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The Development of Cooperation: Child to Adult¹

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Abstract

Male pairs and mixed pairs of ages 8, 12, 16, and 20 participated in a standard "Prisoner's Dilemma" game, and one in which they could alter their choices after seeing their opponent's. Overall cooperation was a decreasing monotonic function of age. Males cooperated with other males more than with females until age 20. There was a steady increase in the rate of choice reversal until age 20. Explanation of the aforementioned results was based primarily on a social learning model.

The Development of Cooperation: Child to Adult¹

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Several studies of "game behavior" have been concerned with the developmental aspects of cooperation and competition, and with sex differences in cooperative behavior. Sampson and Kardush (1965) found that the number of collaborative responses in a standard "Prisoner's Dilemma" (PD) game was significantly lower for a 7-8 year old group of white males than for a 9-11 year old group. White females of the same age groups, however, produced opposite results. This study, together with others which are conflicting regarding the sex variable in game behavior (e.g., Lutzker, 1961, and Bixenstine and Wilson, 1963), suggests that age related changes in cooperative behavior may be different for males and females; the conflicting findings on sex differences may thus reflect age differences in the experimental samples. Data on mixed and liked sex pairs over a wide range of ages would help in clarifying the nature of developmental trends for males and females.

The primary purpose of the present study was to obtain more extensive data on cooperative game behavior over a wide age range, for both male and male-female pairs. Thus, besides trends in overall cooperation, intrasex cooperation (male) could be compared to intersex cooperation. Subjects were run in a standard PD game and in a PD game in which Ss were permitted to modify their initial choices. Deutsch (1960) has shown that when a player is allowed to change

his mind after he and his partner have made their choices in a one trial PD game, the percentage of individuals who chose cooperatively was substantially higher than in a "non-reversible" choice situation. It is of interest to determine whether this "change of heart" is age dependent.

Method

Fifty-four Ss, 36 males and 18 females, were employed in each of four age groups, 8, 12, 16, and 20 years old. A few Ss were a year younger or older than the desired ages. The Ss were recruited from two elementary schools, a high school, a nursing school, and Dartmouth College--all in the Upper Connecticut Valley of Vermont and New Hampshire. The socio-economic and relative intelligence levels of all but the Dartmouth students were judged to be approximately the same. Eighteen of the 36 males (designated M_1) in each age group were randomly chosen before playing the PD game with the other males (M_2), to play the same game at a later time with girls who were relatively as well known to the M_1 s as the M_2 s were to them. Thus, differences in cooperation with males and with females could be observed in the M_1 s at each age level. There were 18 all male pairs (M_1-M_2) and 18 mixed pairs (M_1-F).

As noted, two versions of the PD game were used. In the "change" version Ss were permitted to reverse their choices; in the standard version Ss chose simultaneously and were not permitted to change. Nine M_1-M_2 pairs and nine M_1-F pairs were assigned to each version of the game.

The research was conducted in small, quiet rooms or on a quiet part of a school playground. For the "non-reversible" games, E, sitting between both Ss so that it was difficult for them to see each other, showed and explained the payoff matrix depicted in Figure 1. Explanation of the game mechanics were necessarily made simpler for the two younger age groups. E made certain that each S understood the Prisoner's Dilemmas by answering

Insert Figure 1 about here

all questions and then pretesting the Ss. After E counted to three, the Ss simultaneously revealed their choices, either a black or white token, to each other. E then announced the payoff, in points, and recorded the results. This procedure was repeated for fifteen trials. Ss were permitted no communication with each other during the experiment. The Ss were told they would receive sizable rewards commensurate with the number of points they accumulated at the end of the game. The 8 and 12 year old groups were to receive candy, while the older groups were to receive money. By describing the rewards as "sizable", it was hoped that substantial and relatively equal incentive would be established in the Ss. An individualistic orientation² towards playing the game was established. E stressed that "the object of the game is to get as many points as possible for yourself, and not to worry about how well the other person does."

The same general procedure was followed in the reversible games,

except for one addition. Ss were told that they would be given a short time after they revealed their markers (usually 10 or 20 seconds) in which they could change their choices. Unfortunately, instructions by the three different Es were not strictly uniform in this respect. Hence, some Ss thought they could change their minds only three times, while most Ss thought they could change as long as they wished. The difference in instructions, however, did not cause any significant differences in the frequency of any of the three types of choice reversals.

In order to correct for practice effects in M_1 , related to the sex of his partner, the M_1 - M_2 session was run after the M_1 -F session half of the time. These practice effects were controlled for in order to accurately assess differences between intrasex and intersex cooperation.

After every session a questionnaire was completed by each of the Ss in the two older age groups. This asked them to rate (as good description, poor description, etc.) various motives they might have had in playing the game as they did, thus providing a cognitive measure of cooperation in addition to the behavioral measure. Typical game motives the Ss were asked to rate were "... to keep my own losses at a minimum" and "... to give the other person high pay-offs." Younger Ss were asked subjectively what they were trying to do.

