AVOIDANCE OF RISK AS A DETERMINANT OF COOPERATION

DAVID R. SCHMITT AND GERALD MARWELL

UNIVERSITY OF WASHINGTON AND UNIVERSITY OF WISCONSIN

Pairs of subjects could either cooperate or respond on a lower paying individual task. Whenever both subjects chose to cooperate, either subject could make a response that took \$1.00 of the other's earnings. In Exp. I, a stimulus signalled when a "take" response had been made. Either subject could avoid the loss by switching to the individual task within 5 sec after the stimulus appeared. Rates of cooperation were high when losses could be avoided but decreased again when the avoidance condition was removed. In Exp. II, a response prevented "takes" from occurring for a specified time interval after the response. This procedure also maintained cooperation. When each avoidance response subtracted from earnings, both avoidance responding and cooperation were eliminated.

Recent studies by Marwell, Schmitt, and Shotola (1971) and Schmitt and Marwell (1971) explored the effects of risk on cooperation. Pairs of subjects could either cooperate or work individually. Cooperation yielded more reinforcers than individual work but also entailed the risk that either subject could take \$1.00 of the other's earnings. Under these conditions, cooperation was disrupted whether the opportunity to "take" was scheduled continuously or intermittently during periods of cooperation (Schmitt and Marwell, 1971).

Cooperation can persist under some conditions even when cooperation entails the risk of loss caused by one partner taking money from the other. Marwell *et al.*, found that if subjects could talk to one another, they generally agreed to cooperate and not to take from each other. Schmitt and Marwell found that if taking was possible regardless of task choice, *i.e.*, during either cooperative or individual activity, cooperation eventually emerged despite an initial period of almost continuous taking.

The present study investigated additional conditions that generated cooperation despite the presence of risk. Two means of avoiding monetary loss while cooperating were examined. In Exp. I, a signalled avoidance procedure

was used, in which either subject could avoid loss by making a response after a stimulus indicated that a take had been attempted. In Exp. II, a free-operant avoidance procedure was used in which subjects could avoid the opportunity to take.

EXPERIMENT I

METHOD

Subjects

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

Apparatus

Each of the subject rooms contained a table-mounted panel 9 by 18 in. (22 by 46 cm) with a plunger (Lindsley knob), a switch for choosing to work on a cooperative or an individual task, a button for taking money from the partner, stimulus lights, and two add-subtract counters (Fig. 1). All functions were labelled. The red light in the upper corner of the panel indicated when the tasks were operative. The white light in the lower corner illuminated for 0.1 sec or for 3 sec whenever the other subject made a response. The blue light indicated when the other subject moved his switch to cooperate. The amber light next to the take button was illuminated when money could be taken. The green lights next to the counters flashed for every reinforcement count registered. Each count was worth 0.1 cent. One

¹This research was supported by a grant from the National Science Foundation (GS-1695). Reprints may be obtained from David R. Schmitt, Department of Sociology, University of Washington, Seattle, Washington 98105; or from Gerald Marwell, Department of Sociology, University of Wisconsin, Madison, Wisconsin 53706.

Fig. 1. Diagram of subject panel.

counter showed the subject his own earnings during the current 2-hr session; the other showed his partner's earnings. For all sessions after the first, both subjects' previous totals were posted on a blackboard on the wall directly behind the panel. A closed-circuit television receiver to the left of the panel showed the amount of money available to each subject for work on each of the tasks.

Procedure

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

Table 1 shows the sequence of conditions. In Session 1, the cooperative task was demonstrated first and was followed by a period in which the subjects made a number of cooperative responses. Only coordinated responses were reinforced. Either subject could pull first, thus illuminating the white response light on the other's panel for 3 sec. Reinforcement (a counter advance of six points for each subject) occurred whenever the second subject pulled his plunger in the 0.5-sec period after the response light went out; this response illuminated the response light on the other subject's panel for 0.1 sec. If the second subject

pulled the knob before or more than 0.5 sec after the response light went off, no counter advance occurred. Then, the next pull by either subject reinitiated the other's response light for 3 sec. If the subject responding first pulled more than once without a pull by the other subject, his additional pulls reinitiated the other's response light for 3 sec. Each reinforcement was followed by a 2-sec period during which cooperative responses were not reinforced. The red panel light was turned off during this period.

