THE SOCIAL PSYCHOPHYSICS OF COOPERATION: NONVERBAL COMMUNICATION IN A PUBLIC GOODS GAME

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ABSTRACT: An experiment was conducted to test the hypothesis that cooperation in a social dilemma context could be facilitated by inducing participants to emit "social psychophysical" cues, information in the perceptual array that affords meaningful and consequential social inferences. In particular, participants were asked to engage in mutual eye gaze, to touch one another gently, to communicate in a virtual chat room, or to tap out rhythms in synchrony. All but the last of these manipulations increased contributions to a public good in all-male but not all-female groups. These results suggest the inference systems that are engaged when individuals make decisions about whether or not to cooperate in a group context are responsive to relatively low level nonverbal behavioral cues.

KEY WORDS: cooperation; groups; sex differences; social dilemmas; nonverbal communication.

Social dilemmas, situations in which each individual's pursuit of self-interest leads to deficient aggregate outcomes (Dawes, 1980), continue to be important problems at many levels of social interaction. The social costs of decisions to behave selfishly are evident in macro contexts such as environmental pollution (Van Vugt, Van Lange, & Meertens, 1996) as well as micro contexts such as social loafing in small work groups (Williams, Jackson, & Karau, 1995).

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A more specific version of a social dilemma, the public goods problem (Olson, 1965), involves situations in which it is difficult or impossible to exclude people from the benefits of a particular good or service once it is produced. The dilemma arises because each agent would prefer to enjoy the benefit of a public good without incurring the costs to provision it. Because the obstacles facing the generation of public goods impede potential improvements in social welfare, an important question involves the conditions that favor the provisioning of public goods. The fact that a number of public goods do indeed exist indicates that there are conditions under which they can be produced.

Large literatures in both psychology and economics have emerged investigating the public goods problem (Ledyard, 1996). A common method used in the controlled setting of the laboratory is the voluntary contribution mechanism. In a typical experiment, participants are given an allocation of tokens (an endowment) and told that they will be given an opportunity (or multiple opportunities) to put these tokens into one of two accounts, the "personal account," and the "joint account." Tokens placed in the personal account generate a payment only to the individual subject, while tokens contributed to the joint account increase the size of the monetary pie to be divided among all participants. Each token contributed to the joint account comes at a cost to the contributing individual, but increases the group's aggregate outcome.

This structure creates an incentive for each participant to contribute zero to the joint account and put her entire endowment in the personal account. Of course, if everyone were to contribute their endowment to the joint account, all would be better off than if everyone contributed their endowment to the personal account. So, the extent to which individuals are cooperating with one another can be indexed by the number of tokens contributed to the joint account.

The vast literature on public goods games has established that under these conditions participants deviate from pure self-interest. In a typical 10-round experiment, contributions start at roughly 50% and slide toward zero as the game progresses (see Ledyard, 1996, for a thorough review). However, when players are given a chance to engage in face-to-face communication before they make their actual decisions, contribution rates increase (Dawes, McTavish, & Shaklee, 1977). The reason for this increase remains the subject of debate (Kerr & Kaufman-Gilliland, 1994).

Social Information for Social Decisions

The current experiment looks more closely how communication functions to increase cooperation by looking at the impact of certain non-verbal behaviors in the absence of unrestricted face-to-face communication. In essence, narrowing the "bandwidth" of interaction might make it possible to investigate which elements of the communication stream are important for improving cooperation rates.

The theoretical perspective motivating this research was an evolutionary one, though other points of view might well have yielded similar predictions. Considering cooperation from the evolutionary standpoint suggests that human psychology should not be expected to be designed to cooperate indiscriminately, incurring costs to benefit others under all circumstances (Kurzban & Leary, 2001; Trivers, 1971). Instead, it should expected that people use decision rules that choose to cooperate contingent on particular types of information from the social environment. That is, there might be particular kinds of cues that people use to decide when one is in the type of situation in which cooperating is a good strategy, where "good" means that cooperating under these conditions led to better fitness outcomes than choosing not to cooperate. From this perspective, an important question is what kinds of social information might influence systems designed to generate cooperative behavior. For example, information that others are committed to the group welfare (Kurzban, McCabe, Smith, & Wilson, in press) and information that there are other, perhaps rival, groups in the environment (Bornstein & Rapoport, 1988) seem to be information of this type, eliciting cooperation in these contexts.

