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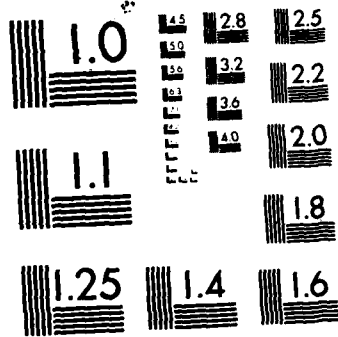
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Psychological and system variables in team problem solving:
Experimental studies of computer-mediated participation

Philip G. Zimbardo

Joan A. W. Linsenmeier
Stanford University

Peter G. Smith

Loren G. Kabat
Health Sciences Center, State University
of New York at Stony Brook

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We argue for the potential value of studying computer-mediated message systems and for their use as remedial interventions to help balance inequities in participation caused by learned patterns of inhibition, dominance and deference. Suggestions for future research utilizing this system are also presented.

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Psychological and system variables in team problem solving:
Experimental studies of computer-mediated participation¹

Philip G. Zimbardo

Joan A. W. Linsenmeier
Stanford University

Peter G. Smith

and

Loren G. Kabat
Health Sciences Center, State University
of New York at Stony Brook

Abstract

A computer-mediated message handling system was developed and refined over the course of three experiments. Turn-taking rules and informational prompts (on-going feedback on rates of participation) were systematically varied during discussions held by four-person experimental teams engaged in problem-solving activities. Variations in shyness (or communication apprehension) and gender composition of the teams were found to influence the process of team problem solving. The extent of individual participation, perceptions of and social-emotional reactions to the group, and the quality of team decisions were modified in some instances by our interventions.

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Many work situations are organized around the activities of individuals working together in teams. For example, "each Navy ship comprises several closely integrated teams that contribute to command decision-making" (Thorndyke & Weiner, 1980). Sometimes teams simply carry out the instructions and commands of team leaders. Often, however, team members themselves help to decide what functions they will carry out, when they will perform them, and how responsibilities will be divided and efforts coordinated. For some teams, their main task is to make decisions. Government panels study issues and set policies, and boards of directors determine the actions to be taken by the corporations they head. Because of the degree to which team performance influences organizational effectiveness, we need to learn more about what factors affect how well teams perform their tasks.

The quality and utility of team decisions depend on at least three types of variables: characteristics of the team task; characteristics of the communication system used by the team; and social and personal characteristics of team members. Important task characteristics include task difficulty and structure, availability of feedback, and time stresses. Key characteristics of the communication network include patterns of information transmission and features of the medium through which information is transmitted (e.g., whether people meet face-to-face or use a telecommunication system). Personal factors include individual differences in skills, motivation, and response style, while social factors involve relationships among individuals, such as roles, relative status, shared history, and group cohesiveness.

These personal-social factors become especially important when dealing with a team whose life extends beyond the performance of a specific and limited task. Most laboratory research on teams has focused on people who come together as strangers, work intensely on an arbitrary task and then part permanently an hour or so later. Among real-world work teams, however, the members usually continue to interact over an extended period of time. They may work on a series of similar, job-related tasks or start to meet in unrelated, social settings. Over time, the team becomes important in the lives of its members, affecting their values, their feelings, and their behavior. Two important effects, for those concerned with team performance, are the evolution of members' feelings about each other and about their mutual activities. Such factors as team morale and cohesiveness have long-term effects on members' commitment to and effort on team tasks.

Our research has addressed the question of how to improve team decision-making within a paradigm that provides information about task, communication, and social-personal factors. We began with the operating assumption that procedures which balance and equalize participation levels within a team will also affect the quality of team products and the tone of members' feelings. We hypothesized that techniques for "democratizing" team participation would improve team performance and also raise team morale.

Hare's (1976) review of literature on small groups noted that "perhaps the most consistent finding in all of the research on social interactions is that some people talk more than others" (p. 82, italics

in original). Similarly, Mansbridge (1973) commented that a recurring problem in groups trying to reach decisions by consensus is "the persistence of ingrained inequalities of influence" (p. 351). Many individuals have developed a response style characterized by minimal participation in particular group settings. Some of these individuals have a reinforcement history in which their ideas and contributions were not regularly acknowledged, accepted, or praised by the groups they were in. Others have learned to defer to authority, to expect dominant team members to take the initiative, while they themselves either follow or reject plans proposed by more active members. In some cases, such individuals make immediate social comparisons within their team, typically judge themselves to be less adequate than others in the skills requisite for the task at hand, and adopt a secondary status. Those with chronic low self-esteem tend to denigrate their potential contributions before they are ever publicly advanced. They feel that whatever they have to say is not really worth saying, and so they keep it to themselves.

