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THE MEASUREMENT OF SHARING AND COOPERATION AS EQUITY EFFECTS AND SOME RELATIONSHIPS BETWEEN THEM[1]

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The initial objective was to determine whether an increase in cooperative responses (minimal cooperation) was also accompanied by an increase in the degree of correspondence in the number of reinforcers of the two subjects (maximal cooperation). Correct matching-to-sample responses of seven pairs of male adolescents were reinforced with money. On each trial, a subject could (1) give the matching-to-sample problem to his coactor (give or cooperative responses), or (2) take the problem for himself (take responses). The first member of the pair to respond made the choice. Correspondence did increase under this procedure as compared to a baseline where problems were distributed randomly. However, the increased correspondence usually resulted from take responses rather than cooperative give responses. This equitable method of problem distribution, designated as sharing, was characterized by the subjects alternately taking problems. The spacing of daily sessions may have been partly responsible for the high degree of correspondence, because correspondence did not increase within the usual number of sessions when the sessions were massed, *i.e.*, all in one day. Daily sessions require cooperative responses, *i.e.*, each subject has to show up each day for the other to earn money, and this dependency upon the coactor's behavior may facilitate some sharing or cooperation to ensure the coactor's attendance.

A cooperation procedure may be defined as one in which the reinforcers of each member of a pair are at least partly dependent upon the responses of the other member (Hake and Vukelich, 1972). The cooperation effect is then defined by increases in these responses by both members of the pair. Hake and Vukelich (1972) suggested a second cooperation effect. While increases in cooperative responses are indicative of control by the reinforcer resulting from the cooperation procedure, control by the reciprocal nature of the cooperation procedure also requires equality or at least an increase in the degree of correspondence between the numbers of reinforcers or cooperative responses of the members of the pair. If cooperation is to be considered a social behavior, correspondence should be calculated as the per cent of the number of reinforcers or cooperative responses of one subject relative to the number of the other subject, rather than relative to a total number of trials or opportunities for cooperation. Simply, if cooperative behavior is a social behavior, it should be under the control of the behavior of the other member of the pair (Keller and Schoenfeld, 1950). Increases in cooperative responses do not necessarily result in increased correspondence: increases in cooperative responses can result in a more unequal distribution of reinforcers than a prior noncooperative procedure. Increases in cooperative responses will be designated as the minimal cooperation effect, while minimal cooperation plus increased correspondence will be designated as maximal cooperation. Since both minimal and maximal effects result from the cooperation procedure, maximal cooperation is simply an advanced type of cooperation.

Hake and Vukelich (1973) measured both minimal and maximal cooperation in a cooperation procedure that allowed subjects to make either individual noncooperative responses or cooperative responses in a matching-to-sample task. The degrees of correspondence obtained under individual and coopera-

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tive responding could be compared, since the relative amount of work required by the two methods could be varied to favor first one method and then the other. When the subjects (retarded hospital residents) responded cooperatively, there was not only an increase in the number of cooperative responses (minimal cooperation), but also a small but consistent increase in the degree of correspondence between the numbers of responses of the two subjects (maximal cooperation). Correspondence was presented in terms of responses rather than reinforcers because the subjects had large accuracy differences in matching-to-sample. However, except under unusual circumstances, such as an extremely large response requirement, the reinforcer would seem to exert more control. Hence, the original objective of the present study was to determine whether or not an increase in cooperative responses (minimal cooperation) was accompanied by an increase in the degree of correspondence in the numbers of reinforcers obtained by the two subjects (maximal cooperation).

In order for a procedure to reveal an increase in the correspondence in the numbers of reinforcers of two subjects, the procedure must also allow the possibility of deviations from perfect correspondence. The present procedure was similar to that of Hake and Vukelich (1973), in that correct matching-to-sample responses were reinforced with points that were exchangeable for money. The procedure differed in that it was a trials procedure, with each trial containing only one matching-to-sample problem that could be distributed to either one of the two subjects. On each trial, each subject could (1) give the problem to his coactor, hereafter designated as a give or cooperative response, or (2) take the problem for himself, hereafter designated as a take response. The first member of the pair to respond determined what occurred that trial. A take response by each subject on a single trial was defined as competition. The possibility of competition was included to increase the possibilities for large deviations from equality.

The original objective of the study was extended when we discovered that increased correspondence could result from take responses as well as from cooperative give responses. For this solution, which appeared to be similar to that which is designated as sharing in real life, the subjects simply alternated taking problems, with only one of them responding on each trial. Hence, sharing was defined as (1) an increase in correspondence plus (2) a predominant method of responding within trials that consisted of no response from one subject and a take response from the other subject. Competition also involved take responses, but both subjects emitted take responses on each trial. Maximal cooperation consisted of an increase in correspondence, but the predominant method of responding within trials was a give response. Subsequent analyses examined the development of both maximal cooperation and sharing as well as relationships between them.

Method

Subjects

The four pairs of subjects consisted of 14- to 16-yr-old male volunteers from the local high school. Since the experiment was conducted during the summer vacation, the subjects were picked up at a commom meeting place or at their homes. Earnings from the experiment and a bonus of 50 cents per day for attending five consecutive days were paid weekly. Each member of a pair was paid on a different day and, as a result, for a different series of sessions.

Apparatus

The apparatus was similar to that of Hake, Vukelich, and Kaplan (1973); that experiment can be consulted for exact dimensions. Each member of a pair had a matching-to-sample apparatus that consisted of a sample panel for producing sample stimuli (left side of Figure 1) and a matching panel for matching the sample stimuli (right side of Figure 1). Each subject's sample and matching panels were color coded, *i.e.*, those of one subject were green and those of the other subject were brown. The matching panels of the two subjects were always 4 m apart, but each subject's sample panel could be placed at different distances from his matching panel.

Each matching panel was affixed to a table in front of the subject's chair. In the center of each matching panel, from the top to bottom, were an opening through which the 1-, 2-, or 3-cent point value of each problem

was projected (magnitude-of-reinforcement stimulus), a light that flashed after a correct matching response on that panel (feedback stimulus), three pairs of buttons with a letter corresponding to each button (matching-response buttons), and a button that was to be depressed before talking (conference button). Two counters labelled "me" and "other person" (self and coactor audit counters, respectively) and covered with one-way glass were on the right side of the panel. Pressing the button to the left of either one of the counters (audit button) illuminated the area behind the glass of that counter so that the points on that counter could be seen. A counter remained illuminated for as long as the subject pressed the button. A three-position switch with a 7.6-cm lever (distribution lever), located on the left side of the matching panel, could be used to distribute problems. The response of the first subject to respond on a trial determined the distribution of the problem. A subject could take the problem himself by pushing the lever to the upward position labelled "me". If this was the first response, the sample-operative stimulus on that subject's sample panel was illuminated, thereby indicating that he could work and receive credit for the problem. Similarly, a subject could give the problem to his coactor by pushing the lever to the downward position labelled "other person". If this was the first response, the sample-operative stimulus on the coactor's sample panel was illuminated, thereby indicating that the coactor could work and receive credit for the problem. The distribution lever was spring loaded so that it returned to the middle position after it was pushed either up or down.