One possibility is that relatively low-level "social psychophysical" cues, information in the perceptual array that affords meaningful and consequential social inferences, might also act as inputs to information-processing devices that are engaged when one is making decisions about whether or not to cooperate with others. The experiment reported here relies on the fact that many inference systems seem to be "encapsulated" and "modular" in their functioning (Fodor, 1983), including social systems (Gigerenzer, 1997). That is, many cognitive systems are activated any time the input conditions for their operation are met (Farah, Wilson, Drain, & Tanaka, 1995, is a good example). As a result, it is possible to "fool" these systems, giving them the inputs to which they are sensitive even though the "normal" (Millikan, 1984) circumstances under which they were designed to operate do not in fact hold.

Research on the "facial feedback" hypothesis illustrates this general approach. It has been shown that when participants are induced to tighten or relax their facial muscles through artificial means, such as placing a pen between their teeth, they experience emotions that in normal circumstances are associated with tension in these muscles (Strack, Martin, & Stepper, 1988). The efficacy of this kind of manipulation has been known for some time in a number of areas of social psychological research (Bem, 1967).

The current experiment uses this approach to investigate specific cues that might enhance cooperation in the context of groups. The particular cues investigated here derive from the argument that mechanisms that support cooperation might be designed in part to solve the adaptive problems of hunting and intergroup conflict, activities that require extremely intricate real-time coordination (Caporael & Brewer, 1991; Kurzban, 1998). It could be the case that cues that reliably correlated with one's ability to coordinate well with others act as inputs to inference procedures that determine how cooperative one should be. These considerations led to the hypothesis that decisions to cooperate would be mediated by the extent to which an actor perceives cues that coordination is possible within a group, with cooperation increasing in the presence of such cues.

Experimental Treatments

The experiment presented here was designed to test this hypothesis by inducing participants to emit social psychophysical cues in the context of a public goods game. Specifically, these participants were induced to match oblique eye gazes with one another, touch one another gently, or tap out rhythms in synchrony. These manipulations were chosen in part because other established models of cooperation, including perspectives that emphasize the role of structural features (Rapoport, 1988), face-to-face communication (Chen & Komorita, 1994), promises and pledges (Chen, 1996), the enhancement of social identity through common fate (Brewer & Kramer, 1986) or the presence of an out-group (Rapoport & Bornstein, 1989) would not predict any effects of these manipulations.

More importantly, these manipulations were selected because they are relevant for establishing coordination among individuals. Although discussions of cooperation have generally emphasized costs and benefits to the parties involved, an equally important problem facing would-be cooperators is that they must coordinate their actions (Tooby & Cosmides, 1996). Individuals have vastly different agendas, goals, and beliefs, as well as an incomprehensibly large number of possible actions. To cooperate, individuals must find the relatively small number of possible acts by which they can benefit one another. That is, they have to be able to coordinate with one another to achieve mutually desirable outcomes. Nonverbal communication is one way in which this coordination is accomplished. (For discussions, see Tooby & Cosmides, 1996; Kurzban, 1998.)

Mutual Eye Gaze

The ability to correctly assess others' intentions (and thus their likely future actions) is an important component of achieving coordination. Recent research on "theory of mind" (Baron-Cohen, 1995), hypothesized systems designed to read the intentions of others, suggests that eye gaze might play a key role in this process. Baron-Cohen (1995) has proposed that one component of the "mind-reading" system is an "Eye-Direction Detector" (EDD), which detects eyes and gauges their direction of gaze. The EDD begins a process that allows for the construction of intentional attributions about the self and another (agent A sees that I see object X) and for inferences to be drawn about other individuals' beliefs. Indeed, existing evidence suggests that eye gaze can increase cooperation, although this evidence is relatively weak and somewhat inconsistent (Hornik, 1987; Kleinke, 1977; Wichman, 1970;).