Next the individual task and the use of the task selection switch were demonstrated. On the individual task, each pull of the plunger advanced the counter and illuminated the response light on the other subject's panel for 0.1 sec. In order to equate the maximum frequency of reinforcement under the individual and cooperative task conditions, each individual response was followed by a 5-sec period in which the red panel light was turned off and responses were not reinforced.

Each subject could choose to work on either the individual or cooperative task by operating the toggle switch on his panel. The cooperative task could be performed only if both subjects choose to work together. If either or both chose to work alone, the individual task

Table 1
Conditions Defining Sessions

Session	Segment	Reinforcers (counts)		Length of Segment
		Cooperation (each subject)	Individual	
1	1. Cooperation only	6	none	335 cooperative responses
	2. Cooperation or individual responding	1	6	135 individual responses
	3. Cooperation or individual responding	6	1	135 cooperative responses
	4. Baseline: cooperation or individual responding	4	3	15 min
2	5. Baseline: cooperation or individual responding	4	3	30 min
	6. Cooperation with taking or individual responding	4	3	30 min
	7. *Cooperation with taking and avoidance or individual responding	4	3	60 min
3	8. Baseline: cooperation or individual responding	4	3	30 min
	9. Cooperation with taking and avoidance or individual responding	4	3	90 min

Additional Sessions: Sequence used in Session 3 was repeated in Sessions 4 and 5 or until cooperation developed in the take-avoidance condition. Then the sequence shown for Session 2 was used for one or two sessions.

*For pairs cooperative in 6, an additional 60 min of taking.

operated for both subjects. Whenever a subject switched to "work with other person", a blue light on his partner's panel was illuminated. At first, the individual task paid at a higher rate (six counts *versus* one count), and then the cooperative task paid more (six counts *versus* one count).

In the final 15 min of Session 1, subjects worked under the baseline condition. Subjects received four counts for cooperating and three counts for working individually. Subjects working for three counts on the individual task could earn approximately \$1.75 per hour, an amount previously found sufficient to maintain participation in the experiment.

Session 2 began with 30 min of the baseline condition to determine whether cooperation was maintained by the one-count difference (steady-state cooperation was defined as at

least 80% of a baseline segment on the cooperative task). Then the cover was removed from the take button, and its function was described and demonstrated. The take button was effective (indicated by the amber light next to the button) only when both subjects switched to cooperation. Whenever either one or both of the subjects switched to work alone, the light went off. Each press of the button took 1000 counts from the other person and gave them to the subject pressing. If the other person had fewer than 1000 counts, all but 10 counts were taken. Approximately 1 min was required to transfer the counts after a press of the take button. During this time the panel light went off, a buzzer sounded continuously, and neither cooperation, individual responses, nor taking was reinforced. The task selection switch remained operative during the transfer

of money. Thus, if either subject switched to the individual task during the transfer and remained there, the take button was inoperative when the transfer was completed. Following the transfer, the button was again operative whenever both subjects switched to cooperation.

A 30-min segment with the take buttons available followed. Partners who cooperated for at least 24 min worked an additional 60 min under the same condition. Partners who did meet that criterion received the following instructions:

Now, if either person switches to work alone within five seconds after the take money button has been pressed—indicated by the sound of the buzzer—no money will be taken.

The function of the switch was demonstrated by having both subjects switch to cooperate, and by having one subject press the take button while the other switched to work alone. A 60-min segment with this signalled take-avoidance procedure followed.

The conditions in subsequent sessions for each pair depended on its previous rate of cooperation. Each session began with a 30-min baseline segment that permitted each of the subjects to accumulate approximately 1000 counts with no opportunity to take. For pairs that did not cooperate during the take-avoidance phase of the previous session, a 90-min take-avoidance period followed the baseline segment. This sequence was repeated for four sessions or until cooperation began in the take-avoidance segment. If cooperation began during a take-avoidance segment, the pair's next session included the following sequence in order to determine the reversibility of the take-avoidance effect. The 30-min baseline was followed by a 30-min take segment and then a 60-min take-avoidance segment. Pairs were terminated after one or two of these sessions.