The sample panel was on a stand that put it at eye level of the seated subject. Illumination of a light (sample-operative stimulus) on top of the sample panel indicated that the panel was operative. The face of the sample panel contained three openings through which the sample stimuli were projected, and a button (sample-producing button) the depression of which resulted in a 1-sec presentation of one of two letters through each of the stimulus openings. The letter combinations were randomized on two, 33-pole steppers that alternated every 2 min so that the letter combinations were presented in different orders.

The experimental room also contained a closed-circuit television camera, a microphone, and a voice-operated relay, all in full view of the subjects. Electromechanical scheduling and recording equipment, the video monitor, and the speaker were located in an adjacent room.

Procedure

Baseline: random distribution of problems. This procedure served as a baseline for evaluating levels of correspondence obtained when the distribution of problems was made dependent upon the subjects' responses. During this procedure the subjects were tested together, but the distribution lever was not operative: the matching-to-sample problems were distributed between the two subjects by the au-

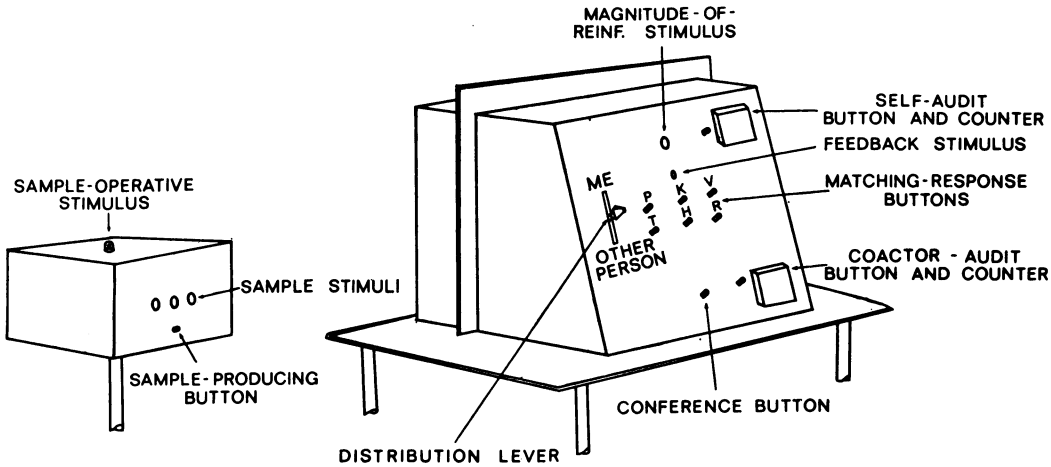

Fig. 1. Diagram of the sample panel (left) and matching panel (right) of one subject.

tomatic scheduling equipment. The sample panel that was operative on a particular trial and the 1-, 2-, or 3-cent point value of each problem were both randomized on 33-pole steppers. Each sample panel and each point value had the same probability of occurrence, but in each session the two distributions occurred in different orders with respect to each other. Hence, even though the two sample panels had an equal overall probability of being operative, the irregular assignment of point values made it possible for a subject to earn more, less, or the same number of points as his coactor in a session.

During this baseline procedure and during the subsequent experimental conditions, the sample panels were arranged so that subjects would cooperate on the matching-to-sample part of the procedure. The rationale was that cooperation at one level, *i.e.*, completion of the matching-to-sample problems, might facilitate cooperation at another level, *i.e.*, distribution of the problems, when the procedure allowed subjects to distribute problems. Each subject's sample panel was placed 4 m away from his own matching panel but next to his coactor's matching panel. Each sample panel still faced the corresponding matching panel, *i.e.*, the green sample panel still faced the green matching panel, so that the subject at each matching panel could see his sample stimuli if his coactor produced them for him (cooperative response). Hence, if the subjects cooperated in matching-to-sample, they could remain seated to produce the sample stimuli for their coactor and to make their own matching response. A subject could still respond noncooperatively by walking to his own sample panel, producing his own sample stimuli, and returning to his matching panel to make the matching response. However, the baseline sessions were numbered from the start of cooperation on the matching-to-sample problems.

The sequence of events on each trial was as follows. Every trial began with the illumination of the magnitude-of-reinforcement stimulus that presented the 1-, 2-, or 3-cent point value of the problem on both matching panels. Approximately 0.5 sec later, the sample-operative stimulus on top of one of the sample panels was illuminated so that the subject at the corresponding matching panel (same color) would receive the number of points assigned to the problem if he worked it correctly. First, however, his coactor who was nearer to the subject's sample panel had to press the sample-producing button, thereby producing a 1-sec presentation of the sample stimuli. Then, a correct matching response by the subject, *i.e.*, depression of the buttons on the matching panel that corresponded to the sample stimuli, was followed by the feedback stimulus and by the recording of the appropriate number of points on the self-audit counter of that matching panel and on the coactor-audit counter of the coactor's matching panel. There were 7.5 sec between trials: the magnitude-of-reinforcement stimulus for the next problem came on 7.5 sec after the previous matching response was completed or, if the problem was not completed, 7.5 sec after the 8 sec allotted to work the problem had elapsed.

A single button press illuminated an audit counter. Subjects were allowed to talk during sessions as long as they kept the conference button depressed. Talking without depressing the button interrupted the session for 2 min, during which subjects could not work problems. Pressing a conference button delayed the scheduling of stimulus events, *e.g.*, the next problem, for as long as the button was depressed.

To ensure that subjects could match-to-sample, each subject was first given an acquisition session during which he was tested alone with his sample panel next to his own matching panel. This training session lasted until he correctly matched on five consecutive problems. The instructions that preceded the acquisition session were essentially the same as those given in their entirety in Hake *et al.* (1973). To summarize, the instructions indicated (1) each point was worth one cent and that the amount earned in sessions would be paid weekly, (2) the function of the various stimuli and response buttons, and how to match-to-sample, (3) how to check his own and his coactor's score, (4) the function of the conference button, (5) that there would be a brief time between problems when all panel lights would be out and problems could not be worked. The instructions before each baseline session were shorter, indicating only that the subjects should watch the letters (sample stimuli) on the stand that was the same color as their matching panel and that

they could work problems any way they wanted as long as they did not move any apparatus.

There were usually two sessions per day, but for all subjects there were occasionally days with only one session. The procedure continued for four to six 20-min sessions.

Response-dependent distribution of problems. In the next procedure, as soon as the 1-, 2-, or 3-cent magnitude-of-reinforcement stimulus was presented, either subject could determine which received the problem by being the first to press his distribution lever. Not pressing the lever, pressing it second, or pressing it before the magnitude-of-reinforcement stimulus had no effect. If a subject pushed his distribution lever up to the "me" position, he took the problem for himself and his own sample panel became operative; if he pushed his lever down to the "other-person" position, he gave the problem to his coactor and his coactor's sample panel became operative. Once a lever was pushed and the problem distributed, the problem was worked in the same way as in the baseline procedure.

The subjects were given instructions that told the functions of the distribution lever, when it was operative, and that if they both pushed their lever the first to respond determined the distribution of the problem. All sessions after the first were preceded by the same instructions that preceded each session under the baseline procedure. There were eight sessions (seven for Pair 4).

