperation was reduced, competition occurred at four counts in one pair and two counts for six pairs. The seven pairs completed the experiment in from four to seven sessions.

The effects of differences in competitive success on competition were examined for six pairs during the initial four-count reinforcer condition where there was considerable variation in proportion of competitive responses (one pair making fewer than 20 competitive responses was excluded). The correlation between difference in competitive success and the

proportion of competitive responses was −0.52. Thus, unlike the result from the previous experiment, the more successful one of the competitors, the less the subjects were likely to compete. No subject in any pair earned more by competing.

Decreasing Reinforcer Sequence

All 10 pairs chose to cooperate rather than work individually in Session 1, but two pairs (M-B and C-M) required five counts before they cooperated. Three pairs (to be discussed separately) did not complete the scheduled reinforcer sequence.

The responses of all pairs completing the reinforcer sequence were a function of the size of the reinforcer for cooperation. Table 3 shows the proportion of cooperative responses made by each completed pair under the reinforcer values. Three of the seven pairs failed to cooperate on at least 75% of their responses during the first hour of Session 2, with cooperation paying six counts. When the reinforcer for cooperation was increased to eight counts during the second hour, all three pair cooperated. During the next session, cooperation again paid six counts. For these three pairs, the proportion of cooperative responses shown for the first six-count period in Table 3 is the average of 3 hr of work. When the reinforcer for cooperation was reduced for the seven pairs, competition occurred at four counts for three pairs, two counts for three pairs, and one count for one pair (the pair worked 1 hr at that magnitude). When the reinforcer for cooperation was increased, cooperation reemerged at six counts for four pairs. One pair each cooperated again at two, four, and eight counts. The seven pairs completed the experiment in from four to eight sessions.

Of the three pairs that failed to complete the decreasing reinforcer sequence, two did not continue after the second session. Both pairs had cooperated on more than 90% of their responses, and thus had earned more than $9 each. In the third pair, one subject quit following the sixth session after the pair had competed when cooperation paid two counts. The pair cooperated initially at eight counts.

The effects of differences in competitive success on competition were examined for six pairs during the initial six-count reinforcer condition (including the two pairs that later terminated and excluding four pairs that made fewer than 20 competitive responses) and for eight pairs during the initial four-count reinforcer condition (including one pair that later terminated). With the six-count reinforcer, the correlation between the difference in competitive success and the proportion of competitive responses was −0.19. With the four-count reinforcer, the correlation was −0.32. Thus, as in the previous sequence, the more successful one of the competitors, the less the subjects were likely to compete. One subject in each of two pairs (P-D and S-W) profited by competing rather than by cooperating when cooperation paid four counts.

Discussion

The results demonstrate an orderly relation between the reinforcer difference for cooperating or competing and task choice. In each of the 14 completed pairs, choice between the two alternatives could be manipulated by varying the size of the reinforcer difference. Pairs

Table 3

Proportion of cooperative responses of pairs under decreasing reinforcer sequence. (Numbers in parentheses indicate hours worked.)

	Counts per Cooperative Response (Each Competitive Response Paid Six Counts)								
Pair	*8*	*6*	*4*	*2*	*1*	*2*	*4*	*6*	*8*
M-B*		1.00(2)	0.86(4)	0.73(4)	0.20(1)	0.87(3)			
U-A		1.00(2)	0.70(4)	0.01(2)			1.00(2)		
S-W		0.93(2)	0.63(4)	0.00(2)			0.59(2)	1.00(2)	
S-S		0.99(2)	0.08(2)					1.00(2)	
P-D	0.99(1)	0.70(3)	0.76(2)	0.00(2)			0.17(2)	1.00(2)	
C-M*	0.75(1)	0.81(3)	0.05(2)					0.98(2)	
T-D	0.78(1)	0.41(3)	0.03(2)					0.53(2)	0.98(2)
Mean	0.84	0.83	0.44	0.19	0.20	0.87	0.59	0.90	0.98

*Cooperated in Session 1 only when cooperation paid five counts and individual responding paid three counts.

differed only in the size of the difference at which changes in choice occurred. Most competition occurred within the range in which subjects *might* have gained by competing, *i.e.*, when cooperation paid fewer than six counts. All but one pair eventually cooperated for six counts or fewer.

From a motivational standpoint, the results thus suggest any effects of relative gain on competition appear only within a narrow range of reinforcer values, where any loss in earnings from competition is small. When competition can no longer be equally as or more profitable than cooperation, subjects no longer compete. This clear relation between reinforcer differences and choice has not been apparent from previous matrix game research, where payoff ranges have not been manipulated for individual pairs.

The results failed to replicate the positive relation between competitive success and likelihood of competition found in Experiment I.

