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UNEQUAL REINFORCER MAGNITUDES AND RELATIVE PREFERENCE FOR COOPERATION IN THE DYAD[1]

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College-student subjects, who were paired with a confederate, chose to respond either independently or cooperatively for money reinforcers. The subject's relative preference for cooperation was assessed by a procedure (analogous to the psychophysical method of limits) in which response choice was monitored as reinforcer magnitude for one response mode was systematically varied while the other remained constant. Relative preference for cooperation was assessed when the confederate's payoff for cooperation was greater than the subject's (Experiment I) and when the confederate's payoff for independent responding was less than the subject's (Experiment II). For some subjects, changes in the confederate's reinforcer magnitudes resulted in shifts in relative preference for cooperation, which reduced the earnings differences, even though these preference shifts reduced the subject's absolute earnings. For those subjects for whom within-dyad differences in reinforcer magnitude produced no effect, a changeover button was introduced that allowed the subject to eliminate the payoff difference without reducing her own earnings; some subjects used this changeover button to eliminate earnings differences. Thus, the behavior of subjects varied, in part, as a function of reinforcer magnitudes provided for the confederate.

A common nonlaboratory situation is one in which reinforcement for independent responding and for cooperative responding is concurrently available (*e.g.*, the choice between doing research independently or as a member of a team). In terms of Hake and Vukelich's (1972) typology of cooperation procedures, such a situation would find a laboratory analogue in an "alternative response" procedure. To behavioral scientists concerned with the genesis and maintenance of cooperative behavior in natural settings (*e.g.*, Ellis, 1971), investigations. that utilize alternative response procedures are of greater interest than those in which a cooperative response is the only reinforced response available and in which, therefore, the choice of cooperation is itself not problematical. In an alternative response procedure, the dependent variable of primary interest is a measure of relative preference for cooperative responding, such as proportion of time spent cooperating (Schmitt and Marwell, 1972) or relative number or rate of cooperative responses (Hake and Vukelich, 1973; Mithaug and Burgess, 1968; Schmitt and Marwell, 1971*a*, *b*). Determinants of choice between independent and cooperative responding that have been investigated include relative reinforcer magnitude (Mithaug, 1969), response effort (Hake and Vukelich, 1973), risk of loss of accumulated reinforcers (Marwell, Schmitt, and Shotola, 1971; Schmitt and Marwell, 1971*a*, *b*), and payoff inequity (Schmitt and Marwell, 1972).

The effects of reinforcer magnitude, reinforcement schedule, response effort, and similar variables on response preference are not uniquely social, since the influence of such factors does not necessarily depend upon the presence of another person. However, there is a class of behavioral effects that can be considered uniquely social in that (1) the apparent presence of another person is a necessary condition for the occurrence of the effect, and (2) the effect occurs in the absence of changes in the experimenter-controlled contingencies maintaining the subject's behavior. For example, Hake, Vukelich, and Kaplan (1973) reported an increase in the frequency of a score-auditing response when a coactor was present, an increase they refer to as a "social stimulus effect".

The present study continued the experi-

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mental analysis of such uniquely social phenomena, and was concerned with how reinforcer magnitude for one member of a dyad affects the responding of the other member. Such effects are of considerable interest to social psychology and sociology, where they are treated under the rubrics of "distributive justice" (Homans, 1974), "inequity" (Adams, 1965), and "relative deprivation" (Stouffer, Suchman, DeVinney, Star, and Williams, 1949).

Within the framework of an operant model, Schmitt and Marwell (1972) found cooperation to be disrupted in an alternative response procedure when the magnitude of money reinforcers for cooperation was arbitrarily increased for only one member of a subject pair. Provocative as the Schmitt and Marwell (1972) findings are, the informativeness of their study is limited for two general reasons. First, because their data summarized the behavior of dyads, it is impossible to determine behavioral effects for individuals in detail. Second, the major dependent variable (per cent of time spent cooperating by 15-min blocks) does not allow for a fine-grained analysis of behavioral effects, even at the dyad level.

In the present experiment, a trial procedure was used in which, on each trial, dyad members chose between two alternative responses, one cooperative and the other independent. The independent response consisted of eight presses alternated left-right between two buttons, followed by point delivery. Each independent response trial allowed both persons to complete one independent response. On cooperative response trials, which occurred only if both members of the dyad chose to cooperate, each person contributed four of the eight presses, and both earned points on completion of the response.

To assess relative preference between the two response modes, reinforcer magnitude (number of points worth 0.1¢ each) for the independent response was fixed, while the payoff for the cooperative response progressed over 20 trials from one to 20 (*i.e.*, from 0.1¢ to 2.0¢). Such a 20-trial progression is referred to here as a "run". Thus, on the first trial of a run in which reinforcer magnitude for the independent response was set at 10 points (1.0¢), the choice was between 1.0¢ independent response and a cooperative response for which each person would earn 0.1¢. On the second trial, the choice was between a 1.0¢ independent response and a 0.2¢ cooperative response, and so on, through the twentieth trial of the run, on which the choice was between a 1.0¢ independent response and a 2.0¢ cooperative response.

The primary dependent variable was the "switchpoint", *i.e.*, the trial within a run at which the pair switched from the independent to the cooperative response mode. All else being equal, one would expect the switchpoint to fall at the first trial in which reinforcer magnitude for responding cooperatively exceeded that for responding independently (*i.e.*, trial 11 in the example above). Any consistent deviation from such a maximizing or "rational" switchpoint could thus be attributed to variables other than reinforcer magnitude.

For each pair, one member was a confederate who imitated the subject's switching behavior whenever reinforcer magnitudes were equal, and who responded so as to maximize her own earnings when reinforcer magnitudes were unequal. Following exposure to a baseline schedule in which payoffs were always equal for both members of the pair, reinforcer magnitude for one response mode was changed for the confederate only; interest focused on changes in preference for cooperation exhibited by the subject, for whom reinforcer magnitudes remained unchanged.

The basic procedure described above for determining relative preference between response alternatives is directly analogous to the ascending method of limits for determining psychophysical thresholds. In the ascending method of limits, stimulus intensity is progressively increased, with the stimulus value at which the subject makes a detection response defining the threshold; in the present procedure, the value of the cooperative response was progressively increased, with the value at which the subject switched from independent to cooperative responding defining relative preference.

For some subjects, within-dyad differences in reinforcer magnitude had no effect on the switchpoint. It should be noted, however, that (assuming a maximizing switchpoint when reinforcer magnitudes are equal) any change in switchpoint reduced total earnings. It was not clear whether such cases of invariance in switchpoint reflected a lack of aversive properties of differential reinforcer magnitudes, or alternatively, that the "cost" (reduction in earnings) of switchpoint changes was too great. In these cases, a changeover procedure, which allowed termination of reinforcer magnitude differences with no reduction of earnings for the subject, was introduced. Finally, for those subjects for whom reinforcer magnitude differences did not appear aversive under the changeover procedure, a condition was introduced in which the allocation of "extra" earnings was ostensibly controlled by the coactor, rather than by the experimenter. Findings by Schmitt and Marwell (1972) suggested that such a manipulation might increase the aversiveness of payoff differences.

EXPERIMENT I

Experiment I assessed the effects of an increase in the confederate's magnitude of reinforcement for cooperation on subjects' relative preference for cooperative responding.