Finally, the baseline procedure was re-instated for four to six sessions.

Results

Correspondence of scores. The correspondence of scores for each session was calculated by dividing the low score for the session by the high score for that same session. Figure 2 shows that the correspondence of scores for each pair increased when the distribution of problems was determined by responses on the distribution lever. There was at least 95% correspondence for each of the last four sessions under the response-dependent procedure. Three pairs attained this level within the first (Pair 3) or second session (Pairs 2 and 4) of the response-dependent procedure; Pair 1 required five sessions. There were also some sessions with high levels of correspondence during baseline, since problems were distributed on a random but 50-50 basis under that procedure. However, only Pair 3 had as many as three consecutive sessions with correspondence at or above 90%, and for no pair did the means under the baseline procedure reach that of the last four sessions under the response-dependent procedure.

All four pairs completed the matching-to-sample problems cooperatively, *i.e.*, they produced the sample stimuli for each other. The cooperative sample-producing response was acquired immediately for the first three pairs,

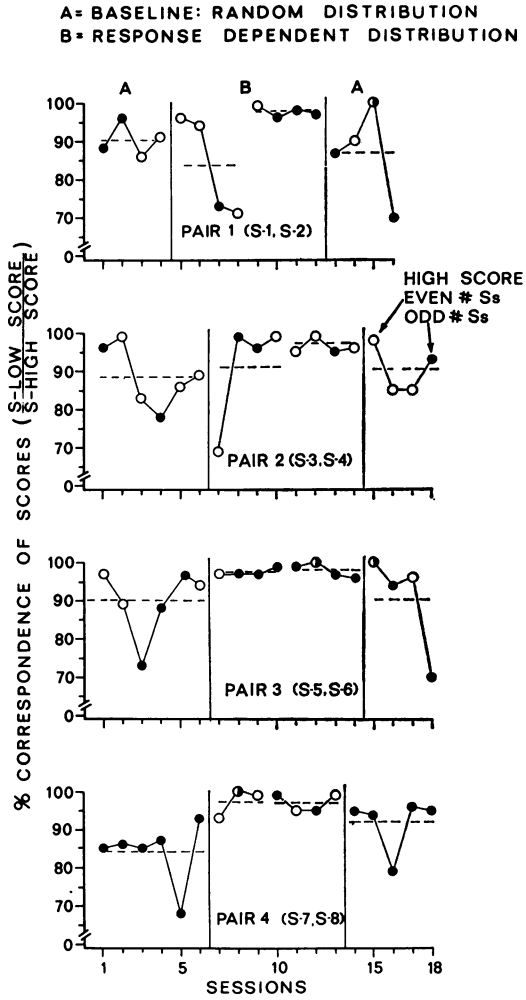

Fig. 2. Session-by-session plot of the correspondence of scores for each pair. The open circles indicate that the even-numbered subject had the higher number of points in the session; solid circles indicate that the odd-numbered subject had the higher number of points. Half-filled circles indicate 100% correspondence. The horizontal broken lines give the mean correspondence for each block of sessions under the baseline procedure, and for the first four sessions and the last four sessions under the response-dependent procedure.

but the fourth pair required four sessions. These first four sessions of Pair 4 were omitted from Figure 2, so that for all sessions in Figure 2, a subject's sample stimuli were produced by his coactor if they were produced at all.

The increased correspondence under the response-dependent procedure was not an artifact of the percentage measure used in Figure 2: increased correspondence was also evident in the absolute scores. For all four pairs, the mean absolute difference between scores for the last four sessions of the response-dependent procedure was smaller than under either exposure to the baseline procedure, even though subjects earned slightly more points under the response-dependent procedure. This is shown in Table 1, which gives the mean high score, the mean low score, and the mean difference between scores for each procedure.

The larger number of points under the response-dependent procedure was due to the occurrence of more problems during that procedure (a mean of 92 per session for both members of a pair) than during the baseline (82 per session). This difference was due to two major factors. First, the mean times to complete a problem under the two exposures to the baseline procedure were 4.6 and 4.0 sec, respectively, while the mean time under the response-dependent procedure was 3.4 sec. The shorter amount of time per problem under the response-dependent procedure allowed more time for problems to occur. Second, presses on the conference button, which interrupted the scheduling of problems as long as a button was depressed, decreased over the course of the experiment, thereby allowing more time for problems during the last two phases.

For the last pair of subjects, the smaller number of points during the initial baseline occurred in part because Subject 8 averaged only 79% correct on matching responses dur-

Table 1

Mean high score, mean low score, and mean difference between scores for each pair under each procedure.

		Response-Dependent Procedure		
Mean Scores	*Baseline: Random Distribution*	*First Four Sessions*[a]	*Last Four Sessions*	*Baseline: Random Distribution*
PAIR 1				
High	60.8	66.5	74.3	79.5
Low	55.0	54.5	72.3	69.0
Difference	5.8	12.0	2.0	10.5
PAIR 2				
High	97.7	109.5	114.8	105.5
Low	86.3	100.5	111.5	95.0
Difference	11.4	9.0	3.3	10.5
PAIR 3				
High	75.5	80.8	98.0	87.5
Low	67.2	78.8	96.0	78.3
Difference	8.3	2.0	2.0	9.2
PAIR 4				
High	72.3	100.0	95.0	90.0
Low	60.8	97.3	92.0	82.6
Difference	11.5	2.7	3.0	7.4
MEANS ACROSS PAIRS				
High	76.6	89.2	95.5	90.6
Low	67.3	82.8	93.0	81.2
Difference	9.3	6.4	2.5	9.4

[a]Only three sessions for Pair 4.

ing this phase. All other subjects averaged at least 90% and usually over 95% correct under each procedure.

Predominant method of problem distribution. The original objective was to determine if increased correspondence accompanied an increase in cooperative responding. However, the cooperative give response was not the only method of problem distribution that was accompanied by increased correspondence. Other methods of distributing problems were possible, since there was a second type of response, the take response. Figure 3, which sorts out each subject's give and take responses, shows the predominant method of distributing problems for each pair. The first two rows show the number of problems each subject gave and took for each session of the response-dependent procedure. The last row, labelled ineffective take responses, shows the number of take responses each subject made after his coactor had already made a take response and distributed the problem to himself. These ineffective take responses reveal the number of times both subjects emitted take responses for the same problem (a take response by one subject and an ineffective take by the other) and are thereby indicative of competition. The number of trials in which the subjects competed is slightly exaggerated, since subjects occasionally made more than one ineffective take response after a problem had been distributed. In most cases, however, there were only one or two ineffective take responses per trial. Examination of the number of ineffective take responses over sessions reveals that while most pairs did compete initially, competition decreased to a low level by the last four