Touch

Touch affords quiet, subtle communication between individuals, and therefore the possibility of coordination. Touch might also serve a function not specifically related to coordination: it may act as a social signal of closeness of relationship. Touch is a socially important act, although the significance of touch varies from culture to culture (Remland, Jones, & Brinkman, 1995). It could be the case that being touched is a cue that one is in a close social relationship with the person touching in much the same way that the state of one's facial muscles is a cue to one's emotional state. As with eye gaze, although some evidence exists that touch can increase cooperation or compliance (Smith, Gier, & Willis, 1982; Willis & Hamm, 1980), other experiments have failed to find these effects (Bohm & Hendricks, 1997; Kleinke, 1980), or have found them only under limiting conditions (Goldman, Kiyohara, & Pfannesnteil, 1985).

Rhythm

Rhythm has the interesting property that it allows synchronization in real time. In essence, it sets up an inductive process by defining temporal spaces. By hearing three beats in a (regular) rhythm, one can infer when the fourth will be, allowing two or more individuals to begin or end some activity at the same time. Because rhythm provides a way to synchronize extremely effectively and communicate one's ability to do so, it is plausible that the appeal of rhythm lies partly in its ability to facilitate complex cooperation.

Little has been written in the psychological literature about the intuitive appeal of rhythm and its possible functional origins, although there have been suggestions that rhythm might play a role in human mating (Grammer, Kruck, & Magnusson, 1998), language learning (Kempton, 1980), and synchronizing social interactions (Condon, 1980). Perhaps more relevant, Feshbach (1994) conducted a study in which participants were asked to fill out a number of questionnaires after listening to martial music, patriotic music, or string quartets. The participants who listened to martial music (which is, of course, characterized by its heavy emphasis on percussion) scored higher than controls on a Nationalism scale. This result is interesting in the context of the possibility that adaptations for cooperation in groups are designed in part for intergroup conflict (Kurzban & Leary, 2001; Sidanius & Pratto, 1999; Tooby & Cosmides, 1988).

Communication

It has been suggested that face-to-face communication has its effect because it enhances social identity (Dawes, van de Kragt, & Orbell, 1988) or because it affords coordination (Bornstein & Rapoport, 1988). Given these possibilities, permitting communication over a computer network, a much less "social" interaction and perhaps one less likely to build social identity, and allowing no discussion of the experimental task, thus preventing coordination, might eliminate the effect that communication has on increasing contributions.

There is some precedent for the notion that communication must be relevant to have an effect. Dawes et al. (1977) found that even face-to-face discussion did not increase contributions when participants were told to discuss an irrelevant topic. This stands in stark contrast to the relevant communication condition, in which contributions increased from 27% to 74%. Very similar effects were obtained by Bouas and Komorita (1996), who replicated the finding that irrelevant conversation had no effect on rates of contribution. In a similar vein, Wilson and Sell (1997) found that communicating one's intended contribution over a computer terminal also had no effect on contributions.

Sex Differences

The cognitive architecture of males and females should be identical to the extent that each sex faced the same adaptive problem (Darwin, 1871). To the extent that males and females faced different adaptive tasks, differences in the design of the psychological mechanisms designed to solve these problems should be observed.

It seems likely that there is overlap in the problems faced by males and females in the realm of cooperation. For example, in social exchange, there is no reason to believe that the sexes differed in the degree to which gains in trade could be beneficial. On the other hand, hunting and warfare, two activities that might have driven adaptations for cooperation in groups, might have constituted different adaptive problems for men and women. There are theoretical reasons to believe that the cost/benefit structure of warfare is different for men and women (Tooby & Cosmides, 1988), and anthropological evidence suggests that both hunting and warfare are predominantly, but not exclusively, male activities (Lee & DeVore, 1968).