Method

Subjects

Five white female undergraduates were recruited through advertisements in the school newspaper promising financial remuneration for participating in experiments.

Apparatus

Subjects were seated in individual sound-attenuating cubicles containing table, chair, and control console. The console (Figure 1) contained counters indicating own and other's earnings, a pair of pushbuttons with indicator lamps for responding independently, a single pushbutton with indicator lamps for responding cooperatively, a two-position task switch for choosing between the two response modes, and a counter indicating the number of points currently available on the cooperative ("single button") task. Finally, on the table beside the control console was a 5 cm by 7.5 cm minibox on which were mounted a blue lamp, a pushbutton, and a toggle switch.

Procedure

Each trial consisted of a period during which responding was possible, followed by a 9.5 sec intertrial interval during which points were delivered. Although there was no time limit on the response period, responding rarely took longer than 1 to 2 sec. During the intertrial interval, all response buttons were inoperative, although the task switches remained functional. The position of the task switches determined whether independent or cooperative responding was available (both were never available simultaneously). Cooperative responding was possible only when both the subject's and the confederate's task switches were in the cooperation position. If either person's switch was in the independent position, only independent responding was possible. In effect, both members of the pair had to agree to cooperate; otherwise, only independent responding was available to both persons.

Independent response. The independent response manipulation consisted of a pair of pushbuttons with their respective indicator lamps. An independent response consisted of four left-right button presses (LR LR LR LR). At the start of a trial in which the independent response mode was in effect (that is, either or both members of the pair had placed her task switch in the independent position), a light indicating that the left-hand button was to be pressed was illuminated. Pressing the left-hand button turned off that light and illuminated a second light, indicating that the right-hand button was to be pressed. The only consequence of an out-of-sequence press was the delivery of an "error signal", a short (0.2-sec) 250-Hz tone of moderate volume through the headphones.

Immediately on completion of the independent response, the response buttons were disenabled, the lights above the buttons turned off, and points were delivered. The intertrial interval did not begin until both the subject and confederate had completed an independent response. Thus, on trials on which the independent response mode was chosen, both members of the pair earned points.

Cooperative response. The cooperative response utilized a single pushbutton with two indicator lamps. The response was identical to the independent response, except that the response requirement was shared. At the start of a cooperative trial (both the subject's and the confederate's task switches in the co-

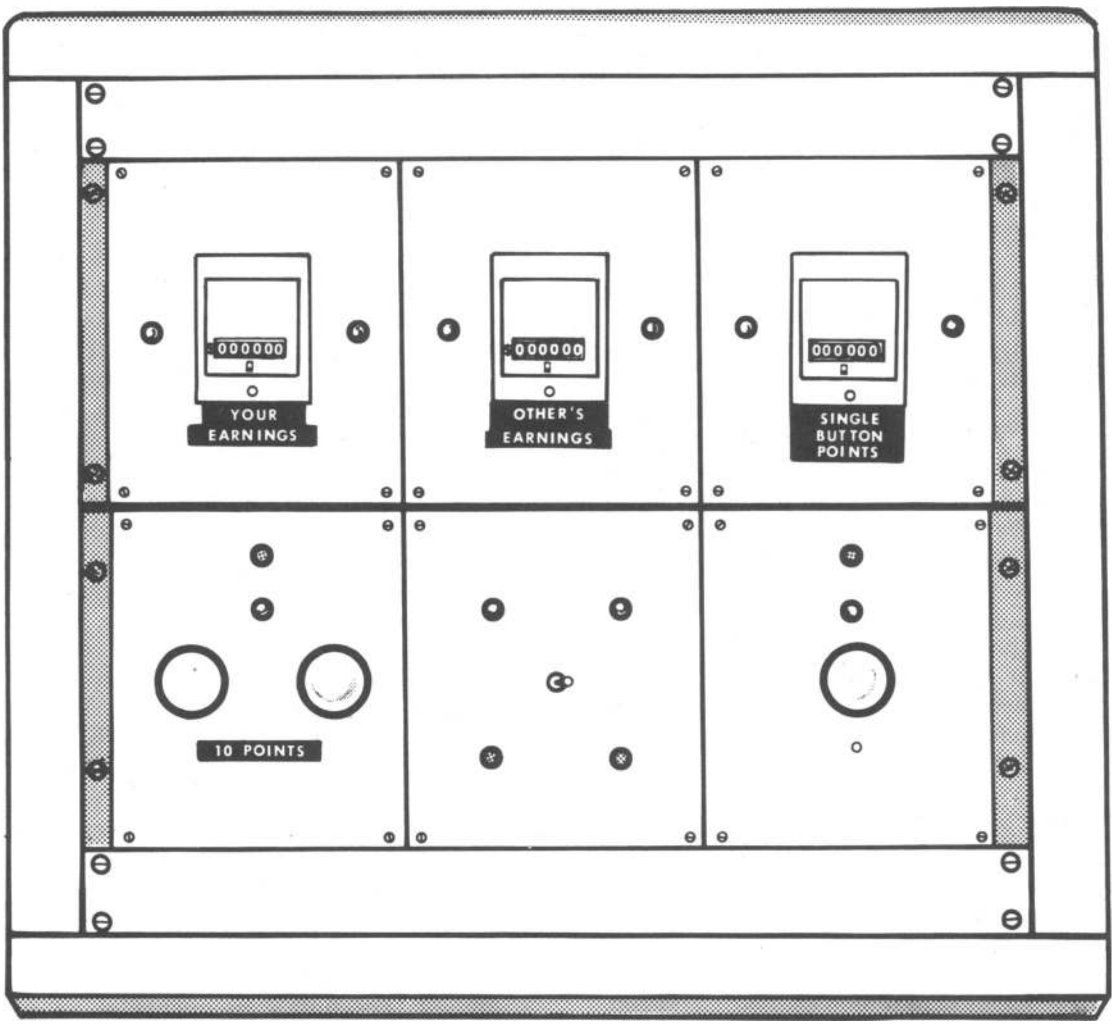

Fig. 1. Subject's control panel. Clockwise from the upper left are the subject's score counter (marked "Your Earnings"), the confederate's score counter ("Other's Earnings"), the prevailing value of the cooperative response ("Single Button Points"), the cooperative response panel, the task switch, and the independent response panel (labelled with the prevailing value of the independent response). The minibox containing the blue light, changeover button, and allocation switch is not shown.

operation position), a light indicating that the confederate was to respond was illuminated. The confederate's press extinguished that light and illuminated a second light, indicating that the subject was to respond. A completed cooperative response consisted of four confederate-subject alternations; a cooperative response trial consisted of one completed cooperative response. During the intertrial interval, points were simultaneously added to both persons' counters. An out-of-turn press by either person during cooperative responding delivered the error signal to both members of the pair, but had no other consequences.

Reinforcement. Points worth 0.1¢ each were accumulated on counters mounted on each person's console. To minimize missed sessions, subjects were paid each session's earnings at the start of the following session. Unauthorized absence would have led to forfeiture of due earnings and termination of participation but no such unauthorized absences occurred. The earnings counters were set to zero at the start of each session.