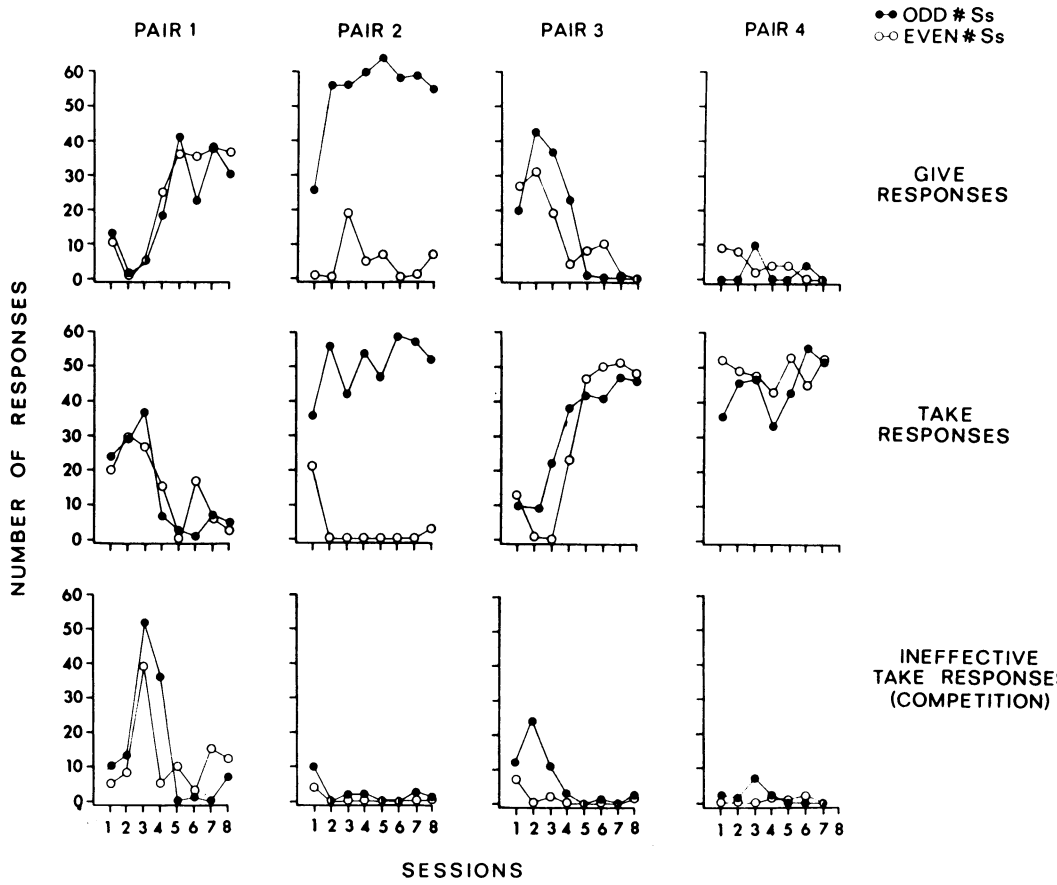

Fig. 3. Number of give responses, take responses, and ineffective take responses for each session of the response-dependent procedure. Filled circles indicate response frequency for odd-numbered subjects and open circles indicate response frequency for even-numbered subjects. Half-filled circles indicate that members of a pair made the same number of responses.

sessions. Hence, the increased correspondence obtained during the last four sessions of the response-dependent procedure (Figure 2) was not the result of competition between subjects of nearly equal speed. However, Figure 3 does reveal that take as well as give responses were involved in some of the terminal methods of problem distribution. When increased correspondence resulted from a predominance of give responses, the method was designated as maximal cooperation. When increased correspondence resulted from a predominance of trials with take responses that were not followed by a competitive response (ineffective take response) by the coactor, the method was designated as sharing. The terminal method for the first pair was maximal cooperation, as the increased correspondence resulted from a predominance of give responses. On the other hand, sharing was the terminal method for Pairs 3 and 4. Sharing was indicated by the predominance of take responses, the absence of competition (ineffective take responses), and the increased correspondence. For Pair 3, sharing was preceded by three sessions during which the subjects usually cooperated, as indicated by the higher number of give than take responses. Pair 4 showed a sharing effect from the outset: the increased correspondence of scores, the predominance of take responses, and the low number of ineffective take responses, were all evident from the first session of the response-dependent procedure. The members of these two pairs simply alternated taking problems: for Pair 3, the subject who was behind took the next problem, whereas the subjects of Pair 4 took alternate blocks of problems worth five to 20 points.

The terminal method of problem distribution for Pair 2 involved a combination of cooperation and sharing. Subject 3 distributed nearly all of the problems by giving part to his coactor and taking part for himself in such a way that the scores of the two subjects were nearly equal. The method was a combination of maximal cooperation and sharing, since increased correspondence was obtained, and since the number of give responses and the number of take responses without a competitive response from his coactor were about equal.

Conferences and audits. Although subjects did talk about methods of problem distribution, there was no consistent change in the number of presses on the conference button during the response-dependent procedure. The only consistent effect was a decrease in the number of conferences by the last exposure to the baseline procedure. The mean number of conferences per session during the initial baseline was 28; the mean number during the last baseline was only seven. The means for the first and last four sessions of the response-dependent procedure were 25 and 16 per session, respectively. The conference button was depressed for approximately 2 sec on the average. On only five occasions (two for Pair 1 and three for Pair 4) did subjects talk without pressing their conference button, thereby producing the 2-min timeout.

The subjects checked scores frequently, as all subjects averaged at least one and usually two or more audits per minute (self plus coactor audits) regardless of the procedure. The number of audit responses during the response-dependent procedure depended in part upon the method of problem distribution. The method used by Pair 3, *i.e.*, the subject who was behind took the next problem, required a steady rate of auditing and only this pair had an increase in audits during the response-dependent procedure. For the other pairs, audits, interpersonal audits particularly, generally decreased to their lowest level during the last four sessions of the response-dependent procedure. The occurrence of a self audit and a coactor audit within 5 sec has been designated as an interpersonal audit (Hake *et al.*, 1973). If these interpersonal audits are indicative of a subject checking the difference between his score and his coactor's score, the low level of these audits during the response-dependent procedure may indicate that score checking decreases when the point distribution has already been decided.

Discussion

Experiment I attempted to determine if minimal cooperation, an increase in give responses, was accompanied by maximal cooperation, increased correspondence of scores. The results did reveal increased correspondence for all pairs, but the effect could not always be defined as maximal cooperation because not all of the subjects showed an increase in give responses. In fact, Table 2 reveals that five of the first eight subjects received most of their

reinforcers through take responses. However, the take responses were not competitive responses. Competition requires two subjects to make take responses for the same reinforcer, as for example when two children reach for the same cookie. It is not competition when one child takes X number of cookies and then does not respond while the other child takes the same number of cookies. The latter method of reinforcer distribution, with only one subject making a take response per reinforcer, is known in the everyday world as sharing. Table 2 shows that sharing was the predominant method of problem distribution for five of the eight subjects.

The major procedural difference between maximal cooperation and sharing is that the former involves an increase in give responses and the latter involves an increase in take responses. Altruism, which involves give responses, and competition, which involves take responses, are other social effects that can be classified along the give and take response dimensions. However, these latter two effects are ordinarily associated with decreased rather than increased correspondence. Hence, classification of these four effects in terms of give and take responses, as well as increased and decreased correspondence, reveals the organization of the major equitable and inequitable methods of reinforcer distribution shown in Table 3. Although there may be other methods that result in either equitable or inequitable distributions of reinforcers, the methods of Table 3 seem to be the major equity and inequity effects.