While some people are relatively quiet across most situations, regardless of the circumstances, the level of participation of other people varies from setting to setting. Thus, for example, some members of racial and ethnic minorities may show depressed levels of participation in a team composed largely of majority group members. Males may feel uncomfortable voicing their opinions in a discussion of a traditionally female-oriented topic, and females may show atypically low levels of participation when the topic being discussed represents a traditionally masculine domain. In addition, a person may be inhibited by the mere presence of individuals of the other sex or by individuals with higher social, organizational, or educational status. Characteristics of the communication setting may confer advantages on certain participants. Some people may have greater access to the attention of others. Also, system and personal factors may interact, and people with different response styles may be more effective with different communication media. For example, people who communicate effectively in writing may feel awkward and inhibited when speaking face-to-face (see Johansen, Vallee, & Collins, 1978).

What are the consequences of the failure of certain members to participate fully in a team's decision-making process? Bales (1950, 1954) has suggested that there are certain advantages to having some members in a group who tend to say little. Their presence can make the discussion go more smoothly than it would if members were constantly vying for the chance to voice their ideas. But, as Bales points out, there is another side to this reticence. "Groups composed of all lows [low participators] may find themselves short on ideas" (1954, p. 49).

One advantage of groups over individuals is that groups can draw on a wider range of talents, viewpoints, and ideas. It is not sufficient, however, for a team member to simply have an idea or possess information that will be useful to the group as a whole. Brillouin (1962) distinguished between "absolute" information, which at least one person possesses, and "distributed" information which is more generally available to more people. Both what is known and who knows it are crucial for the functioning of an organization. If good ideas or useful information are not shared with others, or not presented forcefully enough, they will not

be used, and the advantage of that member's presence will have been lost (Shaw & Penrod, 1962). In addition, low participators may especially refrain from offering opinions in opposition to those expressed by the more dominant group members, and there is evidence that having dissenters express their views can improve a group's decisions (Maier & Solem, 1952; Ziller, 1955). Research on higher-level decision-making has shown that where there is excessive group solidarity without room for dissent, the possibility exists for generating "group-think" solutions that may be nonoptimal, or even pathological (Janis, 1972; Janis & Mann, 1977). Thus it seems that techniques which increase the participation levels of people who are typically reticent in group discussion situations are likely to improve the quality of group decisions.

Increasing the participation levels of these typically reticent individuals may also affect group members' feelings about their group experience. Research has shown that those who talk more during group discussions have more influence (Leavitt, 1951; Riecken, 1958) and that greater influence is associated with greater satisfaction as well (Leavitt, 1951; Haythorn, 1953; Gerard, 1957). Increasing the contributions of low participators may lead them to view themselves as more important to the group and consequently improve their morale (Bavelas, et al., 1965). They can feel more involved and receive increased rewards and respect as a consequence of their greater input. As we have mentioned above, these byproducts may prove especially beneficial in a team which interacts repeatedly over an extended period of time.

While we have hypothesized that democratizing team participation will have a range of beneficial effects, we should note that alternative predictions are possible. For example, decreased participation by those who normally dominate discussions might lower their morale and thereby be detrimental to the team. Another obvious point, often overlooked, is that while sheer amount of input may be crucial to feelings of influence, it is quality and not quantity of ideas that determines how good a team decision will be. We have assumed that people who fail to participate fully in team discussions are inhibited by some suppressing force, but are similar to their teammates in most other ways. Sometimes, of course, those who say less really do have fewer useful things to say. Also, people who are not accustomed to sharing their ideas may be considerably less effective at presenting them. In addition, differences in communication styles may be linked to differences in cognitive structure. People who talk less may be "set" to receive and process information, rather than to transmit it. They may carefully sort through incoming information and slowly frame a response instead of knowing how to respond quickly and, in essence, thinking out loud. Permitting such individuals to voice their thoughts only infrequently may, in fact, be the best way to make efficient use of their unique skills. Furthermore, structuring the communication setting in a way that disrupts their usual mode of response may cause feelings of discomfort rather than, or in addition to, feelings of greater influence and involvement.