The number of points available for an independent response (*i.e.*, the "value" of that response) was fixed and indicated on a label below the independent response buttons. The number of points delivered following a cooperative response increased from trial to trial; the prevailing value of the cooperative response was indicated on a counter labelled "Single Button Points". On the first trial of each session, a cooperative response was worth one point; on the second, two points, *etc.* After the twentieth trial, when a cooperative response was worth 20 points, the progression restarted, with a cooperative response again worth one point. Each series of 20 trials is referred to as a "run". Thus, on a run in which an independent response was worth 10 points, the first trial in the run presented a choice between the 10-point independent response and one-point cooperative response, the second trial presented a choice between the 10-point independent response and a two-point cooperative response, and so on until the twentieth trial, in which the choice was between the 10-point independent response and a cooperative response worth 20 points. Relative preference for cooperative responding, the dependent variable of interest, was indexed by the "switchpoint", *i.e.*, the value of the cooperative response at which the subject switched from individual to cooperative responding.

An important characteristic of the procedure is that earnings are determined by the switchpoint. For any particular value of the independent response, reinforcement will be maximized by switching to cooperation when the value of the cooperative response is equal to (or one point greater than) the value of the independent response.

Instructions. In addition to written instructions describing the console and its operation, subjects were given about 20 min of experimenter-guided practice in the operation of the task switch and response buttons. Subjects were never allowed to see the confederate, and they were informed that neither person would ever learn the other's identity. Finally, subjects were told that the experiment would involve two payoff conditions, one in which payoffs would be equal for both "Person 1" and "Person 2", and one in which the magnitude of reinforcement for the single-button response (the terms "cooperative" or "cooperation" were never used) would be greater for Person 1. The subject was further informed that she had, by coinflip, been permanently designated as Person 2. This "preview" was found to be necessary during pretesting because many subjects otherwise assumed that any asymmetry in payoffs would eventually be reversed. Following training, subjects were never spoken to except for minimal social amenities.

The five different experimental conditions are described below.

Baseline: equal payoffs. Whenever the blue light mounted on the minibox was illuminated, reinforcer magnitudes for subject and confederate were equal. To facilitate the specification of reinforcer magnitudes between response modes and persons, a notational system (based on Burgess and Nielsen, 1974) is used in which the basic equal-payoffs condition would be described as (10:10/N:N). The numbers to the left of the slash refer to the payoffs for an independent response to the subject and confederate, respectively. The numbers to the right of the slash similarly describe the payoffs for cooperation; the N is unspecified because the number of points delivered following a cooperative response varied from trial to trial. In the equal-payoffs condition, the confederate's switching behavior always followed the subject's, that is, the confederate switched response modes within 1 to 2 sec after the subject.

The four experimental conditions below all involved payoff inequality. Whenever payoffs were unequal, the blue light was turned off and the confederate's task switch remained in the cooperation position (that is, the confederate maintained a "maximizing" preference).

Unequal payoffs. The magnitude of reinforcement for a cooperative response was greater for the confederate than for the subject. Reinforcer magnitudes for independent responding remained unchanged. For example, a situation in which the confederate received 15 additional points following a cooperative response would be described as (10:10/N:N + 15).

Changeover. A failure of unequal payoffs to affect the switchpoint could indicate either that payoff differences were not aversive, or that the "cost" of reducing the payoff difference by changing the switchpoint was excessive. To distinguish between these possibilities, a changeover procedure was introduced that allowed the subject to terminate payoff inequality without reducing her own earnings. This condition was a concurrent schedule of the equal-payoffs and the unequal-payoffs conditions. The changeover condition always began with unequal payoffs in effect. A change from the unequal-payoffs condition to the equal-payoffs condition (or *vice versa*) took place either automatically at the beginning of a run, or when the subject operated the pushbutton mounted on the minibox. The button could be used only once per run; once produced, the new condition remained in effect for the remainder of the run. If the subject never made a changeover response, alternating runs of equal and unequal payoffs resulted. Instructions to the subject for this condition (1) described the operation of the changeover button; (2) indicated that the other person's minibox had been removed and that she, therefore, could not tell before point delivery whether payoffs were equal or unequal; (3) indicated that the other person had not been informed about the subject's control over the payoff conditions.

Other-allocated unequal payoffs. For some subjects, exposure to the changeover procedure suggested that payoff inequality had no aversive properties; that is, some subjects failed to make a "no-cost" response to terminate unequal payoffs. For these subjects, an attempt was made to increase the aversiveness of payoff inequality in a manner similar to Schmitt and Marwell (1972), who found that when the relatively advantaged member of a dyad was able to share his excess payoffs but refused to do so, the effect of payoff inequality was greatly enhanced.

In the present case, the subject was given the following written instructions:

1. The small red [changeover] button is disconnected.
2. The toggle switch next to the blue light is now connected for both persons; these switches make it possible for Person 2 [the subject] to receive the extra points in the Blue Light off [unequal payoffs] condition.

   The extra points will be delivered to Person 2 rather than to Person 1 [the confederate] as long as *both* persons have their switches in the "2" position. If *either* person has her switch in the "1" position, the extra points will be delivered to Person 1 as usual.

The instructions were then reviewed orally, to ensure understanding. In brief, the subject was told that the confederate could, if she wished, share the extra points.

Other-allocated unequal payoffs with changeover. This condition, in which the subject's changeover button and the allocation switches were both operative, was designed to maximize the aversiveness of the payoff inequality, while simultaneously making available a cost-free response for terminating unequal payoffs.

Experimental sessions were usually composed of 25 runs (500 trials) and took approximately 100 min. Typical earnings for subjects ranged from $4.50 to $8.00 per session.

Results

Subjects made very few out-of-sequence presses on either task, indicating that cooperative responding was social (*i.e.*, under the control of the confederate's pressing). The task switch was used only during the intertrial intervals and was ultimately used only once per run, at the switchpoint. The only exceptions occurred during training and the first few runs of a new experimental condition.

Data for Subject 1 (Figure 2) show that following training, switching behavior became fairly stable at six or seven under equal payoffs (5:5/N:N). In general, in the equal-payoffs condition, subjects' switching was observed to stabilize at a point that maximized reinforcement.

The introduction of unequal payoffs (5:5/N:N + 30) at run 55 reduced preference for cooperative responding (*i.e.*, produced a rise in the switchpoint). The initial disruption must be attributed to instructional control, since no cooperative responding occurred during runs 55 to 57 and, therefore, no "extra" points were delivered to the confederate; following this, the switchpoint stabilized at about 10. The transient increase in the switchpoint during runs 75 to 79 occurred at the beginning of a new session; similar "start-up" effects appeared fairly frequently.

