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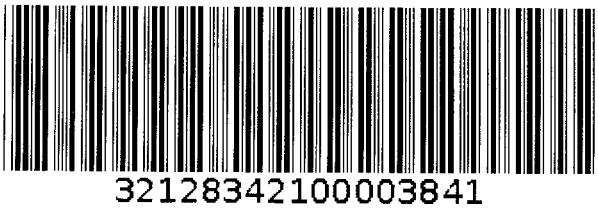

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High and Low Trusters' Responses to Fear in a Payoff Matrix

CRAIG D. PARKS
Washington State University
LORNE G. HULBERT
University of Kent

Interpersonal trust has long been known to influence cooperation. This study tested the hypothesis that one's degree of trust in others will influence the extent to which one reacts to the presence of fear (or the possibility of receiving no payoff for cooperative actions) in a payoff matrix. The hypothesis was formally tested with public goods games and resource dilemma games, with fear manipulated. Results support the hypothesis: when fear was present, high trusters cooperated more frequently than low trusters; when absent, high and low trusters cooperated at the same rate. The findings held across both games. However, the effects of fear within each game were not straightforward: removing fear from the resource dilemma increased low trusters' cooperation rates, but removing fear from the public goods game decreased high trusters' cooperation rates. Results imply that discussion of the role of trust in cooperation must consider whether the particular dilemma contains an element of fear.

A social dilemma can be defined as a situation in which self-interest conflicts with interests of the collective. More specifically, acting in one's own best interests is the dominant behavioral choice in that it will always produce a better outcome than cooperation, regardless of what others do. However, mutual selfishness produces a payoff that is less desirable than that obtained through mutual cooperation (see Komorita and Parks 1994). Research on social dilemmas has concentrated on three different types of dilemmas. One type is the prisoner's dilemma and its variants, which have a

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long history in social psychology. Two more recent (and more realistic) topics of study are public goods and resource dilemmas. Public goods involve a limitless entity that can be used by the entire group. The existence of this entity is largely dependent on some form of contribution from the group members. However, use of the good is not restricted to contributors, hence the dilemma: one can use the good without "paying" for it, but if all act in this way, the good will cease to exist, and all are worse off. An example of a public good is public television. One can watch the station without donating money, but if all viewers act in this way, the station will have no money to broadcast.

A resource dilemma (or social trap) involves some finite resource that all group members may use. The resource is partially replenished at periodic intervals but not necessarily back to its original level. The dilemma here is that the individually rational course of action is to use as much of the resource as possible, but heavy use by all group members will outdistance the replenishment of the resource, and soon, the resource will run out. To prolong the life of the pool, some members must show restraint, although it is not in their best interests to do so. An example is a water table. Chronic overuse of water will dry up a table despite the presence of rain and snow.

Social dilemma researchers have long sought ways to predict how a particular group member will behave in a dilemma situation. Much of this work has focused on interpersonal factors. One such factor is trust. Trust has long been known to be connected to cooperation (e.g., Deutsch 1960). Goal/expectation theory (Pruitt and Kimmel 1977) and its modification, structural goal/expectation theory (Yamagishi 1986b), both argue that the degree of one's trust in others is the primary factor in long-term interdependencies. Basically, it will be the case that those who trust others to "do the right thing" (cooperate) will show high rates of cooperation over time, compared to those who have low trust of others. There is evidence to support this assertion (Komorita, Hilty, and Parks 1991; Yamagishi 1986a).[1] Many definitions of trust have been offered; in our study, we defined it as the belief that others will not exploit one's goodwill (Yamagishi 1986a; see also Komorita and Carnevale 1992).

Recently, Parks (1994) noted that although trust has been thoroughly researched within the prisoner's dilemma and has recently been examined within a public goods format, there has been little investigation into the question of whether it predicts resource dilemma behavior. He measured trust

1. It should be noted that there seems to be no research that clearly establishes a causal relationship between trust and cooperation. That is, it is not clear whether people cooperate because they are trusting or come to trust others as a result of cooperating.

using Yamagishi's (1986a) trust scale and had subjects play either a resource dilemma game or a public goods game. Consistent with previous research, he found trust to be predictive of behavior in the public goods game. However, trust did not predict harvesting behavior in the resource dilemma game. Parks suggested that the discrepancy between the games might be explained by the presence or absence of fear.