Most of the studies in our research program have made use of a teleconferencing system. Whenever two or more people are "wired together" so that they may communicate, a teleconference occurs. Pairs of individuals, small work teams, or larger committees may "come together" to

discuss factual issues, resolve conflicts, or discuss problems of common concern. They may do so without leaving their home bases, thus saving travel time and maintaining access to local resources (libraries, files, assistants, etc.). The use of teleconferencing is becoming increasingly common in our society. For example, AT&T has persuaded business organizations to install private Picturephone rooms throughout the country, and its Picturephone Meeting Service was made available to the general public this year (Newsweek, 1982). It is therefore important to learn how the use of such telecommunication systems affects team functioning and outcomes. While several dozen experiments have compared the effects of general classes of telecommunication media (e.g., audio-and-video systems, such as the Picturephone, versus audio-only systems—see Chapanis, 1975 for examples of this research), few have compared different systems of the same general type (Williams, 1977). In our own research, however, we have focused on a particular audio-only system and varied specific details of its operation.

In his discussion of human factors in teleconferencing, Feehrer (1980) commented that an important problem which must be considered in the design of any audio telecommunications system is how to decide what sounds should be transmitted when more than one participant wants to speak. Perhaps the simplest solution, which Feehrer describes as a "bridge" system, is to transmit all speakers' voices simultaneously. This "cocktail party" solution is likely to be unsatisfactory, however. Listeners hearing multiple speakers at the same time will have trouble determining who is talking and, more importantly, what they are saying without some form of selective attention filter. Another solution, adopted in our research, is to transmit only one voice at a time. But then the question still remains: Whose voice should be transmitted when more than one person wants to talk? According to expert opinion (Johansen, Vallee & Spengler, 1979, p. 14) "perhaps the toughest problem in audio conferencing is the issue of order of speaking."

Speech exchange systems also pose problems in ordinary conversations. How should speaking turns be distributed? Who should talk when, and for how long? Who should follow the current speaker? These are fundamental problems in any conversation among several speakers. Communication theorists describe a talking turn as a valued right to speak allocated to a given person. Turns are often sought, but may also be avoided by some members of a group. The distribution of turns in conversation has been analyzed as a kind of social-power economy (Sacks, Schegloff & Jefferson, 1974).

Informal systems often emerge to determine the turn-taking procedures within a group. In normal, face-to-face settings people can gain the floor through a variety of verbal and nonverbal techniques (Markel, 1975; Duncan, 1972). For example, they may raise their hands or loudly interrupt the current speaker. Those who feel less comfortable engaging in these assertive behaviors, or are less aware of or skilled in effective intervention techniques, will, as a consequence, participate less often. For example, research on sex roles and conversational patterns reveals a marked asymmetry: males interrupt females often, while females rarely violate a male speaker's right to complete a talking turn (Zimmerman & West, 1975). Our audio telecommunication system was designed in an effort

to counteract such imbalances. Participants indicated a desire to speak through the unambiguous and simple act of pressing a request-to-speak button. An automatic parliamentarian built into our computerized system was programmed to choose a speaker from among competing requestors according to specified turn-taking algorithms (see Stodolsky, 1976).

Another special feature of our telecommunication system was the ability to carefully monitor participation levels of all team members. This participation information could then be made available as "on-line feedback" to the team. Some people may routinely keep track of how much they and others are contributing to a group discussion, of who is dominating the discussion and who is talking less. Others, however, are relatively insensitive to their own participation levels and those of their teammates. With our system, we were able to provide all team members with up-to-date information on how much each of them had spoken (termed "informational prompts"). We could then see how this feedback on the degree to which participation was democratically or unequally distributed affected subsequent behaviors and interactions of team members.

Most of the teams which participated in our research were arranged so that, in the absence of special interventions, participation levels would be unequal. One of the social-personal variables which affects how much people speak during group discussions is their level of shyness. Shy people tend to defer to others in social situations. When deciding whether to speak, their estimates of what might be gained are often outweighed by their fears of potential negative consequences, especially the costs of rejection (Zimbardo, 1977). Studying teams composed of both shy and not-shy individuals ensured the presence of a general tendency toward inequality against which our manipulations could be measured. Since a relatively large proportion of the population (about forty percent) define themselves as shy, the operation of shyness as a communication inhibitor is likely to be common in many team settings.