During the changeover condition (introduced at run 100), the changeover button was used on every run to re-instate equal payoffs, and the switchpoint returned to a level similar to that observed during the

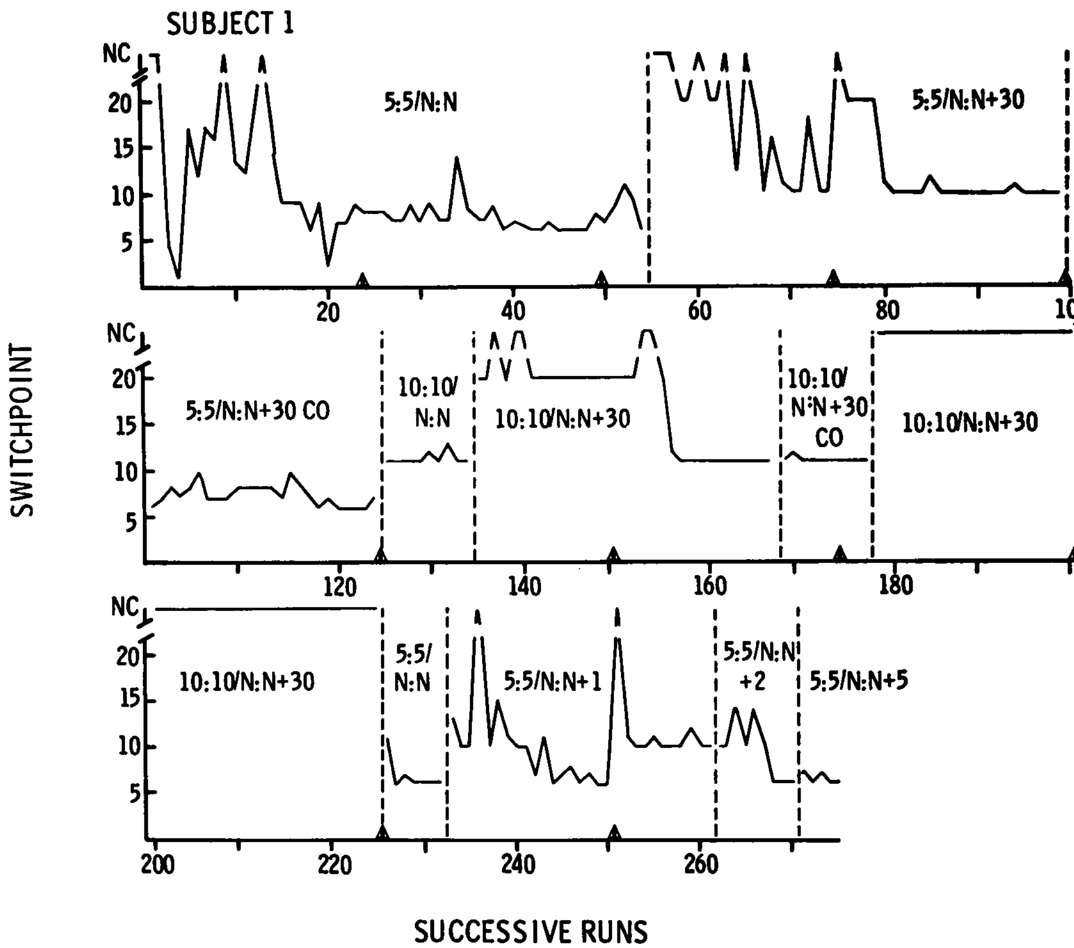

Fig. 2. Switchpoint over successive runs for Subject 1. The higher the switchpoint, the less the relative preference for cooperation. Runs consisting entirely of individual trials are plotted as NC (No Cooperation). Experimental conditions are separated by vertical broken lines, sessions by triangles on the x = axis. Numbers to the left of the slash denote payoffs for the independent response for subject and confederate respectively; numbers to the right of the slash similarly denote payoffs for the cooperative response. OA = other-allocated unequal payoffs. CO = changeover button available.

equal-payoffs baseline. The changeover usually occurred before the first cooperative response, so that no extra points were delivered to the confederate.

Beginning with run 125, the changeover button was removed, and the equal-payoffs condition was re-instated, with the value of the independent response increased to 10 points. This change produced an "appropriate" increase in the switchpoint (*i.e.*, to maximize reinforcement) to 10. When, at run 135, the schedule was changed from (10:10/N:N) to (10:10/N:N + 30), the switchpoint rose to about 20, but returned to 10 following run 155. To determine whether this "recovery" indicated that payoff inequality was no longer aversive, the changeover button was again introduced at run 168. As in previous runs with the changeover button available, the changeover button was used on every run to terminate the payoff inequality, usually before the first cooperative response. When the changeover button was then removed (run 178), the switchpoint again increased; in fact, no cooperative responding was observed for the following 46 runs.

The decrease in the switchpoint to baseline level during runs 156 to 167 appears anomalous in view of the absence of cooperative responding following run 178. When asked after the experiment ended, the subject volunteered that she had "not been her-self" that day, having received a speeding ticket enroute to campus. While the explanatory status of such verbal reports must be considered weak, the incident emphasizes the possible influence of extra-experimental events on behavior observed in the laboratory.

To assess the effects of smaller differences in reinforcer magnitudes, the remaining sessions included periods during which 1, 2, or 5 extra points were delivered to the confederate for cooperative responses, with the value of the independent response set at five. Under the (5:5/N:N + 1) schedule (runs 232 to 260), there was an initial reduction in preference for cooperation, followed by recovery, and eventually stable switching at about 10; this pattern is similar to that observed following the initial introduction of the (5:5/N:N + 30) schedule. However, although the number of extra points was increased to two (run 261), and then to five (run 270), the switchpoint gradually returned to levels approximating those observed under equal payoffs.

For Subject 1, the aversiveness of the 30-point increase in the confederate's magnitude of reinforcement for cooperation is clear from both her task-switching behavior (*i.e.*, refusing to switch into the cooperative mode or doing so only very late in a run) and her consistent use of the changeover button to re-instate the equal-payoffs condition.

Data for Subject 2 are presented in Figure 3. Initial exposure to unequal payoffs of 5, 10, 20, 50, and 90 extra points for the confederate upon completion of a cooperative response had no significant effect on the subject's relative preference for cooperation. During runs 118 to 143, the changeover button was available and used on 23 of the 26 runs to terminate the unequal-payoffs condition (usually before delivery of any extra points to the confederate). After 161 runs, during which the switchpoint remained virtually unchanged under varying degrees of