The existence of these different selection pressures might in part explain why, across cultures, all-male groups differ in important ways from all-female groups (Tiger, 1971; Wrangham, & Peterson, 1997). More specifically, it might be the case that the adaptations unique to males are particularly active in all-male groupings, as this might be a context in which these systems were designed to operate. Participants in the current experiment were run in all-male and all-female groups to address this possibility. Taken together, the evidence that men were more likely to be engaging in cooperative hunting and warfare along with the suggestion that these adaptive tasks require systems capable of real time spatio-temporal synchrony and coordination led to the hypothesis that there would be sex differences in the extent to which evidence of coordination will impact decisions to cooperate. In particular, it was predicted that the eye gaze, touch, and rhythm manipulations would be more effective in increasing contributions in all-male groups than they would be in all-female groups.

Evidence regarding sex differences in economic games is inconsistent (Eckel & Grossman, in press), as is the evidence regarding sex differences in the impact of the specific nonverbal behaviors investigated here (Smith et al., 1982). Very generally, the weight of the evidence might lead to the prediction that touch and eye gaze will increase cooperation more in all-female groups than all-male groups (Kleinke, 1977; Powell et al., 1994), contrary to the prediction derived from the above analysis.

In sum, the experiment described below was designed to test hypotheses based on considerations of the role that social psychophysical cues to coordination might play as relevant inputs to systems designed to decide when one should cooperate. It was predicted that (1) people in groups who engage in mutual eye gaze, touch, and tapping out rhythms would contribute more to a public good than people in groups who do not engage in any of these behaviors or engage in only extremely restricted communication, and (2) this increase in contributions would be more pronounced for male participants than for female participants.

Method

Participants

Two hundred eighty-eight participants were recruited from the University of California Santa Barbara undergraduate community. Each subject was told that he or she could earn up to $12 for their participation. The amount that each subject actually earned depended on the decisions that they and the other participants in their group made during the experiment.

Design

The experiment used a 5 (Condition: Baseline, Eyegaze, Touch, Rhythm, Communication) × 2 (Participant Sex: Male, Female) between-subjects factorial design.

Procedure

The procedure was a standard public goods game that largely duplicated that used by Marwell and Ames (1979). Participants were given a time to report to the laboratory and told that they would earn a $2 bonus if they arrived on time. Six same-sex participants were recruited for each experimental session. However, due to absences, not all groups consisted of exactly six people. If fewer than four people appeared for an experimental session, the session was canceled. Five groups were run in each of the 10 cells.

As participants arrived in the laboratory, they were seated at six computer terminals arrayed in a hexagonal configuration in the center of the room. This arrangement allowed participants to see one another but not other participants' computer screens. Once all six participants had arrived, they were asked to read the instructions (Davis & Holt, 1993) on their computer screens, which explained the nature of the public goods game and how it was to be played. They were informed that they would be playing 10 rounds of a public goods game, that they would start each round with 10 tokens, and that they would receive 50 cents per token for their average token total over the course of the 10 rounds. The instructions informed them that they could divide their endowment (in units of whole tokens) any way they chose between the two accounts each round, and that they would earn the full value of each token that they put in their Personal Account, as well as a fraction of the value for each token they and the other participants put in the Public Account. The amount they earned from the Public Account was one-third of the total number of tokens placed in this account. This information was provided in a table visible to the players throughout the experiment. After having read the instructions, participants familiarized themselves with the interface that they would be using to register their allocation of tokens to the two accounts. An undergraduate research assistant of the same sex as the participants was in the room during the course of the experiment and answered any questions that arose.

In the Baseline condition, once all participants had completed reading the instructions and indicated that they were ready by clicking on a small box on the computer screen, round 1 automatically began. Each player was prompted to indicate his or her choice of allocation of tokens to the two accounts. Once the last person had made a selection, the computer calculated the total number of tokens contributed to the Public Account and provided this information to each player. Each player saw how much they had earned for that particular round (their share of the Public Account plus their contribution to their own Private Account) and the total token contribution to the Public Account by all players. Players were not told how much any of the other players individually contributed.