Results

For the overall cooperation between peers as a function of age, the total number of cooperative responses (W) given by M_1 , M_2 , and F were averaged for the non-reversible games in each age group. To reduce confounding effects of prior success or failure on M_1 , only his first session was included in the analysis. Figure 1 shows that the means from age groups 8 through 20 form a decreasing monotonic function, but the overall differences between the means

Insert Figure 2 about here

do not reach significance ($F=1.8, p < .15$). A significant difference exists only between age groups 8 and 20 ($t=1.74, p < .05$).

To determine whether there was a difference in cooperation of males with other males relative to their cooperation with females, the ratio of M_1 's cooperative responses in the M_1 - F game was analyzed. The mean ratio for each age group is presented in Figure 2. An analysis of variance revealed no significant differences among means ($F=1.8, p < .20$). As determined by cooperative tests, the three lower age groups are not significantly different among themselves; however, there are varying degrees of difference between these groups and the 20 year old group, the only significance occurring between age groups 12 and 20 ($t=2.39, p < .025$).

The number of cooperative reversals (change by player from B to W) was averaged only for M_1 's first session in the reversible

condition. This hopefully reduced the influence of expectation effects which were present in M_1 after he had seen how his partner in the first session reacted. Figure 3 shows that the number of cooperative reversals increases significantly (between ages 8 and 16-- $t=2.52$, $p < .01$; between ages 12 and 16-- $t=1.85$, $p < .05$) until age 20, where it decreases significantly ($t=2.61$, $p < .01$). An analysis of variance indicates limited significance among means ($F=2.3$, $p < .10$). Two other types of response changes also were analyzed; changes to uncooperative response (W to B) and mutual

Insert Figure 3 about here

changes (both players reverse in the same trial.) It will be noted how similar in shape are the plots of the three types of choice reversal. The correlation between the means of cooperative and uncooperative reversals is $.40$ ($p < .10$); between cooperative and mutual reversals, $.96$ ($p < .01$).

A cooperation score was obtained from each S's completed questionnaire by subtracting the sum of the ratings (0=very poor, 1=poor, etc.) of the uncooperative motives. The only complete set of finished questionnaires among the Ss came from M_1 . The correlation between the number of cooperative responses by M_1 in his first game and the cooperation score of the questionnaire he completed after that game is $.32$ ($p < .15$).

Discussion

The decrease in cooperation with increasing age found here is in direct contradiction with the results obtained by Sampson and Kardush. Differences in our experimental design may be responsible for the different results: e.g., use of wider age ranges, and an individualistic orientation in a school setting rather than a competitive atmosphere in a summer camp. Although there was no main effect of age on cooperation, the significant difference between elementary schoolers and college students deserves further elaboration. The present results are not inconsistent with a social learning model of moral development. Assuming competition to be learned behavior, the older age groups may be expected to have a greater habit strength of competitive responses. An alternative explanation is that younger children, who are more inexperienced and insecure in their social relationships, are more afraid of losing the favor of their peers, i.e., are more dependent on their friendship, than are older individuals. Thus, one would expect more cooperative gestures from the younger children in a game situation which had material incentive.

The present investigation of the sex variable in PD games represents improvement over previous studies. Earlier investigations had pairs play PD games, and then separately analyzed all male and female responses. Personality differences within each sex were controlled for only by randomisation. In the present study a single male was observed with another male and with a female, and then his two performances were compared. For the sake of symmetry, it is

unfortunate that intrasex cooperation of the females was not tested (due to lack of time), but the undistorted male cooperation level displayed toward both sexes is of considerable interest.

The high cooperation ratios of the younger groups confirm a familiar belief. At younger (prepuberty) ages there is considerable friction and rivalry between the sexes. In the older groups, intersex relations have become less ambivalent, and here cooperation might be expected. The high variance ($V=7.56$) in the 16 year old group's data caused by high collaboration of certain males who later admitted to sharing a common interest in "making the experimenter go broke" accounts for the unexpectedly high ratio. Still, it is less statistically different ($t=1.08$, $p < .15$) from the oldest group than the other groups are. It is interesting to note that for the 20 year old group, males were more cooperative with females than with other males, although this difference is not significant. One reason for the low ratio may be that the Dartmouth students, having infrequent contact with females during the school year, make a special effort to be "chivalrous."

To explain the phenomenon which Deutsch found, one might offer the obvious explanations of guilt, over having been uncooperative, and altruistic or masochistic behavior. Such forms of behavior are probably learned, and consequently the number of cooperative reversals should increase with age. But how does this line of reasoning explain the nonsignificant increase up to age 16, and then the significant drop in the age 20 group, found in the present study.