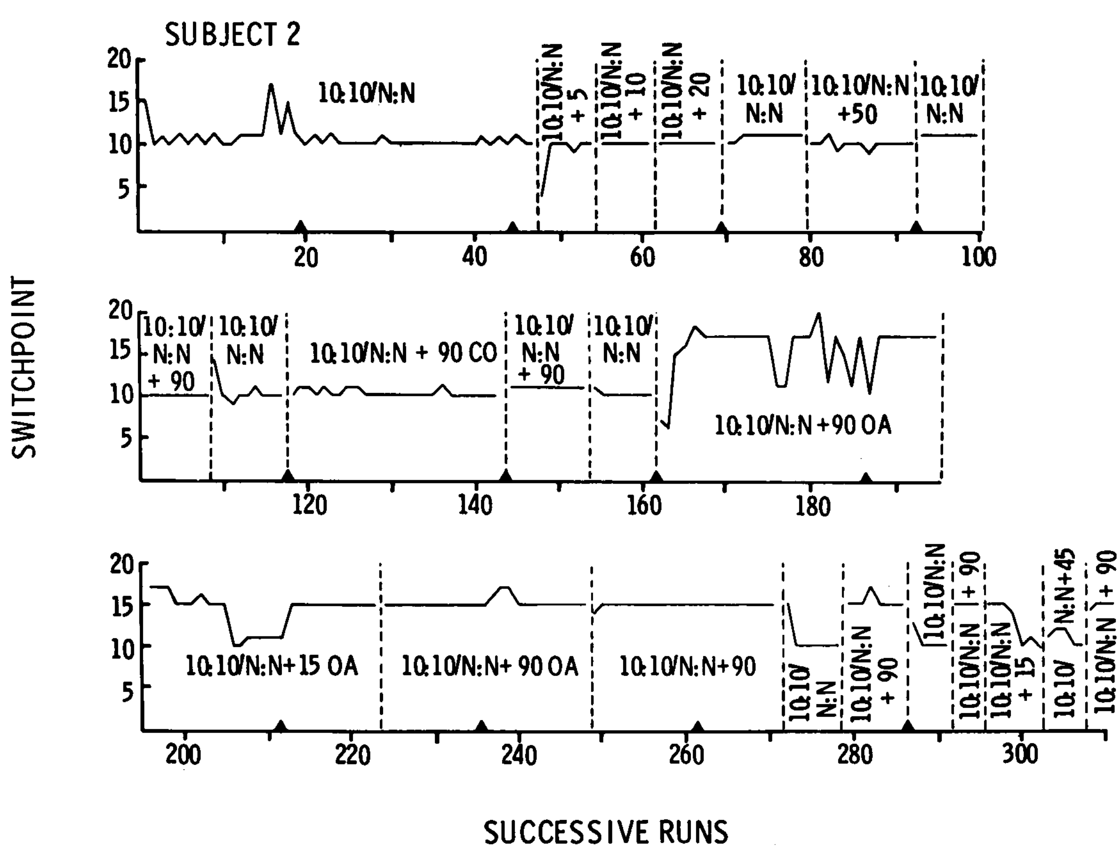

Fig. 3. Switchpoint over successive runs for Subject 2.

payoff inequality, the other-allocated unequal-payoffs condition was introduced. The confederate "took" the 90 extra points on the first cooperative trial, allowed the subject to receive the extra points on the second trial, but then "took" all extra points on subsequent trials. Thus, except for the second cooperative trial in this condition, point-delivery occurred exactly as in the preceding unequal-payoffs condition. However, in the other-allocated unequal-payoffs condition, the switchpoint rose abruptly from 10 to about 17. When the number of extra points delivered to the confederate then decreased to 15 (run 196), the switchpoint fell from 17 to about 15 and remained at that level even when the number of extra points was again increased (run 224).

Beginning with run 249, the allocation switches were inoperative, and only the basic equal-payoffs and unequal-payoffs conditions were employed. The switchpoint remained at 15 under the (10:10/N:N + 90) schedule (runs 249 to 270), then fell to 10 when the equal-payoffs condition was re-instated (run 271). When the number of extra points was set at 15 or 45, the subject switched at 10, but the switchpoint rose to 15 whenever the (10:10/N:N + 90) schedule was re-introduced.

For this subject, then, payoff inequality initially had no effects, but, following exposure to other-allocated unequal payoffs, reduced preference for cooperation was observed.

For Subject 3 (no figure), the switchpoint on initial exposure to the (10:10/N:N) schedule varied between 10 and 13. When payoff inequality was introduced (10:10/N:N + 50), the switchpoint rose to 15, then gradually fell to a level similar to that observed during equal payoffs. Subsequent changes in experimental conditions, including variations in the magnitude of payoff inequality and exposure to both the changeover and the other-allocated unequal-payoffs conditions had no systematic effects on the subject's relative preference for cooperation.

When first given access to the changeover button, the button was used on every run to re-instate the equal-payoffs condition, but the delivery of extra points to the confederate was not completely avoided. Instead, the subject switched to cooperative responding on about trial 10 of each run and re-instated the equal-payoffs condition on trial 15 or 16. Following exposure to other-allocated unequal payoffs, the changeover response occurred earlier, on trial 12 or 13. During the other-allocated unequal-payoffs with changeover condition, the switchpoint remained unchanged, but the changeover response occurred before the first cooperative trial of each run, thus avoiding the delivery of any extra points to the confederate. This pattern was maintained during the subsequent reintroduction of the changeover condition.

For Subject 3, then, relative preference for cooperation was not affected by payoff inequality. However, the subject's use of the changeover button suggests that the aversiveness of payoff inequality increased following exposure to the other-allocated unequal-payoffs condition.

For Subject 4 (no figure), as with the previous subject, no significant changes in relative preference for cooperation were observed throughout the experiment. On initial exposure to the changeover condition, unequal payoffs (10:10/N:N + 90) were terminated on 22 of the first 25 runs, usually before the first cooperative trial. Over the following 31 runs, however, the subject was nearly indifferent to payoff inequality; the changeover button was used only five times, once to produce and four times to terminate unequal payoffs. When the number of extra points was reduced from 90 to 15, the changeover button was not used at all over 10 runs. When the number of extra points delivered to the confederate was again increased to 90, the changeover button was used to produce the unequal-payoffs condition on each of the first seven runs. This "altruistic" use of the changeover button became less consistent over the remaining 14 runs in this condition, however, with the changeover response made on four runs, each time to produce unequal payoffs. For this subject, it thus appeared that, while the unequal-payoffs condition was initially aversive (the changeover button was used to terminate unequal payoffs), it later took on mildly reinforcing properties (the changeover button was used to produce unequal payoffs).

Finally, other-allocated unequal payoffs (10:10/N:N + 90) were introduced. The confederate allowed the subject to receive the extra points on the second and fourth cooperative trial of the initial run under this condition (run 136), after which the confederate took all extra points. No change in the subject's relative preference for cooperation was observed; when the changeover button was made available, the subject did not use it for 23 runs (which therefore alternated between equal and unequal payoffs). The changeover button was used to avoid unequal payoffs on all but two of the following 21 runs; however, no changeover responses occurred during the final 15 runs. Thus, exposure to other-allocated unequal payoffs disrupted the apparently reinforcing nature of payoff inequality that had developed for this subject.

The data for Subject 5 are presented in Figure 4. During the initial equal-payoffs condition (5:5/N:N), switching became stable at five or six. When the unequal-payoffs condition (5:5/N:N + 30) was introduced at run 59, the subject's switchpoint fell to one; that is, the subject chose to cooperate on every trial. When given the changeover button (runs 99 to 135), the subject produced the unequal-payoffs condition before the first or second trial of every run. When equal reinforcer magnitudes were again in effect (runs 136 to 148), the switchpoint again rose to five or six.