Fear can be defined as the possibility that one will receive no payoff from one's actions (Dawes et al. 1986; Rapoport 1987).[2] In a public goods dilemma, contribution to a good that is ultimately not provided results in a zero outcome: one has neither the money nor the good. By contrast, one always receives a positive outcome from a resource dilemma whenever one samples from it. Thus public goods contain an element of fear, whereas resource dilemmas do not. In a game with fear, the primary concern is whether or not one will receive a payoff. A zero payoff will occur only if one cooperates while others do not; someone who does cooperate, then, must implicitly believe that others will not allow him or her to receive the zero payoff (i.e., that she or he will not be exploited). For this reason, trust should influence behavior in a game with fear. By contrast, in a no-fear game, one does not need to worry about whether one will receive a payoff (and hence what others are going to do) but can concentrate on the size of the payoff. Two studies give indirect support to this argument. First, fear has been shown to affect contribution behavior in iterated public goods games (Rapoport and Eshed-Levy 1989); second, fear is known to be related to trust in that high trusters tend to be less fearful than low trusters (Yamagishi and Sato 1986). Given the finding reported earlier that trust predicts public good behavior, it is plausible that fear and trust combine to affect cooperation.

Testing the relationship between trust and fear requires orthogonal manipulation of social dilemma type and fear. It may be argued that a resource dilemma with fear is not very realistic. Why study a fear-present resource dilemma if real examples of such situations are hard to find? We suggest that real examples of fear-present resource dilemmas exist and are important. An example is fishing waters. A population of fish meet the criteria of a resource dilemma: the population is partially replenishable through reproduction, fishermen can take nearly unlimited amounts of fish, and there is (economic) incentive to do so; but if the population is extinguished, all are worse off than if all had limited their catch amounts. If almost all fishermen harvest fish at maximum rates, they will realize large profits when they sell the fish. Consequently, they can buy better equipment and attract more customers (because of their plentiful supply, and perhaps lower bulk prices). By con-

2. This definition of fear should not be confused with Kerr's (1983) conception of fear as the worry that others will take advantage of one's efforts (also known as the "sucker effect").

trast, the lone fisherman who decides to cooperate and to limit the harvest so that the fish can continually replenish themselves will be at a distinct disadvantage. This fisherman will have little income relative to his or her competitors, will not be able to afford modern equipment, and may lose customers because of limited selection. Thus the lone cooperator may go out of business as a result of her or his cooperation.

In this article, we present a study that formally tested the proposition that high and low trusters respond differentially to fear. The following hypotheses were tested:

Hypothesis 1: There will be an interaction between trust and fear. When fear is absent, no differences between the two groups will be observed, but when fear is present, high trusters will cooperate much more frequently than low trusters.

Hypothesis 2: Trust will influence behavior in resource dilemmas when the dilemma contains an element of fear. Again, high trusters will be more cooperative than low trusters.

METHOD

SUBJECTS

Subjects were 94 students enrolled in introductory psychology. Participation was in partial fulfillment of a course requirement.[3]

DESIGN

The design was a 2 (Game) × 2 (Fear) between-subjects factorial. The two types of games used were public goods and resource dilemma games. Following Rapoport (1987), fear was defined as the presence of a zero in the payoff matrix; no fear was defined as the absence of a zero.

QUESTIONNAIRE

Level of trust was determined with Yamagishi's (1986a) trust scale, which requires subjects to indicate degree of agreement (on 5-point scales) with a number of attitudinal statements. Level of trust is determined by summing the scale values: larger point totals indicate greater degrees of trust.

3. The students were from two different schools (36 from one, 58 from the other). Separate analyses were conducted for each of the two subject groups, and no systematic differences were found. Hence, in this article, we report analyses of the combined data set.

GAMES

The public goods game was a five-person minimal contributing set (MCS; Rapoport, 1985; van de Kragt, Orbell, and Dawes 1983) with the following parameters: 4-point endowment, three contributors necessary for provision of the good, and a public goods value of 8 points per person.[4] The resource dilemma was a five-person game patterned after Messick et al.'s (1983) paradigm with the following parameters: initial pool size of 450 points, replenishment rate of 10%, and a maximum harvest size of 12 points. Under these constraints, the optimal harvest size is 8 points. We thus defined a cooperative harvest as being equal to or less than 8 points.