EXPERIMENT III: EFFECTS OF REINFORCER DIFFERENCES ON CHOICE BETWEEN COOPERATION AND COMPETITION IN TRIADS

With dyads, the evidence suggests that competition will be chosen over cooperation only within the limits of potential profitability. But is this a general relation that holds with larger groups as well? As groups grow larger under reinforcer conditions analogous to those for dyads, the reinforcer for a single successful competitive response becomes increasingly large, whereas the reinforcer for cooperation remains constant. For example, if the *average* reinforcer for competition for each person is three counts, the size of a *single* reinforcer is six counts in a dyad and nine counts in a triad. Thus, if the range within which competition is likely is determined by the comparative size of each reinforcer for cooperation or competition, large groups should be more competitive than small ones. To provide a limited test of this question, triads were studied under conditions analogous to the decreasing reinforcer sequence with dyads in Experiment II. Thus, where subjects in dyads earned six counts for cooperating and six for competing, subjects in triads earned six and nine counts respectively.

METHOD

Subjects and Apparatus

Fifty-one female college students volunteered to work as paid participants. Except for the addition of a third person, the setting was similar to that used in Experiments I and II. Figure 4 shows one of the panels (Subject C's). Task responses were made using a large panel button. White panel lights, one for each of the other subjects, illuminated for 0.1 sec or 3 sec whenever one of the other subjects made a response. Amber panel lights indicated when each of the other subjects moved her switch to cooperate. A closed-circuit television screen next to the panel showed the three subjects' point totals during each session. The screen also showed the amount of money available to each subject for work on each of the tasks. A blackboard on the wall indicated the group's earnings from previous sessions.

Procedure

Groups were scheduled to work six 2-hr sessions distributed over approximately two weeks. Subjects also agreed to be available for additional sessions if necessary. Except for the addition of the third person, the procedure was identical to that used in Experiment II. Subjects did not meet during the experiment. In Session 1, the various responses were demonstrated. Subjects were first shown how to make a cooperative response. One of the subjects pushed her task button first, thus illuminating for 3 sec the white response lights on the other subjects' panels. Any one of the subjects could make this initial response. Reinforcement (a counter advance of five counts for each subject) occurred whenever both of the

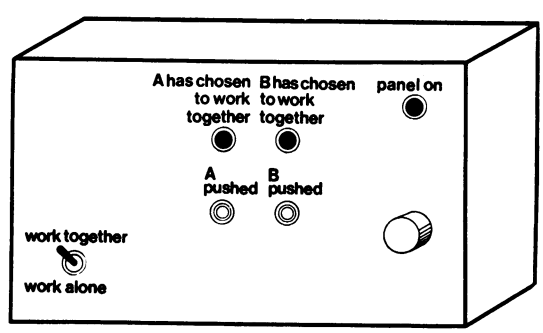

Fig. 4. Diagram of one subject's panel (Subject C) in three-person setting (Experiment III).

other subjects pushed their buttons in the 0.5-sec period after the response lights went out. This response illuminated the appropriate response lights on the other subjects' panels for 0.1 sec. If either of the subjects responding second pushed her button either before the response light went off or more than 0.5 sec after it went off, no counter advance occurred. Then, the next push by any subject reinitiated the response lights on the others' panels. If the subject responding first pushed more than once without a push by the other subjects, her additional pushes reinitiated the others' response lights for 3 sec. Each reinforcement was followed by a 2-sec period during which the red panel light was turned off and cooperative responses were not reinforced. Following the instructions, subjects made 335 cooperative responses.

Next, the individual task and the use of the task-selection switch were demonstrated. As in Experiment II, this condition was included to determine if subjects would opt for cooperation when the alternative was noncompetitive. On the individual task, each button press advanced only the counter of the subject making the response, and illuminated the response lights on the other subjects' panels for 0.1 sec. Each individual response was followed by a 5-sec period during which the subject's red panel light was turned off and responses were not reinforced.

Each subject could choose to work on either the individual or cooperative tasks by operating the toggle switch on her panel. The cooperative task could be performed only if all three subjects chose to work together. If one or two subjects chose to work alone, the individual task operated for all subjects. Whenever a subject switched to "work together", an amber light on each of her partners' panels was illuminated.

Subjects then worked 30 min with a choice between cooperative and individual responding. Initially, cooperation paid four counts and individual responding three counts. Groups that were cooperative on at least 80% of their responses worked under this condition for 30 min. Pairs that cooperated on less than 80% of their responses during the first 15 min earned five counts for cooperating during the second 15 min.

Session 1 concluded with a demonstration of the competitive contingencies. The subject pulling first was rewarded by a counter advance of 15 points. Each reinforcement was followed by a 5-sec period during which the panel lights went out on all panels and no additional responses by any of the subjects were reinforced. Subjects made a total of 335 competitive responses.

In Session 2, groups began the decreasing reinforcer sequence with each subject receiving six counts for cooperating and nine counts for competing (competition thus averaged three counts). The reinforcer for cooperation for groups that were competitive was increased further in two-count steps until cooperation developed. Next, the reinforcer was reduced until subjects competed, then raised until the group again cooperated. The 75% response criterion for cooperation or competition was used to determine when to change conditions.

Results

All but two of the 17 groups chose to cooperate rather than work individually during Session 1. The two noncooperative groups were not studied further.

Study of the remaining 15 groups under the decreasing reinforcer sequence produced one highly unusual result: 11 of the groups failed to complete the scheduled sequence. Reasons most commonly given for terminating were a failure to earn enough money and obtaining another job.