To avoid a possible "floor effect", the number of points delivered for an independent response was increased to 10 at run 149, and switching quickly became stable at 11. When the unequal-payoffs condition (10:10/N:N + 30) was re-introduced at run 154, the switchpoint fell to six. During runs 167 to 173, the changeover button was made available, and the subject re-instated unequal payoffs before the first cooperative trial of every run. During

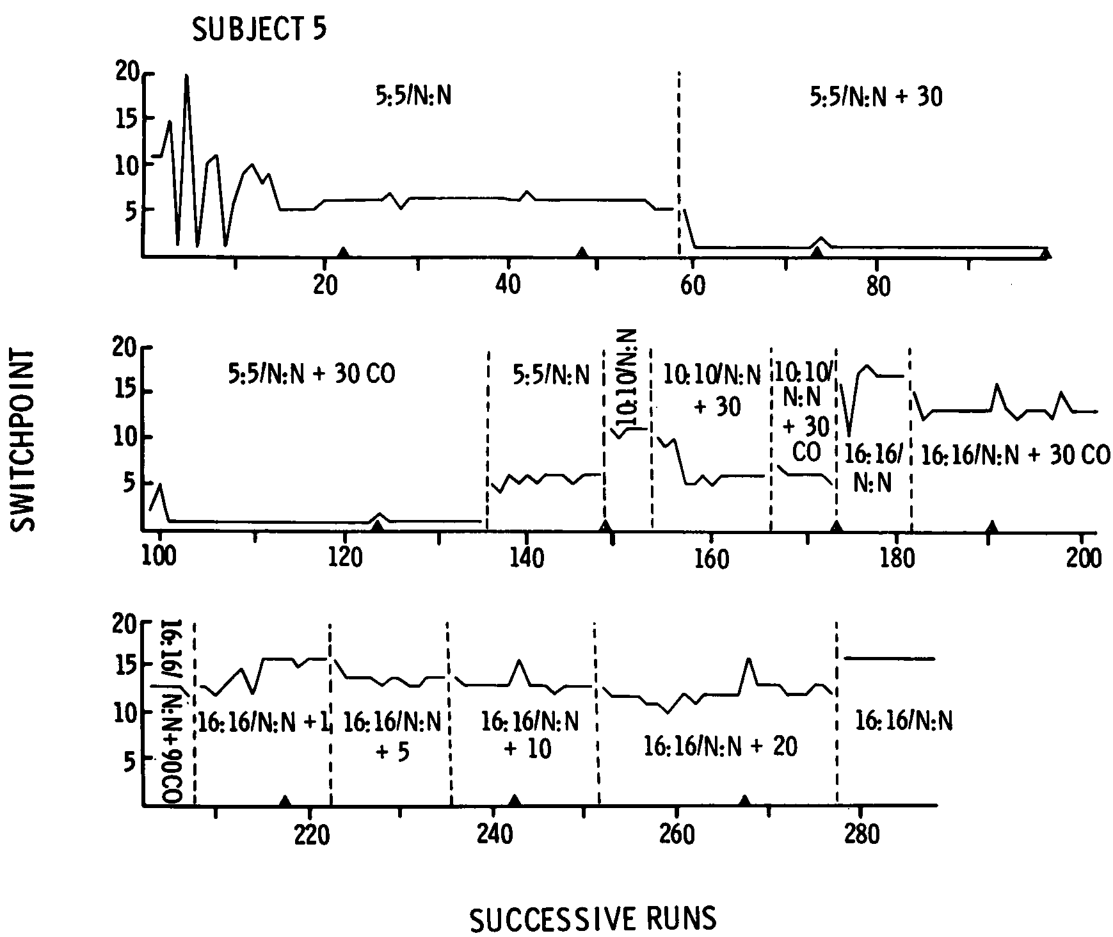

Fig. 4. Switchpoint over successive runs for Subject 5.

the subsequent equal-payoffs (16:16/N:N) period, switching stabilized at 17. The re-introduction of the changeover condition (16:16/N:N + 30) at run 182 dropped the switchpoint to 13, each switch to cooperation preceded by a changeover response to produce payoff inequality. Increasing the number of extra points delivered to the confederate from 30 to 90 affected neither the subject's relative preference for cooperation nor her use of the changeover button (runs 203 to 207). Thus, the effect of increasing the confederate's magnitude of reinforcement for cooperative responding by 30 or 90 points was, for Subject 5, a consistent four- to five-point increase in relative preference for cooperation, as indicated by switchpoint reductions of from five-six to one, from 11 to six, and from 17 to 13.

Finally, unequal payoffs involving 1, 5, 10, or 20 extra points for the confederate were introduced in order to determine whether this "altruistic" behavior would be maintained by smaller differences in reinforcer magnitudes. As shown in Figure 4, switching occurred at 16 when the confederate received one extra point for a cooperative response (runs 208 to 222), at 14 when the confederate received five extra points (runs 223 to 235), at 13 when 10 extra points were delivered (236 to 251), and at 12, when 20 extra points were delivered (runs 252 to 277). During the final equal-payoffs period (runs 278 to 288), switching was stable at 16. These results show a consistent positive relationship between the size of the difference in reinforcer magnitudes (up to differences of 20 to 30 points) and the strength of this subject's relative preference for cooperation.

Discussion

The results of Experiment I indicate that the reinforcer magnitude for one member of a dyad may partially control the responding of the other member whose reinforcer magnitude remains unchanged. However, important individual differences were observed. For Subject 1, increasing the confederate's magnitude of reinforcement for cooperative responding reduced relative preference for cooperation. This was true for Subject 2 only after exposure to the other-allocated unequal-payoffs condition. The effects of payoff inequality for Subject 3 were apparent in her use of the changeover button to re-instate equal payoffs; exposure to the other-allocated unequal-payoffs condition increased the magnitude of the effect (*i.e.,* the changeover response occurred earlier in the run). For Subject 4, the changeover button was used first to avoid the unequal-payoffs condition and later to produce it. This latter response pattern was, however, disrupted by exposure to the other-allocated unequal-payoffs condition. Finally, Subject 5 showed a preference for cooperation that was positively correlated with the magnitude of payoff inequality.

EXPERIMENT II

In Experiment I, the effects of unequal payoffs were examined when the subject was the lower-paid member of the pair; in Experiment II, the subject was the higher-paid member. Payoff inequality in Experiment I resulted from an increase in the confederate's magnitude of reinforcement for cooperative responding; in Experiment II payoff inequality was produced by decreasing the confederate's payoff for independent responding.

Method

Subjects

Five undergraduate females, recruited through an advertisement in the school newspaper, served as subjects.

Apparatus and Procedures

Apparatus and procedures were as in Experiment I, except that the "preview" informed the subject that during the unequal-payoffs condition, the other person (*i.e.,* the confederate) would earn fewer points for the independent response.

Results

Results for Experiment II are shown in Figures 5 and 6. During equal payoffs, these data are consistent with those from Experiment I, in that switchpoints tended to stabilize at values that maximized earnings.

For Subject 6 (upper panels, Figure 5), unequal reinforcer magnitudes for independent response (10:1/N:N) had no effect on relative preference for cooperation, although, when available (runs 46 to 55), the changeover button was used on every run to terminate the unequal-payoffs condition before the first independent trial of the run. To al-