Does sharing really differ from cooperation? In sharing, if individuals are not making competitive take responses, are they not "letting" each other take reinforcers? In other words, did not the present procedure simply fail to make the cooperative give response observable and measureable? This was also our first reaction. It is probably because of such reasoning that sharing has not been differentiated from cooperation in the literature. For example, sharing was the equitable method in the experiments of Miller and Thomas (1972, Experiment II) and Madsen (1967, Experiment IV), but the procedure was designated as cooperation. In these studies, only one member of a pair could receive reinforcement on each trial if he pulled a string attached to a weighted pen and moved the pen to a target. The coactor could prevent him from moving the pen to the target by pulling his string, which was also attached to the pen. The equitable method of distributing reinforcers was for each subject to "let" his coactor pull the pen to the target on alternate trials. Why not make this "letting" response observable and measureable? By requiring an overt letting response, the reinforcers of each individual would then be in part dependent upon the letting response of the coactor, the procedure would be cooperation, and the letting responses would be cooperative responses. Sharing becomes cooperation by requiring an overt letting response.

There may be good reason to distinguish between sharing and cooperation: the procedural difference may lead to different behavioral effects. Both sharing and cooperation can result in increased correspondence, but Table 2 showed that more subjects chose sharing than cooperation. There are several reasons why taking might be chosen over giving. First, if competition is the initial method of reinforcer distribution, sharing is an easier transition to an equitable method than cooperation, since sharing is on the same response dimension as competition and would involve dropping only one take response. A change to cooperation, however, would require dropping both take responses and switching to a new

Table 2

Response dimension and method of reinforcement distribution by which each subject received most of his reinforcers.

Subject	*Predominant Response Dimension*	*Predominant Method of Reinforcer Distribution*
EXP I		
1	Give	Cooperation
2	Give	Cooperation
3	Take	Sharing
4	Give	Cooperation
5	Take	Sharing
6	Take	Sharing
7	Take	Sharing
8	Take	Sharing
EXP II		
9	Take	Sharing
10	Take	Sharing
11	Take	Sharing
12	Take	Sharing
13	Take	Competition
14	Take	Competition

response dimension. Second, from a developmental point of view, sharing would be expected to be more common with young individuals, since all species learn to take reinforcers before they learn to give them. Third, sharing would be expected to be a more stable behavior than cooperation because of a shorter delay of reinforcement. Reinforcement following a take response is fairly immediate, but reinforcement and a give response are separated by the variable time required until the coactor makes a give response that presents a reinforcer to the subject. Consider for example, the extreme cases in which only one subject is responding and making either take responses or give responses. If the individual is making take responses, his responses will be maintained. If, however, all of his responses are give responses, his behavior would be expected to decrease and become unstable due to inadequate reinforcement.

Table 3

Classification of major equity and inequity effects along give and take response dimensions.

	Equity Effects (increased correspondence)	*Inequity Effects (decreased correspondence)*
Take responses	sharing	competition
Give responses	maximal cooperation	altruism

EXPERIMENT II

The major objective of Experiment II was to evaluate further a possible difference in behavioral effects between maximal cooperation and sharing. Specifically, of these two major methods of equitable reinforcer distribution, is sharing the method of choice? Three more pairs were tested using the basic procedure of Experiment I.

A second objective was to evaluate one aspect of the present procedure that may have been responsible for the unusually high levels of correspondence or equity. Most studies of the Prisoner's Dilemma Game (PDG), the procedure used most often to study the behaviors that result in equity and inequity, have not revealed the degree of equity obtained in the present study (Nemeth, 1970). The usual PDG consists of trials, during which each of the two participants chooses between a cooperative response and a competitive response without knowledge of his coactor's choice. The possible outcomes for each choice are determined by the joint play of the subjects and these outcomes are visible to the subjects in the cells of a 2 X 2 matrix that contains a cell for each possible combination of cooperative and competitive choices of the two subjects. For example, a cooperative choice by both subjects results in an intermediate magnitude of reinforcement for both cooperative responses, and a competitive choice by both subjects results in the smallest reinforcement for both competitive responses. However, a cooperative choice by one subject and a competitive choice by the other results in no reinforcer for the cooperative response and the largest reinforcer for the competitive response. In his recent review of research using variations of the PDG, Nemeth (1970) stated: "This expectation of mutual cooperation, however, is strikingly different from the results usually obtained in bargaining studies, since subjects generally cooperate on approximately one-third of the trials [p. 297]."

Many differences between the present procedure and the usual PDG could account for the differences in results. First, in the PDG, the results are frequently calculated differently than in the present experiment: the number of trials with cooperative responses by one or both subjects is considered relative to the total number of trials, as opposed to the method used here or in Hake and Vukelich (1973) in which the numbers of reinforcers and/or responses of one subject are considered relative to those of the other subject. Second, in the present experiment, sharing, a second and perhaps more common method of equitable reinforcer distribution, was available in addition to cooperation. Third, in the present experiment, the subjects were already cooperating on one part of the task—they produced the sample stimuli for one another—and this cooperation at one level may have facilitated the choice of an equitable method of reinforcer distribution. There was also one large methodological difference between the present study and the usual PDG: the PDG is usually completed in one session, while the present experiment lasted several sessions spaced over several days. Experiment

II evaluated this methodological difference by first testing two of the pairs under a massed-sessions procedure with all eight sessions of the response-dependent procedure in one morning, and then testing them under the usual spaced-sessions procedure. If the spaced sessions of Experiment I did account for part of the differences between the results of Experiment I and the PDG results, the massed procedure of Experiment II should not produce the same levels of correspondence found in Experiment I, nor as quickly. Also, the change from massed to spaced sessions should then produce high levels of correspondence.

Experiment II also contained several refinements in the apparatus, procedure, and data analysis, *e.g.*, separate manipulanda for give and take responses and in the data analysis the various types of responses were weighted in terms of the point value of the problem. To evaluate the effects of these changes, the first pair was a systematic replication of Experiment I and was not tested under the massed condition.

Method

Subjects

The three pairs of subjects consisted of 13- to 16-yr-old male volunteers from the local high school. Since this experiment was also conducted during the summer vacation, the subjects were picked up at a common meeting place or at their homes. Earnings from the experiment and a bonus of 50 cents per day for attending five consecutive days were paid weekly. Each member of a pair was paid on a different day and, as a result, for a different series of sessions.

Apparatus

The apparatus was the same as in Experiment I except that the distribution lever was replaced by two distribution buttons, which had the same function as the distribution lever. In addition, two lights (problem-distribution lights), colored to correspond to the matching-to-sample panels, were located directly above the buttons. These problem-distribution lights indicated when subjects could distribute a matching-to-sample problem and, after the subjects had responded, the lights indicated which of the subjects had received the problem.