RESULTS

During baseline segments, all pairs were cooperative. With taking possible, five of the six pairs were almost totally non-cooperative, with taking occurring in all but one of the pairs. Figure 2 shows the cooperative and individual response rates for the five non-cooperative pairs during the total time spent under

baseline, taking, and take-avoidance conditions (4 to 6 sessions). For all five non-cooperative pairs, the take-avoidance condition led to substantial cooperation. Pairs *G-M* and *D-T* began cooperating in Session 2, pairs *M-B*, *D-C*, and *V-C* in Session 4. All pairs ceased cooperating when the possibility of avoidance was removed (with taking still possible), but began cooperating again when avoidance was possible.

In most take-avoidance segments, the attempts to take were fewer than 20, with a range from 1-155. In four of the five initially non-cooperative pairs, the number per segment decreased following cooperation. Only four take attempts were successful—three by the same subject in pair *M-B* and one in pair *V-C*. The remainder were nullified by switches to the individual task, all but five by the subject being taken from.

The sixth pair (not shown in Fig. 2) cooperated from the outset. Although both subjects took once soon after the possibility of taking was introduced, they cooperated immediately thereafter. Because of this persistent cooperation, the take-avoidance condition was not introduced. The pair remained cooperative throughout Sessions 2 and 3 when the take condition again followed the baseline.

DISCUSSION

The opportunity to terminate the take signal and avoid monetary loss by switching to the individual task produced high rates of cooperation. However, there were large differences among pairs—approximately 180 min—in the time before cooperation began under take-avoidance. Once cooperation began, all pairs were generally successful in avoiding takes and experienced little disruption in cooperation. The absence of many successful takes contrasts with the substantial number of take attempts even after the emergence of cooperation. The fact that take attempts entailed little risk and minimal disruption may have been responsible for their persistence.

EXPERIMENT II

With the signalled avoidance procedure used in Exp. I, subjects could nullify takes by switching to the individual task. In Exp. II, a free-operant procedure was introduced to determine if it would also be effective in produc-

Fig. 2. Cooperative and individual response rates during baseline, take, and take-signalled avoidance conditions.

ing cooperation. With this procedure, subjects could prevent any take attempts rather than avoid loss following a taking response. Either subject could make a response that prevented taking for a specified period of time. Delay intervals of several lengths were studied to determine the shortest one under which cooperation would be maintained. In comparison with the signalled avoidance procedure, free-operant avoidance required a much larger number of responses and continuous monitoring in order to avoid takes.

For pairs that cooperated in the avoidance condition, a small cost for each avoidance response was introduced to determine whether responding would be suppressed and taking would be less effectively avoided. Weiner (1963) found that a response cost led to a reduced rate of response in human subjects. The present study extended the analysis of response cost to cooperative behavior.

METHOD

Subjects and Apparatus

Ten female and four male college students worked in same-sex pairs. The apparatus was that used in Exp. I except that a second (avoidance) button and light were located above the take button and light. A press of the avoidance button by either subject turned off the take button and light for a specified period of time (indicated on a label next to the button). The light next to the avoidance button went on for the duration of the interval, regardless of task choice.

Procedures

Procedures in Session 1 and the 30-min baseline segment in Session 2 were identical to those in Exp. I. The baseline in Session 2 was followed by a 30-min segment with taking possible (as in Exp. I) but with the reinforcer

for cooperation raised from four counts to five counts.

Subsequent procedures differed depending upon whether pairs were cooperative or uncooperative in the 30-min take segment.

Non-cooperative pairs. For pairs that were non-cooperative in the 30-min take segment in Session 2, the avoidance button was uncovered on each panel. Subjects received the following instructions:

Each of you now has a button which you can press to turn off the "take money" button for 30 sec even though both of you have switched to work with the other person. Pressing the top button once will turn off the take money button for 30 sec. Pressing the top button again while the take money button is still off will restart the 30-sec period.