Despite their failure to complete the sequence, most of the terminating groups worked enough sessions to permit some analysis of the effects of reinforcer differences. Three groups worked a total of two sessions, and two groups each worked 3, 5, 6, and 7 sessions. The four completed groups worked from six to eight sessions. Including both the complete and incomplete groups, 13 eventually cooperated. Six of these groups worked enough sessions to determine the point at which they competed. Only the four complete groups were studied until they again cooperated.

The reinforcer for which groups first cooperated varied considerably, but tended to be higher than with dyads. Five of the 13 groups cooperated at six counts, four at eight counts, three at 10 counts, and one at 12 counts (the median was eight counts). When the reinforcer for cooperation was reduced for six of

Table 4

Proportion of cooperative responses of completed triads under decreasing reinforcer sequence. (Numbers in parentheses indicate hours worked.)

	Counts per Cooperative Response (Each Competitive Response Paid Nine Counts)							
Triad	*10*	*8*	*6*	*4*	*2*	*4*	*6*	*8*
M-B-H			1.00(2)	0.76(4)	0.00(2)	0.93(2)		
W-O-B			1.00(2)	0.53(4)	0.26*(4)	1.00(2)		
A-F-P		0.98(1)	0.65(3)	0.37*(4)		1.00(7)		
M-B-E	0.94(1)	0.69(2)	0.33(3)	0.23(4)			0.62(2)	0.97(2)

*Competitive on more than 75% of responses during last 2 hr.

these groups, two competed at four counts and four competed at two counts.

Table 4 shows the proportion of cooperative responses made by each of the four completed groups under the reinforcer sequence. Two groups cooperated first at six counts, competed at two counts, and cooperated again at four counts. The third group cooperated at eight counts, competed at four counts, and cooperated again at six counts. The fourth group cooperated at 10 counts, competed at four counts, and cooperated again at eight counts. With regard to the points at which they cooperated and competed, the completed groups were not greatly dissimilar to those that terminated.

The number of groups was sufficient to permit examination of the effects of differences in competitive success on competition during the eight-count, six-count, and four-count cooperative rewards. For the three conditions, the correlation between the average difference between competitors in competitive success and the proportion of competitive responses was 0.67 (N = 6), 0.36 (N = 11), and 0.08 (N = 8), respectively. Thus, the more successful one or two of the competitors, the more subjects were likely to compete. None of the subjects profited by competing with the eight-count reinforcer. Competition was profitable for one of the subjects in two of the 11 groups with the six-count reinforcer and six of eight groups with the four-count reinforcer.

Discussion

The data suggest that for triads as well as dyads, the size of the reinforcer for competition determines the attractiveness of competition *vis-à-vis* cooperation. Although average reinforcer values for cooperation and competition were identical, the median dyad cooperated at six counts, whereas the median triad cooperated at eight counts. The clear pattern for both dyads and triads is that competition is likely only within the range in which it is potentially profitable. Only one of 13 triads (8%) and three of 17 dyads (24%) were competitive beyond the point where the reinforcer for cooperation exceeded the reinforcer for competition. In each of these exceptional cases, cooperation began when it was favored by a two- or three-count difference. No subjects chose only to compete. Thus, all groups that completed the reinforcer sequence evidenced a lawful relation between task choice and the reinforcer difference between cooperation and competition.

A major difference between the dyads and triads was the latter's fundamental instability. The consequences for many subjects in triads were highly aversive. More than two-thirds of the triads, compared with less than one-fifth of the dyads, failed to complete the reinforcer sequence. This long-term difference has not been apparent in previous research, where groups were studied for far shorter periods of time. The factor that probably contributed most to withdrawal by triads was low earnings. With three persons competing, the chances of one person earning little money—sometimes less than one dollar per hour—were considerably greater than with two persons. Because less than half of the groups cooperated at first with the six-count reinforcer for cooperation, some subjects received little money early in the experiment despite high potential earnings. In several cases too, a drop in earning was followed by withdrawal. When groups cooperated at eight counts, each subject averaged over four dollars per hour. When a subsequent reduction in the reinforcer was accompanied by competition, earnings for most subjects

were reduced by half or more. Because of the inequities likely with competition, one would expect increasing instability with further increases in group size.

Triads were more likely to be competitive the greater the differences in competitive success among the subjects. The relation was stronger the larger the reinforcer for competition. The results from the three experiments are thus not consistent regarding the effect of differences in competitive success on likelihood of competing.

In conclusion, several practical implications of the findings should be noted for those concerned with increasing cooperative choice *vis-à-vis* competition. One is that the likelihood of persons cooperating seems to be readily manipulatable. Any effects of individual differences in disposing subjects to compete appear to be overridden by moderate reinforcer differences. Another concerns the detrimental effects of an increase in the number of competitors. Where the size of reinforcer for competition increases in proportion to group size, temptation to compete increases as well. And the probability that a given competitor will be successful decreases, thus increasing his likelihood of withdrawal from the potentially cooperative situation.

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