Procedure

Baseline: random distribution of problems. The baseline procedure was basically the same as in Experiment I: the matching-to-sample problems were distributed between the two subjects by the automatic scheduling equipment, and the sample panels were still arranged so that subjects would cooperate in completing the problems. There were changes in the duration and value of some stimulus events. The point values of problems were increased to 1-, 3-, or 6 cents. The magnitude-of-reinforcement stimulus, which started each trial by presenting the point value of the next problem, was illuminated for 3 sec before the problem was distributed to one of the subjects. In addition to the illumination of the sample-operative-stimulus on top of the sample panel, distribution of the problem was also indicated by illumination of the distribution light corresponding to the color of the apparatus that was operative. Problems were completed in the same way as before, but the time allotted was increased to 10 sec. After 10 sec, all stimulus lights were extinguished for 5 sec, during which matching responses had no effect. Hence, all trials lasted 18 sec, regardless of how fast the problem was completed. The audit counters were illuminated in the same way except that five responses were required to illuminate the counter for a constant duration of 2 sec. Subjects could still talk to each other by pressing the conference button, but presses on the conference button no longer delayed the scheduling of stimulus events.

As in Experiment I, baseline was preceded by a brief training session. The instructions were the same as in Experiment I except for the changes noted above.

Response-dependent distribution of problems. Under this procedure, the distribution of problems was determined by the subjects' responses on the distribution buttons. After the magnitude-of-reinforcement stimulus had been on for 3 sec, the two distribution lights were lit, indicating that either subject could then determine which received the problem by being the first to press one of his distribution buttons five times. If a subject completed the response requirement on the button labelled "me", and he was the first to complete a response requirement, his distribution light

remained lit and his sample operative stimulus was lit, indicating that he could complete and receive credit for that problem (take response). If a subject completed the response requirement on the button labelled "other person", and he was the first to complete a response requirement, his coactor's distribution light remained lit and his coactor's sample-operative stimulus was lit, indicating that the coactor could complete and receive credit for the problem (give response). Once a problem was distributed, the procedure was the same as in baseline. The instructions during this procedure were similar to Experiment I except as they concerned the procedural changes described above.

Experimental design. For Pair 5, the experiment was essentially a systematic replication of Experiment I, with the baseline and response-dependent procedures being the major conditions. There were 1, 2, or 3 sessions per day under each procedure. The number of sessions per day was irregular, but there was an attempt when time permitted, to have each number of sessions per day represented once every three days. Sessions also varied in length, lasting either 16, 18, or 20 min. The variations in sessions per day and session length were to reduce the possibility of the subjects dividing the points equally by each subject alternately taking all of the points for one session or one testing day. As in Experiment I, the only way points could be kept even for a day or block of days was to come out even each session.

For Pair 5, there were 12 sessions of baseline, six occurring before the response-dependent procedure, and six afterwards. There were two response-dependent procedures. The first one, which lasted seven sessions, was the same as in Experiment I, with each subject's sample panel next to his coactor's matching panel so that the subjects cooperated on the matching-to-sample problems. For the last eight sessions, the subjects did not cooperate on the matching-to-sample task, as each subject's sample panel was placed next to his own matching panel.

Pairs 6 and 7 were tested under both massed and spaced sessions. In order to provide the initial baseline procedure, the massed-sessions part of the experiment did require two days. The initial six baseline sessions were conducted in one morning and the eight massed sessions under the response-dependent procedure were conducted the next morning. Only eight response-dependent sessions were provided because the previous five pairs (Pair 5 above was completed before this part of Experiment II) had reached increased correspondence within eight sessions, and this was about all that could be conducted in a single morning. The massed sessions were followed by 22 and 11 spaced sessions for Pairs 6 and 7, respectively. More than eight sessions were conducted under the spaced procedure because later sessions indicated gradual changes toward increased correspondence. These sessions were followed by six more baseline sessions. The number of sessions per day and ses-

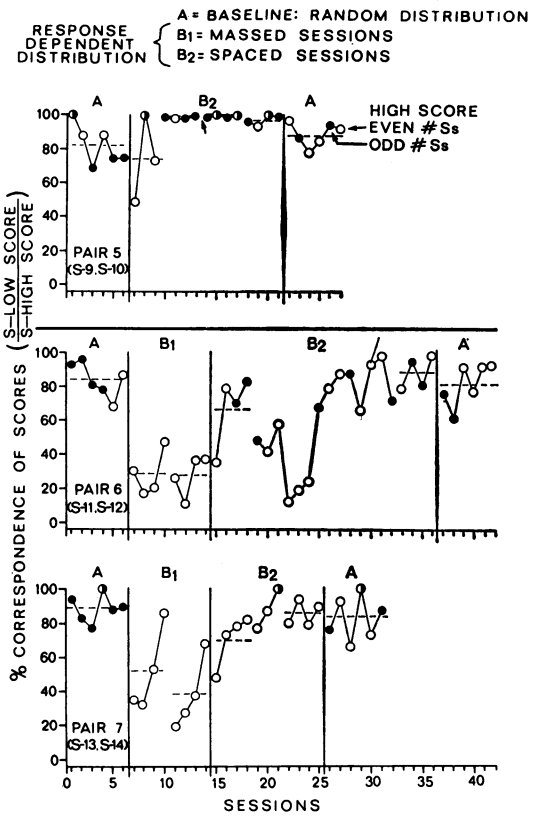

Fig. 4. Session-by-session plot of the correspondence of scores for Pairs 5, 6, and 7. The open circles indicate that the even-numbered subject had the higher number of points for a session and solid circles indicate that the odd-numbered subject had the higher number of points. Half-filled circles indicate 100% correspondence. The horizontal broken lines show the mean correspondence for each block of sessions under the baseline procedure and for the first four and last four sessions under the response-dependent procedures. The arrow on the graph of Pair 5 indicates when each subject's sample panel was moved next to his own matching panel.

sion lengths were arranged in the same way as for Pair 5.

Results

Correspondence of scores. Figure 4 shows that Pair 5 did replicate the results of Experiment I: correspondence was consistently over 95% by the fourth session of the response-dependent procedure and stayed there, regardless of whether the subjects completed the matching-to-sample problems cooperatively (first seven sessions) or individually. The correspondence of Pairs 6 and 7 did not reach the levels of Pair 5 or the levels in Experiment I, but correspondence eventually did consistently reach the 80 to 90% range by the last four sessions of the response-dependent procedure. The most noteworthy feature of the data of Pairs 6 and 7, however, is the difference between the massed and spaced sessions. The correspondence of the first five pairs all consistently reached over 95% within the first eight sessions of the response-dependent procedure, but neither Pair 6 nor 7 came close to this. Pair 6 averaged about 30% correspondence for the last four sessions of the response-dependent procedure with massed sessions and Pair 7 averaged about 40%. The correspondence of Pair 7 was consistently into the 80 to 95% range by the sixth session of the response-dependent procedure with spaced sessions, whereas the correspondence of Pair 6 did not consistently reach this level until about the fourteenth session of the spaced procedure. Under the spaced sessions, correspondence did increase to a consistent 80 to 90% range but it did not increase as quickly, particularly for Pair 6, as was the case for the previous pairs that were not exposed to the massed procedures.

The lack of correspondence under the massed sessions can also be seen in Table 4, which gives the mean high score, the mean low score, and the mean difference between scores for each condition. The total points earned per session averaged 180 to 200 points regardless of the condition, but the mean differences for the last four sessions under the massed condition were 90 to 110 points and the mean difference for the last four sessions under the spaced condition ranged from two to 16 points.