At different stages of our research we have focused on different consequences of our experimental interventions. Throughout our research program we have directly measured participation in team discussions—how often and for how long team members speak and, where appropriate, how long they spend actively requesting a chance to contribute. Another dependent variable has been the quality of team decisions. We have compared decisions made by our teams to decisions made by task experts. Finally, we have looked at a variety of measures reflecting members' perceptions of and responses to the process through which their team decisions were reached. For example, team members were asked to assess their own and others' contributions and to report on emotions felt during team discussions. We expected that our set of interventions would reduce differences in participation levels, improve decisions, and lead to more favorable perceptions of the team experience.

This paper presents a series of three studies. A second technical report (Z-82-02) presents two further studies in our research program. All three studies reported here employed an audio telecommunication network which experimentally-created teams used while engaged in problem-solving tasks. Common to all the studies was the constraint

imposed on "free" participation in team discussions by a computer-mediated turn-taking procedure. Two different turn-taking rules were programmed into our system, and one or both appear in each of the teleconferencing studies. Group composition was systematically varied within and across studies, as we compared teams with different levels of shyness (or communication apprehension) and teams varying in gender. The tasks for all but the first study were simulated survival situations; teams made decisions regarding the priority and value of particular strategies, problems, and salvaged items. All studies were carried out in a laboratory setting, which was progressively refined over the three years of our research program. Each of the three studies in this first phase of our research will be presented individually, after which the entire body of findings arising from this new approach will be discussed.

Introduction to Study One

The initial, exploratory study in our research program was based on a novel methodology developed by David Stodolsky for his dissertation research (Stodolsky, 1976) and was reported earlier (Stodolsky, Bascom, & Zimbardo, 1979). The research focused on the effects of a particular turn-taking rule used to resolve conflicts among team members who wished to address the team at the same time. Because we felt that equalizing participation levels would have a number of beneficial consequences, we concentrated on a rule specifically designed to minimize differences in how much people spoke. A computer integrated into our telecommunication system kept a cumulative record of how much speaking each team member had done. Whenever team members wanted to speak, they signalled this desire to the computerized system. If no one were talking and more than one person wanted to speak, the system chose the next speaker using an equal timesharing (EQTS) rule. The automated parliamentary program checked to see which of the individuals waiting to speak had spoken least thus far and then automatically selected that person to be the next speaker.

The EQTS rule made it easier for people who spoke little initially to get a chance to contribute more. At the same time, people who had already spoken a great deal were not given another chance until others wishing to speak had had their say. This same sort of rule is sometimes used informally by leaders of face-to-face groups. For example, heads of work teams sometimes directly solicit contributions from reticent team members, and faculty members conducting college seminars sometimes ask students dominating class discussions to hold back.

In addition to looking at the influence of this system variable on team interaction and performance, we also looked at the consequences of member differences in general response style. As we have discussed above, an important factor influencing the degree to which people participate in group discussions is their level of shyness. Communication apprehension is a variable closely related to shyness; it is considered by communication researchers to be its "conceptual twin" (Parks, 1980). The two constructs also have been shown to overlap considerably with reticence and unwillingness to communicate (Kelly, 1982). The most commonly used measure of communication apprehension is the Personal Report of Communication Apprehension (PRCA) developed by McCroskey (1970) to measure individuals' self-perception of how uncomfortable they feel about speaking in front of others. Teams in the present study were set up so that they would differ from one another with respect to the PRCA scores of their members. Some teams contained only individuals with very high scores, some only members with moderately high scores, and so forth. We were interested in seeing how these teams would differ and, especially, in whether they would be affected differently by their experience with our EQTS rule.

Method

Subjects and experimenters

Fifty-two male undergraduates enrolled in Stanford University's introductory psychology course participated in this study. They received

\$3.00 plus credit toward their course research requirement in exchange for their participation. The experimental sessions were conducted by a male research associate and a male undergraduate assistant.

Procedure

Teams of four students were scheduled for each experimental session. When all four students had arrived at the laboratory, they were seated at separate subject stations, each equipped with a computer terminal and a special signal button, a microphone, and earphones.