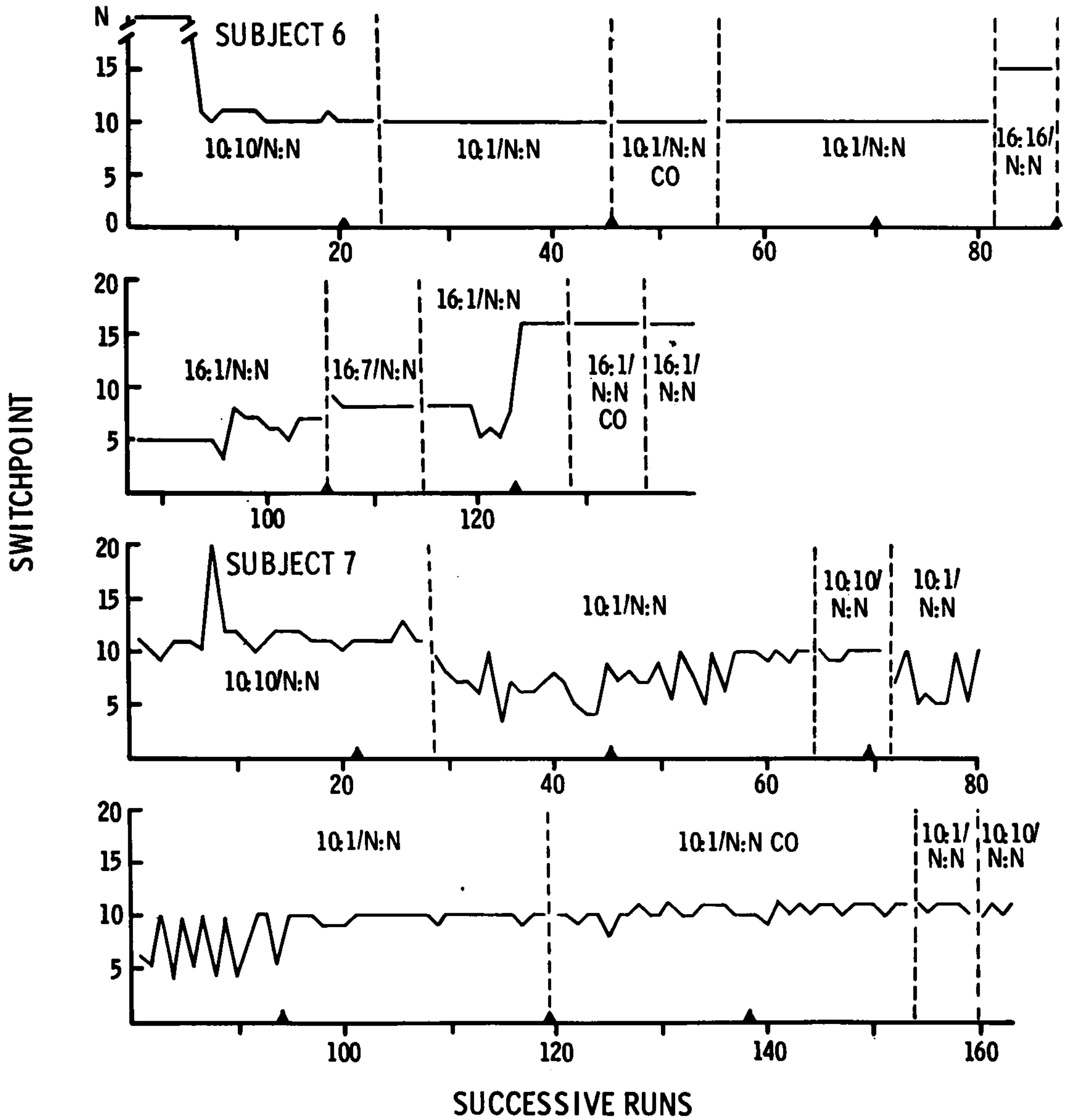

Fig. 5. Switchpoint over successive runs for Subjects 6 and 7.

low for a larger difference in payoffs, the value of the independent response was increased to 16 at run 82. With the subsequent re-introduction of unequal payoffs (16:1/N:N) at run 88 the switchpoint was reduced, followed by partial recovery.

While the data from an intermediate degree of payroll inequality (16:7/N:N) suggest an intermediate effect, it is overshadowed by a general rise in the switchpoint, so that by run 124, the switchpoint was no longer suppressed, even by the (16:1/N:N) schedule. Nevertheless, unequal payoffs continued to be aversive; when the changeover button was available (runs 129 to 135) it was used on every run to terminate payoff inequality before the first independent response.

For Subject 7 (lower panels of Figure 5), the introduction of payoff inequality (10:1/N:N) immediately increased relative preference for cooperation, which gradually declined over the succeeding 35 runs. Following a second exposure to equal payoffs, the unequal-payoffs condition was re-introduced at run 72. Extreme variability in the switchpoint resulted, with an overall increase in relative preference for cooperative responding, again followed by a return to the level observed during equal payoffs. During the first session with the changeover button (runs 120 to 139), the subject terminated unequal payoffs five times and produced unequal payoffs four times; overall, the subject allowed payoff inequality on 54% of independent response trials. During the 15 changeover runs of the following session, unequal payoffs were terminated nine times and produced twice; the subject allowed payoff inequality on only 27% of independent trials. When the changeover button was removed (run 154), no effect on the switchpoint was observed.

Data for Subject 8 (upper panel of Figure 6) show that initial exposure to the unequal-payoffs condition (10:1/N:N) produced a transient increase in relative preference for cooperation. The changeover button, introduced at run 63, was used to re-instate equal payoffs on every run, usually before the first independent response trial. Beginning with run 82, the value of the independent response was raised from 10 to 16 to allow for a greater difference in reinforcer magnitudes. The introduction of unequal payoffs (16:1/N:N) at run 89 produced extreme variability in the switchpoint, with an overall increase in relative preference for cooperation, a pattern that continued when payoff inequality was reduced (16:7/N:N).

The data for Subject 9 appear in the lower panel of Figure 6. The introduction of unequal payoffs (10:1/N:N) produced a transient lowering of the switchpoint. When the changeover button was introduced (run 48), it was used to produce the equal-payoffs condition on every run, typically before the first independent trial. When unequal payoffs were again scheduled (runs 59 to 96), the subject chose the cooperative response on every trial of every run, thus eliminating any difference in earnings. This pattern persisted when the magnitude of reinforcement for the independent response was increased from 10 to 16.