The function of the avoidance button was demonstrated. Subjects switched to cooperation and pressed the avoidance button to show that the take light went out and the take button was no longer effective. A 60-min period with the free-operant avoidance schedule and taking both in effect followed the demonstration. Takes could not be nullified by switching to the individual task.

The reinforcer for cooperation was five counts, as in the preceding take segment. The larger count was used in this and all subsequent take and take-avoidance segments so that when the one-count cost for each avoidance response was later introduced, cooperation would remain more profitable than individual responding even if a number of avoidance responses were made. Reinforcement of cooperation during the baseline segments remained at four counts.

Conditions in subsequent sessions for each pair depended upon its previous rate of cooperation. In each session, a 30-min baseline was followed by a 30-min take segment and a 60-min take-avoidance segment. If high rates of cooperation did not develop after at least two sessions, in which avoidance responses prevented taking for 30 sec, the interval was lengthened to 180 sec. If cooperation developed under the 30-sec interval, the interval was reduced to 10 sec. If a pair began cooperating during any of the take-only segments and continued to cooperate in the following take-avoidance segment, it was terminated.

When the shortest of these intervals that produced cooperation was determined, a 1-count cost for each avoidance response was introduced. Each press of the avoidance button subtracted one count from the subject's own counter. The size of the cost was shown on a label next to the avoidance button. If the response cost eliminated avoidance responding and cooperation, the avoidance intervals were lengthened to either 30, 180, or 600 sec until avoidance responding and cooperation reoccurred.

Cooperative pairs. For pairs that were cooperative in the 30-min take segment in Session 2, the take condition was continued for the remainder of the session. In Session 3, the 30-min take segment was followed by the introduction of the 30-sec avoidance interval to determine if avoidance responses would also be made by previously cooperative subjects.

RESULTS

All pairs were cooperative during baseline conditions in which the opportunity to take was unavailable. With taking possible in Session 2, five pairs were totally non-cooperative and two were cooperative. Taking occurred in three of the non-cooperative pairs.

For the two pairs that cooperated without taking throughout Session 2, the 30-sec avoidance condition was introduced in Session 3 following the baseline and 30-min take segment. One pair continued to cooperate without making any avoidance responses in two sessions. The other pair made 47 avoidance responses while continuing to cooperate. In the next session, the avoidance interval was reduced to 10 sec. With this higher response requirement, avoidance responding ceased while cooperation continued. Cooperation without avoidance responses continued when the 30-sec interval was reintroduced in a final session. Thus, for both cooperating pairs no stable pattern of avoidance responding developed.

Figure 3 shows the mean cooperative and individual response rates for the five non-cooperative pairs during the total time spent under the baseline, take, and avoidance conditions (6 to 8 sessions). All five pairs began to cooperate in one of the no-cost avoidance conditions. Four of the five began cooperating at a high rate in the 30-sec avoidance condition and the fifth cooperated when the avoid-

Fig. 3. Cooperative and individual response rates during baseline, take, and take-free-operant avoidance conditions.

ance interval was increased to 180 sec. Three of the four pairs cooperating in the 30-sec avoidance condition also cooperated when the interval was reduced to 10 sec. The fourth pair continued to cooperate in the take segment preceding the 10-sec condition and was not studied further. All other pairs cooperated only in the baseline and avoidance conditions and worked individually during the intervening take segments. Overall, a single take occurred in the 30-sec condition and nine takes occurred in the 10-sec condition—all in pair

T-H. Avoidance response rates during cooperation ranged from approximately 4 to 35 per minute (Table 2).

For the four pairs making avoidance responses and cooperating, the one-count cost for each response was introduced. The avoidance interval for each pair was the final one used in the previous no-cost segment—180 sec for *P-S* and 10 sec for *M-C*, *T-H*, and *W-O*. The addition of the response cost eliminated almost all avoidance responding (Table 2) and cooperation (Fig. 3) for all four pairs.

Table 2

Avoidance responses per minute for initially non-cooperative pairs (Number in parentheses indicates number of sessions worked).