The experimenter briefly explained to participants the procedure they would be following and then asked them to read some printed instructions. These oral and printed instructions informed participants that they would be working on a problem-solving task in which they would have to correctly select and order four out of six objects. They were told that they would be making a series of guesses individually, but that there would also be special conference periods during which they could share information and ideas about how to solve the problems. To increase their motivation they were also told that the team whose members used the best strategies would receive a cash prize.

Team members were told that when they wanted to speak during a conference period, they should press their signal buttons. This would send a signal to a computerized system indicating their desire to speak. Whenever no one was speaking, the computer would select the next speaker from among those requesting a turn. The name of the person selected would be shown on the computer display screens of all four members, and that individual could then speak to the others through his microphone. Participants were informed that whenever more than one person wished to speak, the next speaker would be chosen according to an equal timesharing rule—whoever had spoken least thus far would be given the next opportunity to speak. Participants were also told to continue to hold down their signal buttons until they had actually finished speaking.

The computerized system kept track of how much each person had spoken as well as who was speaking or requesting to speak at any given time. Whenever no one was speaking, it used the EQTS rule to select a new speaker from among those requesting a chance to participate. If no requests were made during a specified length of time, the conference period was automatically terminated.

Because it was physically possible for team members to speak to one another at times other than official conference periods, or when the computer had chosen someone else to speak, the research assistant closely monitored each session to enforce the proscription that no one speak out of turn. Each session lasted for about 80 minutes. At the end of the session team members were told about the aims of the research and paid for their participation.

The problem-solving task. The tasks on which team members worked were logic problems patterned after a popular game called Mastermind (marketed by Invicta Plastics Limited). Participants had to guess what sequence of four colors their opponent, the computer, was "thinking of."

The game proceeded through a series of trials. Individuals entered their guesses on their computer terminals, had a chance to discuss their choices and strategies during a conference period, and then saw a clue presented by the computer. Then, a new trial (guess-discuss-get clue) began. Conference periods were terminated after a fixed period of time (or when no team member wanted to speak), and each game was terminated after participants had made four guesses. Teams played three games in all, each involving a different "correct" sequence of four colors.

The clues presented to team members were a preset sequence of guesses supposedly made by a robot, along with feedback indicating how accurate these guesses were. The feedback indicated how many of the correct colors the robot had selected, as well as how many were in the proper ordered position. (No such feedback was given on team members' own guesses.) The robot always demonstrated an optimal strategy, i.e., one which used all information given by previous clues.

Independent variable

The one independent variable in this initial, exploratory study was the shyness level of the participants. Individuals were selected to participate in this research, and assigned to teams, based on their PRCA scores (McCroskey, 1970). This measure was part of a battery of questionnaires given to all students in the introductory psychology course. Four quartiles were formed, and each team included individuals from only one quartile. Thus, while shyness level varied from group to group, the members of any single group were relatively homogeneous with respect to this variable. Four groups of very shy men, three of moderately shy men, three of moderately assertive (not-shy) men, and four of very assertive men participated. Most groups included four individuals. However, due to scheduling conflicts, plus the failure of some students to keep their appointments, four of the groups included only three men.

Dependent variables

Two types of dependent measures were obtained in this study. The first involved a quantitative index of the extent of participation in conference period discussions. The computer kept a record of both how much time each team member spent talking and how much time each spent pressing the signal button while waiting for a chance to speak. Based on the sequence of events in each team, it was also possible to calculate a number of more complex measures, such as how often requests to speak were actually granted. In addition, problem-solving performance data were collected to indicate how well each team did on the experimental task. The computer kept track of all guesses made by team members as they tried to solve the problems with which they were presented. These guesses were then scored to determine the degree to which they deviated from an optimal problem solving strategy, one which best utilized all available information.

Results

Effects on participation

One important dependent variable calculated by our computerized system was the amount of time individual team members spent requesting to speak, i.e., the number of seconds which elapsed between the time a person pressed his signal button to indicate his desire to speak and the time the computer granted his request and displayed his name as the next speaker. A repeated-measures analysis of variance carried out on individual scores for this measure indicated that those differing in shyness level also differed in their total request time ($F(3,48)=11.13$, $p<.001$); moreover, the pattern of these differences changed over time ($F(6,96)=5.04$, $p<.001$). As can be seen in Figure 1, on the first problem solving game,