The fear manipulation was introduced via the game information given to subjects. For the public goods game, the manipulation involved using a no-fear matrix (see Rapoport 1987), which is shown in Figure 1. This matrix provides a "money-back guarantee"; if a subject contributes to a good that is not provided, the contribution is returned to the subject. This guarantee removes the potential zero payoff typically associated with public goods. For the resource dilemma, the fear manipulation was implemented by requiring that the smallest (i.e., most cooperative) harvest be within 2 points of the second-smallest request, or else the person would receive nothing. Thus a cooperative individual needs at least one other person to be similarly cooperative to receive a payoff.[5]

The games were conducted such that subjects believed their game partners were the other subjects, but in reality, each subject played against a set of strategies preprogrammed by the experimenter. The strategies were as follows:

Tit-for-tat (TFT). This strategy imitates what the subject chose on the previous trial.

TFT delayed one and two trials. Both of these are imitative; however, the imitated choice is the one the subject made two or three trials ago, respectively (Komorita, Hilty, and Parks 1991).

A random strategy. In the resource dilemma game, the random strategy was a series of choices with a mean of 8 and a variance of 1; in the public goods game, the random strategy was a random series of 10 cooperative and 10 competitive choices.

4. Note that the MCS is not a social dilemma in the formal sense, because noncontribution does not strictly dominate contribution. Specifically, when the number of other cooperators is equal to $m - 1$, it is better to cooperate than not cooperate, as inspection of Figure 1 will make plain.

5. It may be even more effective to manipulate fear by using negative payoffs. However, some concern has been expressed that the presence of negative payoffs may lead to the introduction of unwanted framing effects (see Komorita and Carnevale 1992), and the empirical data on this issue have been inconsistent.

	Fear Present					Fear Absent				
	Total Contributors					Total Contributors				
	1	2	3	4	5	1	2	3	4	5
Contribute	0	0	8	8	8	4	4	8	8	8
Not contribute	4	4	4	12	12	4	4	4	12	12

Figure 1: A Public Goods Payoff Matrix with and without Fear

Finally, all games proceeded for 20 trials, although the exact number was left unspecified to subjects. The resource dilemma game could have ended as early as the 12th trial if the group consisted of subjects who always harvested the maximum amount. No group exhausted the pool before the game was to end; however, all groups had reduced the pool size by at least 33% by the 10th trial, and by the end of the game, only one group had as much as half of the resource left.

PROCEDURE

Subjects entered the laboratory in groups of five. They were seated and then given the trust scale, along with two other scales designed to mask the purpose of the trust questionnaire. After all scales were completed, the experimenter collected them and then began the game. Subjects were told that they would be playing a game with the others in which they would accumulate points and that their performance would allow them to receive some winnings after the game had been completed. The amount of the winnings was contingent on their point total. In the public goods game, subjects were then given a payoff matrix. In the resource dilemma game, they were given information on the initial size of the pool, the replenishment rate, and the harvest range.

In the public goods game, each subject's desk had a switch with which to make choices. The subject moved the switch one way to make a cooperative choice and moved it the opposite way to make a defecting choice. The switches were connected to a central light panel hidden from subjects' view. Movement of the switch illuminated one of two lights. The experimenter observed the lights, recorded the choices of all subjects, and then provided subjects with written feedback regarding their payoff for that particular trial. In the resource dilemma game, subjects were given a large number of slips of paper and instructed to write on a slip their harvest choices for a particular

trial. These slips were then collected by the experimenter, subject choices were recorded, and feedback was provided.[6]

After completion of the 20th trial, the experimenter announced that the game was over. A short questionnaire assessing game goals was then distributed. After completion of the questionnaire, subjects were individually led into a second room, given pens and/or pencils in exchange for their points, debriefed, and dismissed.

RESULTS

We first scored the trust questionnaires and dichotomized subjects by taking a median split. We then conducted a 2 × 2 × 2 (Game × Fear × Trust) ANOVA on the overall frequencies of cooperation, defined as the proportion of cooperative choices over trials. We obtained a main effect for trust, $F(1, 86) = 15.13$, $p < .01$, and a marginal effect for fear, $F(1, 86) = 3.76$, $p = .06$. We obtained interactions between trust and fear, $F(1, 86) = 4.11$, $p < .05$, between fear and game, $F(1, 86) = 12.87$, $p < .01$, and between trust and game, $F(1, 86) = 4.03$, $p = .05$. Table 1 presents the main effects and the trust-fear interaction. It can be seen that high trusters cooperated more frequently than low trusters, and more cooperation occurred when fear was absent than when it was present. The interaction speaks directly to our first hypothesis and was as predicted: when fear was present, there was a large difference in the cooperation rates of low versus high trusters, but when fear was absent, no such difference was observed (HSD = 0.17, $\alpha = .05$, $MS = .043$).[7] Note also the significant increase in low trusters' cooperation when fear was absent.