	AVOIDANCE INTERVAL						
	(No Cost)			(1 Count Response Cost)			
	10 sec	30 sec	180 sec	10 sec	30 sec	180 sec	600 sec
M-C	12.8*(1)	10.1*(2)		0	0.1 (1)	0.7*(1)	
T-H	34.5*(3)	7.5*(1)		2.3 (1)	2.6*(1)		
W-O	23.3*(2)	11.4*(2)		0.2 (2)	0 (1)	1.7*(1)	
P-S		1.0 (2)	8.0*(1)			0 (2)	0.1*(1)
C-C		3.6*(1)					

*Substantial cooperation (*i.e.*, five or more cooperative responses/min).

However, when the avoidance interval was lengthened, both avoidance responding and cooperation eventually increased.

DISCUSSION

The free-operant avoidance procedure was as effective as signalled avoidance in producing high rates of cooperation with the opportunity to take.

With the exception of one pair, almost all taking was avoided by the high rates of avoidance responding. Apparently after some experience with taking, most subjects found that its aversive characteristics outweighed the reinforcing ones that led to the taking initially.

The small response cost for avoidance responding in Exp. II was effective in almost eliminating the avoidance behavior. The magnitude of the suppression was unexpected, since even frequent avoidance responses costing one count would continue to make cooperation profitable. Avoidance response rates for each subject would have to exceed 20 per minute (a rate well above the six per minute needed for him singly to keep the take button inoperative under the 10-sec interval) before cooperation would become less profitable than working individually. In fact, if each pair's avoidance response rates in the last no-cost segment had continued during the first response cost segment, three of the four would have continued to profit by cooperating.

Two differences between Weiner's (1963) study and the present one may account for the more extreme effects now obtained. First, the present study used concurrent rather than single operants. Typically, a reinforced alternative response leads to greater suppression of the punished behavior than a single response (Azrin and Holz, 1966). Second, the present study used counter points that were paid off in money at the end of each session. In Weiner's study, subjects received a standard hourly wage, and thus point loss may have been less aversive.

With one exception, the cooperation produced by signalled or free-operant avoidance did not continue when the avoidance condition was removed. The reversibility of this effect contrasts with the non-reversibility found by Marwell *et al.*, (1971) for communication and Schmitt and Marwell (1971) for the opportunity to take regardless of task choice.

Comparison of these studies with the present ones suggests that one important difference may be the presence or absence of behaviors that affect the strength of the taking responses themselves. For example, communication led to agreements not to take, which in turn brought extra-laboratory stimuli to bear on taking behavior. Similarly, where subjects could take while working on either task, cooperation was preceded by a period of bilateral, profitless taking with few task responses made. In this condition, taking itself appeared to extinguish. In contrast, takes in both of the present avoidance procedures were either nullified or avoided and little if any money was lost either through taking or missed task responses.

In conclusion, if previous research in this setting has demonstrated the fragility of cooperation in the face of interpersonal risk, the present findings suggest that efforts directed toward the establishment of avoidance procedures in cooperative situations are worthwhile activities. This has not been apparent in other studies of cooperation and risk where mixed-motive matrix games have been widely used. In these settings, exploitation and avoidance are typically confounded in that the only way in which a subject can avoid his lowest outcome is to make an exploitative choice. However, if even small costs will retard or prevent effective avoidance, the practical application of these procedures may be more limited than the economics of a situation might suggest.

REFERENCES

- Azrin, N. H. and Holz, W. C. Punishment. In W. K. Honig (Ed.), *Operant behavior: areas of research and application*. New York: Appleton-Century-Crofts, 1966. Pp. 380-447.
- Marwell, G., Schmitt, D. R., and Shotola, R. Cooperation and interpersonal risk. *Journal of Personality and Social Psychology*, 1971, 18, 9-32.
- Schmitt, D. R. and Marwell, G. Stimulus control in the experimental study of cooperation. *Journal of the Experimental Analysis of Behavior*, 1968, 11, 571-574.
- Schmitt, D. R. and Marwell, G. Taking and the disruption of cooperation. *Journal of the Experimental Analysis of Behavior*, 1971, 15, 405-412.
- Weiner, H. Response cost and the aversive control of human operant behavior. *Journal of the Experimental Analysis of Behavior*, 1963, 6, 415-421.

Received: 30 January 1971.

(Final Acceptance: 28 July 1971.)