Subsequent rounds proceeded similarly. The game continued for 10 rounds. At this point, the computer generated a list of the total payoffs to each individual player, and the experimenter assembled envelopes with appropriate totals out of view of the participants. Participants were paid 50 cents for every token that they earned on average over the course of all 10 rounds. Participants were called by the experimenter individually, given their envelope with their cash payment, debriefed, and dismissed. Participants in the baseline condition were in the laboratory for about 20 minutes. Participants in the experimental condition were in the lab slightly longer, but always less than 30 minutes.

Experimental Manipulations

In each of the experimental conditions, a manipulation was added before each round began. In the oblique *Eyegaze* condition, participants were instructed that they were to look obliquely[1] into the eyes of the players next to them for 3 seconds before each round. The text of the instructions was as follows:

> Before you make your contribution decisions each round, we are going to ask you to make eye contact with other members of your group. All you will need to do is, at the appropriate time, shift your eyes to the left or right (you will be told which) to meet the gaze of the person next to you, who will similarly be moving their eyes to look toward you. While you do this, keep your head as still as possible, turning only far enough so that you can see the person next to you out of the corner of your eye. In addition, please try to keep your expression neutral.

The computer coordinated the eye gazes with a series of countdowns and beeps. Before each eye-gaze, participants saw a three-second countdown and were instructed to turn when the countdown reached zero. One half of the participants (in every second seat) were directed to look right first, and the other half were first directed to look left. After this, participants performed the same procedure, but in the opposite direction. In this way, each participant matched gazes with the person to their right and to their left. In the few cases in which fewer than six participants were present, participants were still directed to look in the appropriate direction, even if there was no one in the direction that they were looking. After the sequence was complete, participants were prompted to indicate their allocation decision.

In the *Touch* condition, the procedure was similar except that instead of gazing at one another, participants were told to touch one another lightly on the shoulder. This was accomplished by having participants mimic the game "telephone":

> Before each round, we are going to ask you to play a version of a game sometimes called "Telephone." One of the members of your group will be selected to begin. They will be shown a number on their computer screen between 1 and 5. The goal is to communicate this number to every other member of the group. However, the only way you are allowed to communicate is by tapping your neighbor (lightly) on the shoulder or arm. Tap once for one, twice for two, and so on.

At the beginning of each round, one participant was randomly selected by the computer to begin, and the direction that the telephone game was to proceed was also randomly determined. When the last player had indicated the communicated number by entering it into the computer, participants were prompted to make their allocation decision.

In the *Rhythm* condition, participants had two opportunities to hear a rhythm played by the computer and were then directed to tap out the rhythm in synchrony with the other participants. Each rhythm consisted of eight or nine taps, and lasted roughly 3 seconds. Participants saw the following instructions:

> Before each round, we are going to ask you to tap out a simple rhythm. Once everyone is ready, the computer will start a short countdown. You will see numbers counting down and hear beeps once per second. When the countdown reaches zero, you will hear the rhythm. Simply listen while the rhythm is being played. Next, the computer will begin another countdown and play the rhythm a second time. After the rhythm has played twice, the countdown will begin a third time. When it reaches zero, copy the rhythm that you heard, tapping it out on the desk in front of you. This time, the computer will not be playing the rhythm along with you. So that everyone starts tapping simultaneously, use the beeps to determine when to begin tapping.

Five different rhythms were used in a preset order. The five rhythms were played in this order in the first five and the last five rounds of the game. The computers were set to prompt participants to make their allocation after sufficient time had elapsed to allow them to tap out the rhythm.

In the *Communication* condition, participants had the opportunity to type messages to the other players for 30 seconds prior to each round. Participants saw six boxes on their screen, each one containing the messages typed by one of the other participants. Where each participant's messages were placed was randomized between rounds. Pre-testing showed a tendency for participants to send messages about the content of the game despite explicit instructions not to do so. To strengthen the directive not to send messages about the content of the game, a notice that they were being recorded (which they were) and monitored (which they weren't) was added to try to encourage compliance with the rule that the game not be discussed. The instructions were as follows:

> After all players have indicated that they are ready to begin each round, a countdown clock will begin. You will have thirty seconds to send notes to the other players in the room. Every player will see everyone else's notes. You may type whatever you wish, EXCEPT you MAY NOT SEND ANY NOTES ABOUT THE GAME YOU ARE PLAYING. That is, YOU MAY NOT ASK OR ANSWER ANY QUESTIONS ABOUT ALLOCATING TOKENS OR ANY OTHER ASPECT OF THE GAME. You may discuss anything else you wish. Note that everything you type is being monitored and recorded.