All subjects averaged at least 96% correct on the matching-to-sample problems throughout each condition.

Predominant method of problem distribution. Figure 5 shows that the result for the replication pair were similar to those of Experiment I, in that sharing was the predominant method of distribution and it occurred

Table 4

Mean high score, mean low score, and mean difference between scores for each pair under each procedure.

		Response-Dependent Distribution				
		Massed Sessions		*Spaced Sessions*[a]		
Mean Scores	*Baseline: Random Distribution*	*First Four Sessions*	*Last Four Sessions*	*First Four Sessions*[b]	*Last Four Sessions*	*Baseline: Random Distribution*
PAIR 5						
High	106.5			106.3	101.5	105.3
Low	87.0			73.0	99.3	93.2
Difference	19.5			33.3	2.2	12.1
PAIR 6						
High	103.7	153.3	149.5	117.8	97.5	105.3
Low	86.3	41.8	39.8	76.3	86.5	86.2
Difference	17.4	111.5	109.7	41.5	11.0	19.3
PAIR 7						
High	102.0	132.0	139.5	120.3	106.0	106.7
Low	89.3	64.0	49.0	85.3	90.5	88.8
Difference	12.7	68.0	90.5	36.8	15.5	17.9

[a]For Pair 5, only the data for the condition with the sample panels in the cooperation positions are included. Moving the sample panels had little additional effect.

[b]Only three sessions for Pair 5.

within eight sessions of the introduction of the response-dependent procedure. Both members of Pair 5 competed during the first three sessions (row 3) when the correspondence of scores was also low (Figure 4), but competition decreased in the fourth session for Subject 10 and in the seventh session for Subject 9. Except for one more session of competition by Subject 10, the predominant method from then on was sharing (row 4): each subject ordinarily took alternate problems with no competitive response from his coactor and correspondence was over 95%. It should be noted that an ineffective take or competitive response was recorded whenever the loser completed two button presses on the take button. This was done because during competition, one subject completed the FR 5 before the other subject, who sometimes stopped responding when the problem had been distributed.

The results of Pairs 6 and 7 were similar to previous pairs in that there were equitable methods of problem distribution and that take responses were predominant. The major difference was the persistence of competitive responses. Competition was most persistent during the massed sessions, where it was the predominant method for all eight sessions and there were no signs of any equitable method of distribution. For the previous five pairs, competition had dropped to a low level by the eighth session of the response-dependent procedure, equitable methods of distribution were evident, and correspondence had increased. During the spaced procedure, sharing did become evident for one member of Pair 7 by the sixth session and correspondence reached the 80 to 95% range (Figure 4). Competition still remained the predominant method of distribution, as the subjects competed for most of the session and then

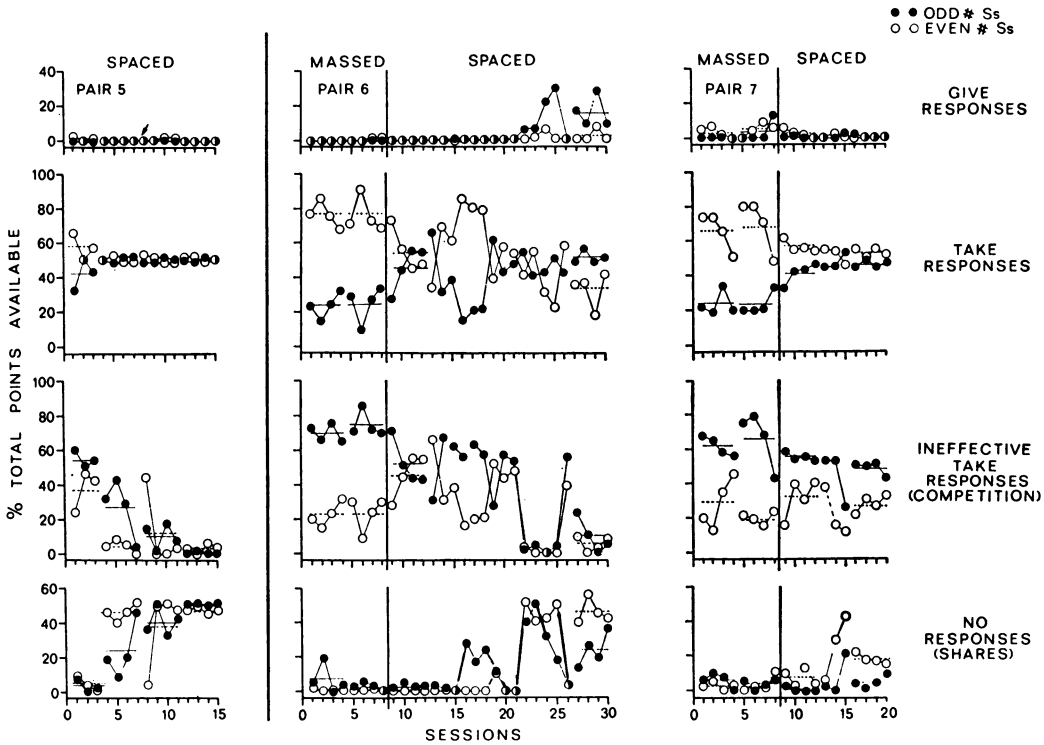

Fig. 5. Percentage of total points available in a session for which the subjects of Pairs 5, 6, and 7 made give responses, take responses, competitive responses, or shares for each session of the response-dependent procedure. Filled circles indicate percentages for odd-numbered subjects and open circles indicate percentages for even-numbered subjects. Half-filled circles indicate that pair members responded in the same way for equal percentages of the points. Horizontal solid and horizontal broken lines show the mean percentages over the first four and last four sessions of the massed- and spaced-session procedures for odd- and even-numbered subjects, respectively. The arrow on the graph of Pair 5 indicates when each subject's sample panel was moved next to his own matching panel.

Subject 14, the usual winner (Figure 4), shared near the end of the session, presumably to even the scores. Hence, for this pair, correspondence increased within eight sessions of the spaced procedure, sharing did emerge as a secondary method (over 15% of total session points) for Subject 14, but competition remained the predominant method of distribution.

For Pair 6, Subject 11 did stop making take responses on problems his coactor took during the eighth session of the spaced condition, but this cannot be designated as sharing because these sessions were correlated with a decrease rather than an increase in correspondence (Figure 4). Competition did give way to sharing during the fourteenth session of the spaced procedure, when both members received most of their points through sharing and correspondence increased to the 80 to 95% range. Competition did occur again at a high level for one session after sharing appeared to be the consistent method of problem distribution. One member of this pair, Subject 11, also had a secondary pattern of cooperation, as he gave an average of 16% of the total points available in the session during the last four sessions.

Since the data of Figure 5 were in terms of the per cent of total points available, rather than the actual number of each type of response, Table 5 provides the mean number of gives, takes, ineffective competitive responses, and shares per session. Table 5 also shows the

Table 5

Mean number of gives, takes, ineffective competitive responses, and shares for the first and last four sessions of each condition of the response-dependent procedure. The number in parentheses is the mean point value of the problems for each response category.