The fear-game interaction is shown in Table 2. This analysis reveals that the presence or absence of fear strongly affected choice in the resource dilemma game. When fear was introduced into the game, cooperation rates fell by more than half (which, with an HSD of 0.17, is a significant decrease). By contrast, the presence or absence of fear had a marginal effect on cooperation in the public goods game. This latter result is consistent with work by Dawes et al. (1986), in which a no-fear manipulation in a public goods game had little effect on cooperation.

The trust-game interaction is shown in Table 3. It shows a significant difference in cooperation rates between high and low trusters in the public

6. Payoffs were determined by combining the subject's choice with the predetermined choices of the four robots and consulting the appropriate cell of the payoff matrix. In the resource dilemma game, subjects also received information about remaining pool size.

7. Because the cell sizes were unequal, we used an approximate n value of 23.23 for the HSD test.

TABLE 1
Effects of Trust and Fear and Their Interaction on Cooperation

	Trust		
	Low	*High*	*Mean*
Fear			
Present	.15	.45	.32
Absent	.35	.41	.38
Mean	.26	.44	

TABLE 2
Interaction between Fear and Game

	Fear		
	Present	*Absent*	*Mean*
Game			
Public goods	.46	.32	.39
Resource dilemma	.19	.44	.31
Mean	.32	.38	

goods game but not in the resource dilemma game. This is consistent with Parks's (1994) findings.

Finally, we expected that similar patterns of behavior would be seen across the two games. That is, the frequencies of cooperation in the no-fear public goods game should be the same as those in the no-fear resource dilemma game, and so on. Tables 4 and 5 present frequencies of cooperation by high and low trusters at each level of fear for each game. It can be seen that within each game, differences between high and low trusters were observed when fear was present but that no differences existed when fear was absent. Note that the conditions typically studied are fear-absent resource dilemmas and fear-present public goods. If one focuses on just these two rows, one sees differences between levels of trust in the public goods game but not the resource dilemma game. This is the observation reported by Parks (1994). It thus seems that trust will be predictive of cooperation, regardless of the specific game, so long as fear is present.

We also analyzed the trial-by-trial behavior of subjects. The trial data were combined into four blocks of five trials and analyzed with a $2 \times 2 \times 2 \times 4$

TABLE 3
Interaction between Level of Trust and Game Type

	Trust		
	Low	*High*	*Mean*
Game			
Public goods	.23	.49	.39
Resource dilemma	.28	.35	.31
Mean	.26	.44	

TABLE 4
Cooperation by High and Low Trusters at Each Level of Fear within the Public Goods Game

	Trust		
	Low	*High*	*Mean*
Fear			
Present	.22	.58	.40
Absent	.28	.40	.32
Mean	.25	.48	

ANOVA, with repeated measures on the last factor. We found a main effect only for block, $F(3, 258) = 5.93$, $p < .01$. The main effect is the familiar decline in cooperation over time. However, the decline is not consistent but levels off after the second block of trials (*M*s = .41, .32, .34, and .33, respectively).

REGRESSION ANALYSIS

Dichotomizing subjects into high- and low-trust groups fails to take advantage of the continuous nature of the scale. Perhaps when trust is treated as a continuous rather than a discrete feature, its relation to cooperation becomes less pronounced. To check this, we conducted a regression analysis with frequency of cooperation as the criterion and fear, game type, and trust score as the predictors. Table 6 summarizes the results. It can be seen that the results are consistent with the ANOVA analysis. Trust was a highly significant predictor of cooperation, fear was slightly so, and game type was nonsignificant.

TABLE 5
Cooperation by High and Low Trusters at Each Level of Fear within the Resource Dilemma Game

	Trust		
	Low	*High*	*Mean*
Fear			
Present	.12	.36	.24
Absent	.44	.44	.44
Mean	.27	.40	

TABLE 6
Regression Analysis of Trust, Fear, and Game Type

Factor	*Beta Weight*	t
Trust	.428	4.55**
Fear	.186	2.17*
Game type	−.115	−1.23
Multiple $R = .469$ $F(3, 90) = 8.45, p < .01$		

*Significant at .06 level. **Significant at .01 level.