After thirty seconds had elapsed, participants were prompted to make their contribution decision.

Results

The dependent variable was the number of tokens that participants, on average, contributed to the Public Account. For simplicity, the effect of time was investigated by splitting the game into two sets of five rounds. A 5 (Condition: Baseline, Eyegaze, Touch, Rhythm, Communication) × 2 (Participant Sex: Male, Female) × 2 (Time: First Half, Second Half) mixed factorial ANOVA was performed with time as a repeated measure (see Table 1).

The primary hypotheses of interest concerned the effect of the experimental manipulations relative to baseline for each sex. So, although the three-way interaction between time, condition, and participant sex was not significant, $F(4, 283) = 1.64$, $p = .16$, two separate 5 (Condition: Baseline, Eyegaze, Touch, Rhythm, Communication) × 2 (Time: First Half, Second Half) ANOVA's for male and female participants were conducted with time as a repeated measure. Results of this analysis for male participants revealed a main effect for time, $F(1, 134) = 47.40$, $p < .001$, with contri-

TABLE 1

Mean (Standard Deviation) Contributions in Tokens by Sex and Condition

		Contribution		
Condition	*n*	All Rounds	First Half	Second Half
Male Participants				
Baseline	27	3.06 (1.88)	3.85 (2.40)	2.27 (1.72)
Eyegaze	27	4.39 (1.91)	4.94 (2.35)	3.83 (1.94)
Telephone	28	4.18 (2.31)	4.44 (2.55)	3.92 (2.31)
Rhythm	27	3.81 (2.32)	4.47 (2.39)	3.14 (2.48)
Communication	30	4.76 (2.54)	4.93 (2.62)	4.59 (2.69)
All Conditions	139	4.05 (2.26)	4.53 (2.46)	3.58 (2.37)
Female Participants				
Baseline	29	4.02 (1.88)	4.42 (2.10)	3.62 (1.85)
Eyegaze	29	4.00 (1.34)	4.17 (1.22)	3.83 (1.71)
Telephone	29	4.17 (1.65)	4.37 (1.63)	3.97 (1.86)
Rhythm	27	4.25 (1.64)	4.65 (1.65)	3.85 (1.81)
Communication	36	4.81 (1.81)	5.17 (2.07)	4.45 (1.99)
All Conditions	150	4.25 (1.69)	4.58 (1.79)	3.97 (1.85)

butions decreasing from the first half to the second half of the game, a marginal main effect for condition $F(4, 134) = 2.36$, $p = .056$, and an interaction between condition and time, $F(4, 134) = 2.88$, $p < .05$. To interpret this interaction, contributions were examined separately for each half of the game. In the second half of the game, mean contributions differed from Baseline in the Eyegaze, Communication, and Touch conditions (all p's $< .05$), with contributions in the Baseline condition lower than in the experimental conditions. There were no significant differences between Baseline and experimental conditions in the first half of the game, and there was no evidence of any effect of the Rhythm manipulation (see the top half of Table 1 for means).

Looking at the marginal condition main effect only as a point of possible interest, Dunnett tests with Baseline as the control condition indicated that, for males, contributions in the Eyegaze and Communication conditions were significantly higher than contributions in the Baseline condition (both p's $< .05$) and that contributions in the Touch condition were marginally higher than contributions in the Baseline condition, $p = .10$. Mean contributions in the Rhythm condition were not significantly different from mean contributions in the Baseline condition.