		Spaced Sessions[a]			
Subject Pairs	*Response Categories*	*First Four Sessions*	*Last Four Sessions*	*First Four Sessions*	*Last Four Sessions*
	Give	0	0	0	0
	Take	26.33 (3.00)	28.25 (3.60)	28.25 (3.50)	29.25 (3.33)
S-9	Comp.	28.66 (3.75)	17.00 (3.13)	4.75 (4.16)	0.50 (1.00)
	Share	2.66 (2.63)	15.50 (3.16)	25.75 (3.16)	28.50 (3.43)
Pair 5					
	Give	1.33 (1.50)	0	0.75 (1.00)	0
	Take	31.33 (3.65)	32.50 (3.17)	30.50 (3.31)	29.00 (3.39)
S-10	Comp.	21.33 (3.30)	2.25 (3.55)	6.75 (3.48)	1.00 (6.00)
	Share	5.00 (1.73)	26.00 (3.60)	21.50 (3.51)	28.25 (3.24)
		Massed Sessions		Spaced Sessions	
	Give	0	0	0	9.00 (3.58)
	Take	16.50 (2.94)	13.00 (3.48)	29.00 (3.34)	28.75 (3.39)
S-11	Comp.	41.25 (3.55)	44.25 (3.27)	26.75 (3.99)	4.75 (3.84)
	Share	4.75 (3.05)	1.75 (2.00)	6.00 (1.00)	13.50 (3.39)
Pair 6					
	Give	0	0.50 (2.00)	0	0.50 (6.00)
	Take	46.00 (3.50)	46.00 (3.22)	32.75 (3.44)	18.25 (3.51)
S-12	Comp.	15.50 (3.03)	12.50 (3.54)	29.00 (3.34)	2.50 (4.10)
	Share	1.00 (1.50)	0.50 (2.00)	0	26.25 (3.32)
	Give	0	2.25 (2.89)	0.50 (1.00)	0.50 (6.00)
	Take	17.25 (3.61)	14.75 (3.25)	27.50 (3.12)	32.50 (2.95)
S-13	Comp.	31.75 (3.85)	31.50 (4.31)	32.00 (3.84)	23.50 (4.32)
	Share	4.75 (2.47)	5.75 (1.26)	0.25 (1.50)	4.50 (2.17)
Pair 7					
	Give	4.50 (1.39)	6.25 (1.56)	4.00 (1.00)	0.25 (1.00)
	Take	36.50 (3.67)	37.25 (3.84)	32.00 (3.88)	28.00 (3.97)
S-14	Comp.	14.00 (4.09)	12.75 (3.25)	18.75 (3.71)	14.00 (4.20)
	Share	3.25 (1.54)	2.00 (3.50)	8.75 (1.86)	18.50 (2.01)

[a]For Pair 5, the two conditions under the response-dependent procedure involved the location of the subject's sample panel either next to his coactor's matching panel (first condition) or next to his own matching panel (second condition).

mean point value of the matching-to-sample problems for each response category.

Conferences and audits. The only consistent trend revealed by the analysis of the number of conferences and audits was a higher rate of both during spaced than massed sessions.

GENERAL DISCUSSION

Choice of sharing over cooperation. The present experiments first revealed a procedural difference between sharing and cooperation. The two also now appear to differ in terms of at least one behavioral effect: when subjects distribute reinforcers equitably, sharing rather than cooperation will be the method chosen most often. This finding is summarized in Table 2, which shows the response dimension and method of distribution by which each subject received most of his reinforcers. Eleven of the 14 subjects received most of their reinforcers through take responses, and sharing was the predominant method of reinforcer distribution for nine of these 11 subjects. Only three subjects received most of their reinforcers through give responses and cooperation. The discussion section of Experiment I mentioned several aspects of the procedural difference between sharing and cooperation that could be responsible for the preference for sharing, but the extent to which each was a factor must await further study.

The initial objective of this study—to determine whether an increase in give responses (minimal cooperation) was accompanied by increased correspondence of scores (maximal cooperation)—had to be enlarged because of the occurrence of sharing, a second major method of reaching increased correspondence. However, the present results indicate that correspondence of scores is an important effect to consider, regardless of whether the minimal effect is an increase in give or take responses. First, comparisons of the stable level of correspondence with the level during the control procedure or with the level at the start of the response-dependent procedure revealed consistent changes in correspondence. Second, increases and decreases in correspondence appear to be related to different methods of reinforcer distribution and, in fact, may be essential to differentiating various methods. For example, an increase or a decrease in correspondence can be the basis for distinguishing between an equity effect such as cooperation and an inequity effect such as altruism, both of which involve an increase in give responses. With respect to an increase in take responses, increased correspondence is usually associated with sharing, while decreased correspondence is usually associated with competition. Competition would appear to provide the only exception to the above classification, since high levels of correspondence can result between individuals of exactly equal ability, or when there is a secondary pattern of sharing. In the latter case, the increased correspondence would appear to be the result of the secondary method of sharing, as was the case for Pair 7.

Comparison of massed and spaced sessions. Several differences between the present procedure and the Prisoner's Dilemma Game were suggested to account for the higher levels of correspondence under the present procedure, but one difference that was shown to have an effect was the use of spaced sessions as opposed to the massed sessions of the PDG. For the first five pairs tested only with spaced sessions, increased correspondence was reached within the first eight sessions of the response-dependent procedure. On the other hand, when Pairs 6 and 7 were first tested with all eight sessions in one morning (massed), neither pair showed any indication of an equitable method of reinforcer distribution. Increased correspondence did emerge, however, when the procedure was changed to spaced sessions. Although these two pairs did show a greater persistence of competition than usual under the spaced procedure, the extended history of competition under the massed sessions may have been the reason.

At least two factors could underlie the differences between massed and spaced sessions. First, the necessarily longer time period of the spaced sessions may have allowed greater opportunity to learn other methods of reinforcer distribution and/or to develop a social relationship, both of which might have an effect. Second, the spaced procedure allowed an extra-experimental cooperative dependency: each subject had to attend the session in order for either to participate and, hence, earn money. A subject received his 50-cent bonus if his coactor did not attend the session, but he lost whatever money he might have earned during the session. This dependency on the coactor's attendance may have facilitated some

sharing or cooperation during the session to ensure the coactor's continued attendance. The operation of this dependency was evident in the form of verbal threats to quit if the subject did not get to work some problems. All spaced-session procedures have to consider the possibility of such a dependency. Reducing the effects of this dependency may be desirable, since it is extra-experimental, and since it may speed acquisition. Its effects could be reduced by either (1) increasing the size of the bonus relative to the session earnings so that the subjects get most of their money regardless of their partner's attendance, or (2) by guaranteeing the subject his share of the session earnings even if his coactor does not show up. The possibility of exercising this dependency could also be reduced by reducing the response requirement involved in showing up. For example, if the high-school students of the present experiment had been tested during study hall periods of the school day, the response requirement of showing up would have been reduced, because the school schedule already required the subjects to be in the study hall. If the experiment does not concern social factors, the dependency could be reduced by having the coactor be a confederate with whom the subject never interacts.

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