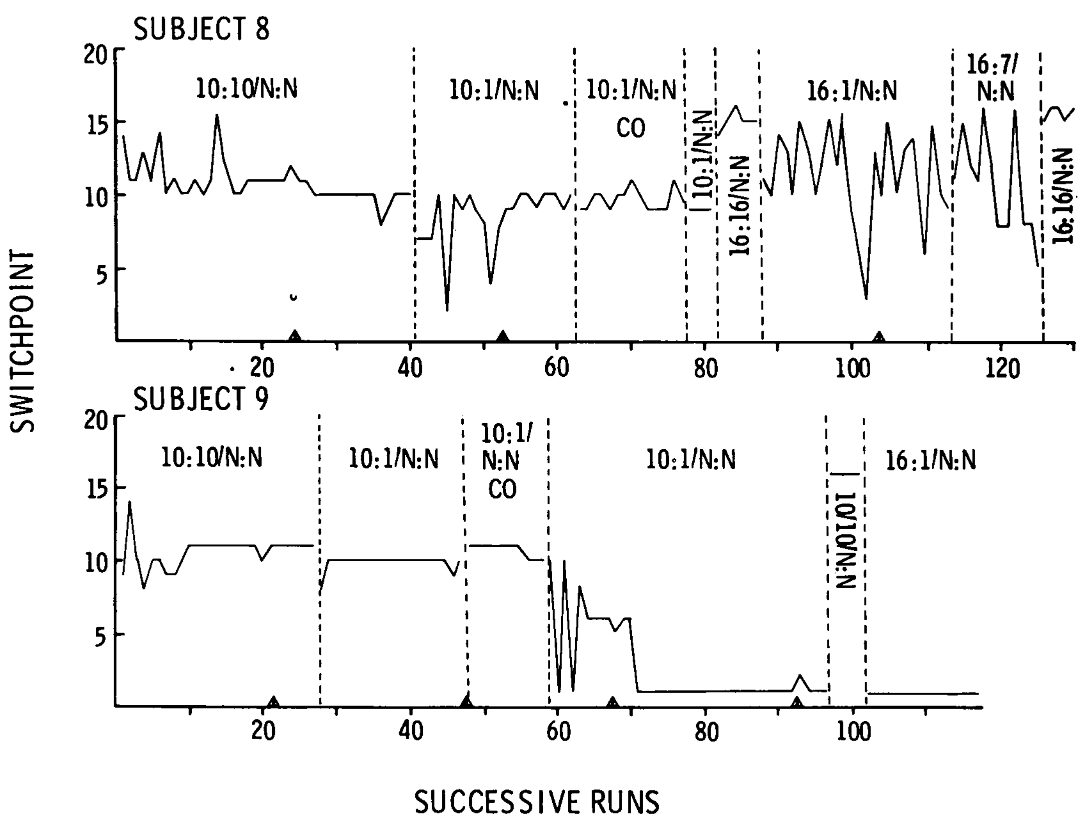

Fig. 6. Switchpoint over successive runs for Subjects 8 and 9.

For Subject 10 (no figure), the switchpoint became stable at about 10 during initial exposure to the equal-payoffs condition (10:10/N:N). Unequal payoffs (10:1/N:N) produced an immediate drop in the switchpoint to between three and seven for the 12 runs remaining in that session; during the following session, every trial of every run was cooperative. A reduction in the size of the payoff difference for an independent response (10:7/N:N) had only a transient effect on this pattern of total cooperation. At run 117, the independent response payoff was raised to 16 during equal payoffs, and the switchpoint immediately stabilized at five; re-introduction of the unequal-payoffs condition (16:1/N:N) at run 124 produced total cooperation. Similar increases in the payoff for an independent response from 16 to 24, to 36, and finally to 48, failed to disrupt this pattern.

Discussion

Like those from Experiment I, the results of Experiment II demonstrate that a change in one dyad member's reinforcer magnitude can affect the other's behavior. Again, individual differences were found, although these were not so striking as those in the first experiment. For Subjects 9 and 10, unequal reinforcer magnitudes for the independent response eliminated independent responding. For the three remaining subjects, increases in relative preference for cooperation engendered by payoff inequality were transitory and of lesser magnitude. Of the four subjects (6, 7, 8, and 9) given the changeover button, only Subject 7 allowed a significant number of unequally reinforced trials, and only she ever used the button to produce the unequal-payoffs condition.

GENERAL DISCUSSION

The present research examined inequality in reinforcer magnitude between a subject and a confederate as a determinant of the subject's relative preference between cooperative and independent responding. When reinforcer magnitudes were equal, the subject preferred the response alternative that provided the larger payoff. When payoffs for one of the response alternatives were unequal (the confederate earning more than the subject in Experiment I, the confederate earning less than the subject in Experiment II), changes were observed that suggest that the inequality of reinforcer magnitudes was aversive for most subjects. For some subjects, the inequality was sufficiently aversive to produce shifts in the switchpoint; that is, subjects were willing to earn less money in order to reduce the inequality. For other subjects, the switchpoint was not affected, but the subjects made a changeover response to terminate payoff inequality. All of the behavioral effects occurred in the absence of changes in the subject's reinforcer magnitude. We term such effects "uniquely social", on the (untested) assumption that they depend upon the apparent presence of another person.

Our results are generally consistent with those of Schmitt and Marwell (1972). However, the present procedure, unlike theirs, permits assessment of increases in preference for the unequally reinforced response alternative. Such "altruistic" behavior was observed in several subjects, again highlighting the recurrent problem of between-subject differences in response to a standardized situation.

Results from the other-allocated unequal-payoffs condition provide cross-procedural validation for Schmitt and Marwell's (1972) finding of enhanced disruption of cooperation during "rectifiable" payoff inequality (*i.e.*, a condition in which accumulated reinforcers could be transferred between dyad members) when the higher-paid member did not allow the earnings difference to be significantly reduced. In the present procedure, dyad members ostensibly could share the "extra" points by using the allocation switches. Results showed that when the confederate refused to share, payoff inequality became more aversive for the subject. The number and variety of such setting conditions and contextual factors that interact with payoff inequality as it affects response preference is probably substantial.

Most studies of cooperation using alternative response procedures have stressed the disruptive effects of experimental manipulations on cooperative responding. The present research found independent responding to be as "disrupted" by payoff inequality as was cooperative responding, suggesting that the form of the response alternatives may be relatively unimportant. That is, there is no evidence that the present results would have been different had the procedure provided a choice between two independent responses or two cooperative responses, rather than between an independent and a cooperative response.

Previous investigations of cooperative responding in the presence of a reinforced alternative independent response have suggested that behavior under such conditions takes on categorical properties; that is, subjects choose to respond in one mode exclusively. An examination of the data presented by Hake and Vukelich (1973), for example, indicates that only rarely did any cooperative responding occur during sessions in which considerable independent responding occurred, and *vice versa*. In the present procedure, on the other hand, such categorical behavior was only rarely observed; more typical was the case in which at least one cooperative trial and one independent trial occurred within each run. Such a procedure is presumably more sensitive to experimental manipulations, in that it ensures that subjects are frequently exposed to the contingencies for both response modes.

It is also notable that, in the present procedure, behavior was more likely to be under the control of immediate, rather than long-term, contingencies. Changes in the switchpoint resulted in relatively large momentary payoff differentials, but in limited long-term reductions in earnings. For example, consider a subject who has been switching to cooperation at 10 during equal payoffs. A shift in the switchpoint from 10 to eight (as might be produced by a reduction in the confederate's payoff for the independent response) results in an immediate 20% reduction in reinforcer magnitude on the eighth trial (from 10 points for an independent response to eight points for the cooperative response). However, if the switchpoint remains at eight for all 25 runs of the session, total earnings will accumulate to $6.30, compared with $6.38 had the switchpoint remained at 10, a negligible difference. The apparent fact that immediate ("local") reinforcer magnitudes control local choice finds a parallel in the effects of unequal payoffs. It is not clear from previous research whether the effects of payoff inequality are due to the delivery of unequal amounts of reinforcement *per se*, or to the resulting inequality in accumulated reinforcers. Schmitt and Marwell (1972), for example, explicitly informed subjects of the total payoff differential as it accumulated across sessions. In the present research, the effects of payoff inequality appeared immediately in the absence of any information about differences in accumulated earnings, suggesting the importance of momentary, rather than cumulative, payoff differences.

Although the procedure could be used with pairs of "real" subjects, a confederate was employed to maximize experimental control. It seems desirable for the experimenter to specify the behavior of one member of the dyad in advance in order to control one source of variability—the behavior of the coactor.

Finally, reinforcer magnitude is only one characteristic of a schedule of reinforcement; the effects of between-subject (*i.e.*, the members of a dyad or larger group) differences in other characteristics and parameters merit investigation.

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