Similar tests for female participants revealed a main effect for time, $F(1, 144) = 29.47$, $p < .001$, with contributions decreasing from the first half to the second half of the game. There was no main effect for condition, and the interaction was non-significant.[2]

Of secondary interest, the three-way ANOVA described above revealed a significant interaction between time and condition, $F(4, 283) = 2.61$, $p < .05$. Breaking this interaction down, a one-way ANOVA on mean contributions from the first half of the game yielded no main effect for condition, ($p > .20$), whereas a similar ANOVA on the mean contributions from the second half of the game yielded a significant main effect for condition, $F(4, 283) = 4.52$, $p < .005$. Dunnett tests with Baseline as the control condition indicated that this effect was driven by significant differences in the second half of the game between the Baseline condition ($M = 2.97$) and the Eyegaze ($M = 3.83$), Touch ($M = 3.95$), and Communication conditions (M = 4.52), with contributions being lower in the Baseline condition (all p's $< .05$). There was no significant difference between contributions in the Rhythm ($M = 3.50$) and Baseline conditions.

Finally, the three-way ANOVA also indicated an interaction between time and participant sex, $F(1, 283) = 4.08$, $p < .05$. This interaction derives from the fact that male contributions fall off faster than female contributions (see Table 1 for means).

Discussion

Three experimental manipulations, Eyegaze, Communication, and Touch, effectively increased male contributions relative to the Baseline condition. In large measure, these effects were driven by contribution decisions in the latter half of the game. One experimental condition, Rhythm, had no detectable effect on contribution rates. There was no evidence that any of the experimental manipulations increased contributions for female participants. In fact, average contributions for females across conditions were strikingly similar to one another.

Contrary to predictions, contributions increased for males in the Communication condition. However, there is evidence that male participants did not obey the restriction that they not discuss the game itself in their communications. Statements recorded from this condition included: “Lets all give 10 to the [public] account and get paid 20 tokens,” “All unite and go big [and] we make out like villains,” and “Let’s attack the psych guy and just take all the money!” Comments of this variety were not found in records of conversations among females. Despite specific instructions to the contrary, male participants discussed the game and solicited contributions. This might explain in part the higher contribution rates of males in this condition. Given the difficulties in the present study with compliance with the rule that the game not be discussed, it would be premature to reject the hypothesis that communication on an irrelevant topic over a computer network does not increase cooperation. Additional work, perhaps using a method that ensures compliance with the rules, will be needed to give this hypothesis a thorough test.

The lack of increase in male contributions in the Rhythm condition is interesting and counter to predictions. It does indicate, however, that not just any manipulation will increase contributions above the Baseline condition for male participants. One potential explanation for the failure in this condition comes from observations on the part of the research assistant conducting the individual sessions. Apparently, participants were often unable to tap out rhythms in synchrony with one another, particularly in the first five rounds of the game. If participants were out of sync, perhaps this was a cue to the *lack* of coordination, as opposed to a cue to its presence. Although the predictions for the rhythm condition were not borne out, this route might still be worth pursuing. Further care should be taken in subsequent studies to ensure that participants can tap the rhythm in synchrony. The use of simpler or familiar rhythms or more practice trials are potential solutions to this difficulty.

Situating the Findings

Although the vast empirical efforts using the public goods paradigm have generated a number of models (Ledyard, 1996), few if any of these would seem to predict the results reported here. Clearly, pure game theoretic accounts, which predict that players are responsive to incentives (Rapoport, 1988), are inadequate, as contributions changed across conditions while structural parameters were constant.

Theories that emphasize the role of communication apply only to the condition with the virtual chat room. The effectiveness of this type of communication for male participants, who discussed the game, but not female participants, who did not, combined with previous findings that irrelevant communication does not always have the effect of increasing contributions (Bouas & Komorita, 1996; Dawes et al., 1977) indicates that the propositional content of the communication might be a key factor in explaining its effectiveness. This implicates coordination as an explanation for the success of communication in eliciting cooperation in a public goods setting.