Since both the number of uncooperative and mutual reversals vary in much the same way as cooperative reversals, the relevant dependent variable seems to be not the separate types of changes, but the total number of reversals. This suggests that some sort of exploratory behavior, a desire to discover means of evoking more cooperation from one's peer, develops with age. By college age, when interpersonal relationships have a more stable pattern, perhaps individuals have developed a set expectancy of what their partners will do; hence, "feeling out" occurs less. This resignation to the other's action, a familiar enough theme, seems to harden with age.

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Footnotes

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²In his 1960 article entitled "Trust and Suspicion," Deutsch mentions two other types of orientations, cooperative and competitive.

Figure 1. Game Matrix: First number in each pair represents payoff in points to Player One; second number represents payoff to Player Two.

		Player Two	
		White	Black
Player One	White	1,1	0,2
	Black	2,0	0,0

Figure 2. Individual cooperation and male cooperation ratio as a function of age

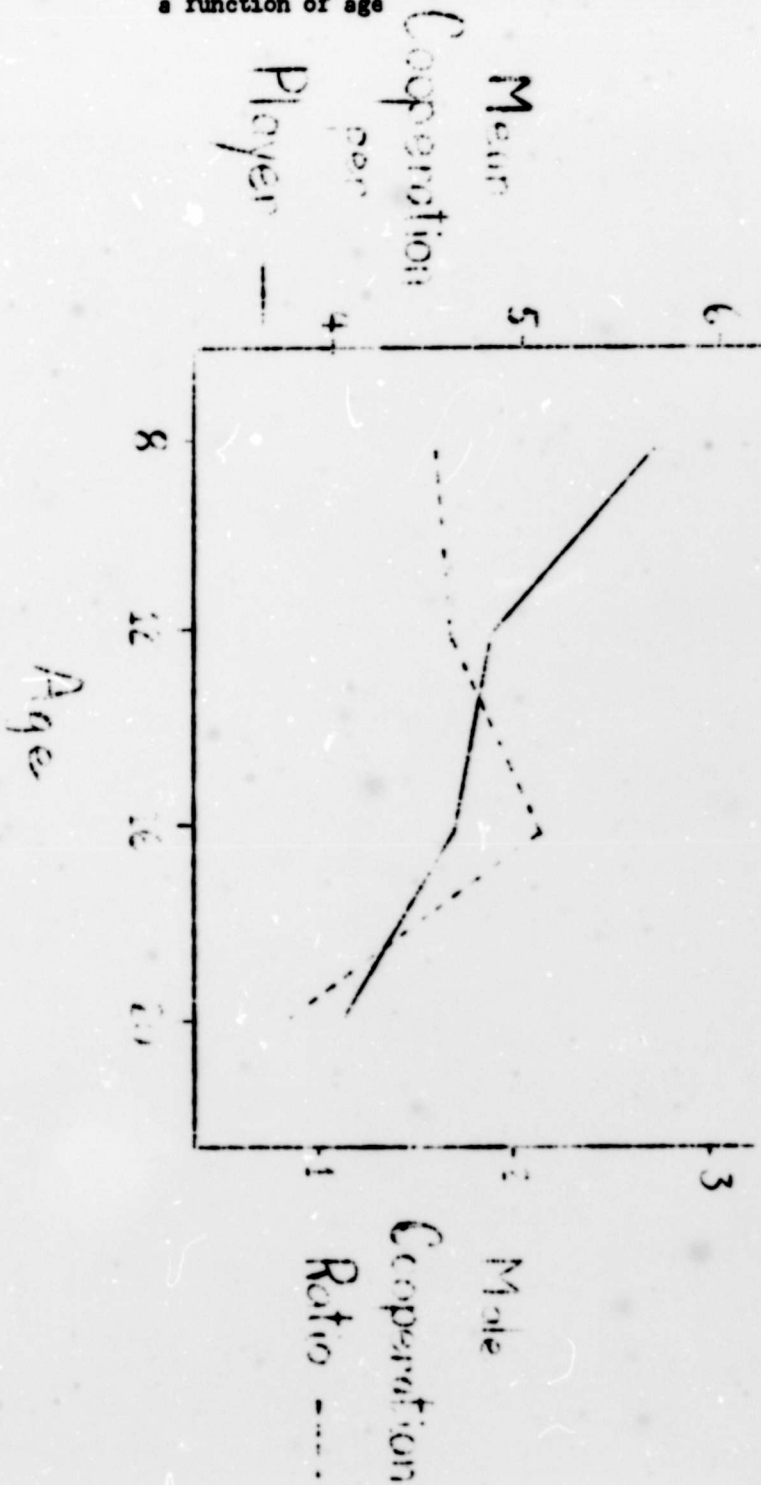


Figure 3. Reversals as a function of age.