DISCUSSION

The purpose of this study was to demonstrate two points: (1) an individual's degree of trust in others can predict cooperative social dilemma behavior when the dilemma contains an element of fear and (2) trust will predict behavior in fear-containing dilemmas regardless of the specific type of dilemma. We were able to support both of these propositions. We found that when fear was present, differences in the frequency of cooperation of high and low trusters could be discerned, but no such differences were detectable in a fear-absent game. Further, these effects held for both public goods and resource dilemma games. By obtaining a trust-game interaction, we were able to replicate Parks's (1994) finding that trust is predictive of public goods, but not resource dilemma, behavior. However, the rest of our analyses indicate that that is not the whole story. We also need to look at whether fear is present in the dilemma. If it is, then knowing a person's degree of trust in others will help predict that person's rate of cooperation, regardless of dilemma

type. If fear is absent, knowledge of the person's trust level will not aid in prediction.

The results have implications for the induction of cooperation in intergroup settings. As has been shown, when fear is present, low-trust individuals will be inclined toward lower rates of cooperation than high trusters. To bring about greater cooperation among these low trusters, one needs to help them overcome their suspicions of others and convince them that other people generally want to work for the common good. The temptation is to argue for removal of the fear element. As can be seen in Table 1, the cooperation rate of low trusters jumped from 15% to 38% when fear was removed. However, close inspection of Tables 4 and 5 suggests that it may not be that simple. Certainly, removing the fear from a resource dilemma is a positive step; doing so produced equal rates of cooperation between high and low trusters. Removing fear from the public goods game also equated cooperation rates but did so primarily by inhibiting high trusters from cooperating. This curious pattern does not affect our conclusions, but it does suggest that, at least in a public goods setting, something more is going on than a simple trust-fear-cooperation series of relations. Future research addressed at clarifying this process is warranted.

Our results also have implications for theories of long-term cooperation. Pruitt and Kimmel (1977) argued that long-term cooperation can be established only after group members develop mutual trust. Yamagishi (1986b) argued that, in theory, Pruitt and Kimmel's argument should be true, but in large, real groups, it is unlikely that all group members will come to trust all other members. Hence other means of encouraging cooperation (e.g., punishment of noncooperators) are necessary. Our findings support Pruitt and Kimmel's hypothesis: high trusters do cooperate more than low trusters. However, we suggest that their argument be modified somewhat. We have shown that when fear is absent from the dilemma, one's degree of trust is not related to cooperation. Encouraging the development of mutual trust in no-fear situations should thus have little effect on cooperation rates. Under these circumstances, Yamagishi's solution of punishing noncooperators (which has been shown to be effective at enhancing cooperation; see Yamagishi 1986a, 1986b) may be preferred. In sum, we argue that development of mutual trust is important only when the dilemma contains a fear element; when fear is absent, punishment of noncooperators should be considered the primary solution.

A discussion of trust, fear, and punishment brings up a related point regarding trust and coercion. In studies of punishment and trust, Yamagishi (1986a, 1988) found that low trusters contributed more toward establishing a sanctioning system than did high trusters. It may be that the presence of

coercive elements will increase one's trust in others (i.e., one is more likely to believe that others will do the right thing if one knows that they will be punished for not doing it). In a more long-term sense, fear may actually induce cooperation if the fearful consequence is sufficiently severe. Persons who might otherwise be disinclined to cooperate may nonetheless do so after envisioning life without the good or resource. For example, those tempted to avoid donating blood might nonetheless donate after they consider the implications of a national lack of stable, regulated blood banks.[8]

Finally, researchers might gain further insight into the role of fear in cooperation by drawing on elements of decision theory. Research on prospect theory (Kahneman and Tversky 1979) has shown that there is a discontinuity in utility functions for positive and negative payoffs. The effects of fear may be based partially on where along this discontinuous function the person locates a zero payoff. Objectively, it is located at the point of discontinuity. However, it may be the case that low trusters frame a zero payoff as a loss (e.g., "I didn't receive anything"), whereas high trusters frame it as a gain (e.g., "I didn't lose anything"). In this way, trust may be related to one's method of framing outcomes.

The relationship between trust and cooperation, then, seems to be more complex than was originally thought. The role of trust in cooperation certainly warrants further investigation by social dilemma researchers.

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