Perhaps more relevant to the current studies are theories that emphasize the social aspects of the public goods problems. Much of this research has been driven at least in part by social identity theory (Tajfel & Turner, 1986). For instance, Brewer and Kramer (1986) found that participants cooperated more (under certain limiting conditions) when a group identity manipulation was used, a finding replicated by Wit and Wilke (1992; but see Bouas & Komorita, 1996). Chen (1996) similarly found that social identity plays some role in eliciting contributions, but argued that it alone is not sufficient for doing so.

The current results do not fit precisely into this general context. Social identity theory does not predict (at least explicitly) that the social psychophysical cues used here have any bearing on social identity—the classic precursors to social identity are factors such as similarity, proximity, and common fate. In addition, the theory does not predict that the precursors of social identity should differ by sex (see Gaertner & Insko, 2000, for a recent discussion).

Is it possible that these nonverbal behaviors increased social identity in males but not females? A functional view of social identity might help explain why this could be the case. Social identity, first developed in the context of ingroup favoritism in allocation of rewards (Tajfel, Billig, Bundy, & Flament, 1971) seems closely related to the issue of within-group cooperation. Social identity can perhaps profitably be thought of as an internal psychological parameter that plays a role in deciding the extent to which one is in a potentially cooperative group.

If, as suggested above, the nature of cooperative activities males and females engage in are different, the qualifications of a good cooperator should also vary by sex, as should the variables that influence the social identity parameter. This view suggests that these nonverbal behaviors are pushing the social identity parameter around because they predict the potential for cooperation better for all-male than all-female groups.

This points to two important components of future work in this area. First, in terms of theory, thought needs to be given to other nonverbal behaviors that might have a differential impact on cooperation rates in males and females. Particularly important would be manipulations that show the reverse effect of the ones shown here. One possibility is to have participants engage in direct rather than oblique eye gaze before making contributions. Direct eye gaze, implying threat or dominance rather than conspiracy (Kleinke, 1986), might have the opposite effect of oblique eye gaze, and therefore decrease cooperation rates for males more than for females.

Second, methodologically, additional dependent measures should be incorporated to determine if these manipulations are building social identity as measured by existing scales (Luhtanen & Crocker, 1992). Examining the nonverbal behaviors in males and females that act to facilitate or inhibit the acquisition of social identity constitutes an interesting area of inquiry in its own right, and could be pursued outside the context of the social dilemma method used here.

It is, of course, important to remember that these nonverbal behaviors were elicited from participants, rather than being spontaneously produced. While this calls into question the ecological validity of the experiment, the finding that the manipulations nonetheless had an effect speaks to the modularity of the perceptual and inferential systems involved and to the power of nonverbal behaviors themselves. Apparently, even non-voluntary nonverbal behavior on the part of others can influence one's own judgments and behavior.

Conclusions

The findings reported here are both encouraging, and, in some sense, alarming. They are encouraging in that team building and cooperation in groups of males might be turn out to be a relatively easy process to facilitate. Subtle cues seem to induce males to increase the extent to which they are willing to sacrifice a portion of their own gain to benefit the rest of the group. Females, in contrast, appear to be relatively indifferent to these particular nonverbal behaviors.

This finding is alarming in that it seems that males are ready to accept extremely scant evidence that they are in a meaningful group capable of cooperating. If indeed male psychology is well designed for cooperating because of adaptations for intergroup conflict (Kurzban & Leary, 2001; Sidanius & Pratto, 1999; Tooby & Cosmides, 1988), then the ease with which males form cooperative associations is also the ease with which males can form groups for the purpose of intergroup conflict. This analysis suggests it is extremely important to understand both the precursors and consequences of group formation.

Notes

1. Because direct eye-gazes could be interpreted as threatening, oblique eye-gazes were used.
2. Although sex differences were predicted only in the impact of the experimental manipulations on contribution decisions, an exploratory test was run to determine if contributions in the Baseline condition differed between male and female participants. This analysis is post-hoc, included merely as a point of interest. This t-test yielded a marginally significant difference, $t(54) = 1.907$, $p = .062$ (two-tailed), with female contributions higher than male contributions.

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