Insert Figure 1 about here

the total amount of time participants spent requesting to speak corresponded directly to their shyness level. Very shy individuals spent the least amount of time requesting to speak; moderately shy individuals spent, on the average, about five seconds more; moderately assertive (or not-shy) individuals spent slightly more time than that; and, finally, very assertive individuals spent the most time requesting. The assertive groups and the very shy group maintained their relative levels across the three games, with the assertive individuals showing some decrease in their willingness to wait for a chance to talk and the very shy individuals consistently spending only a small amount of time waiting to talk. The behavior of the moderately shy individuals, however, deviated markedly from this pattern. Their total request time steadily increased across the three games so that, by the third game, they were spending four times as many seconds as the highly assertive participants holding down their request buttons and waiting for a chance to participate in the group discussion. Clearly, increased exposure to our equal timesharing paradigm and increased experience with the experimental task were associated with a continued increase in the motivation of moderately shy individuals to participate more fully on this team problem solving task.

Analysis of the total amount of time that team members actually spent talking, as opposed to waiting to talk, indicated that, on the average, those who spent more time waiting to talk ended up doing more talking. Not surprisingly, the least talking was done by participants in teams composed of four very shy individuals ($\bar{X}=54$ sec.). The most talking occurred in moderately shy groups ($\bar{X}=167$ sec.), but this amount was not significantly different from the amount done by highly assertive individuals ($\bar{X}=164$ sec.). Moderately assertive individuals did an amount of talking intermediate between these two extremes ($\bar{X}=90$ sec.).

One other measure of participation which yielded different values for individuals differing in their shyness was the number of requests not granted, i.e., the number of times that a person requested to speak, but

did not receive a turn because the conference time ran out before those ahead of him had finished speaking. Like their total request time, the total number of ungranted requests of moderately shy individuals also steadily increased during the experimental session. The values for the other groups, however, remained at a steady low level. Thus, one potential disadvantage of encouraging moderately shy individuals to participate in group discussions is that, in a setting where only one person can speak at a time, a greater desire to participate may lead to greater frustration and, perhaps, greater antagonism towards other team members whose own participation prevents you from having your say.

Effects on performance

Analysis of the quality of the guesses made by participants within each shyness level revealed an unexpected pattern of results. The moderately shy men, whose participation rate improved most over time, performed worst on the logic task. Variability across teams, games, and our two performance measures (use of information on color and use of information on location) kept these results from being statistically significant. Still, it is noteworthy that on both performance measures for the final game, the moderately shy teams made the poorest scores ($\bar{X}$ = 4.41 for the moderately shy, 4.78 for the very shy, 5.20 for the moderately assertive, and 5.27 for the very assertive; scores are means for the two performance measures and higher scores are better). While our novel equal timesharing paradigm encouraged moderately shy individuals to participate more in group discussions, it did not benefit the quality of their performance on the task at hand.

Discussion

Three important conclusions can be drawn from the results of this initial study. First, the PRCA measure used as an index of shyness successfully reflects differences in behavioral tendencies in our experimental situation. The ordering of teams according to PRCA scores perfectly mirrors their ordering with respect to desire to participate in discussions during the first problem solving game. Secondly, the imposition of our EQTS rule dramatically affected the behavior of moderately shy individuals. In particular, it strengthened their desire to speak. Finally, in contrast to its effect on moderately shy individuals, the EQTS rule did not affect the behavior of very shy individuals in our experimental context. In retrospect, this seems quite reasonable. Since the absolute level of requests to speak was so low among these very shy students, there were practically no occasions when two team members wanted to speak at the same time. The EQTS rule was thus rarely used to resolve conflicts among potential speakers, so little effect of exposure to it would be expected.

One surprising finding in this initial study was that differences in participation in group discussions did not correspond to differences in quality of performance on the group task. In fact, the moderately shy individuals, who appeared to be most motivated to participate, actually made the worst guesses. What might account for this apparent discrepancy? A number of factors may contribute, and clues are provided by the relationship between shyness level and the two other measures of

participation which we have discussed. Despite their increased request time, moderately shy individuals spent no more time actually talking than those who were very assertive. Because only a fixed amount of time was allotted for group discussions and only one person could speak at a time, increased motivation to participate could increase actual time spent talking only up to a certain point. Even if an individual is able and motivated to make a worthwhile contribution to his group, the group cannot benefit from his ideas if he does not have sufficient opportunity to present them.

In addition, as a consequence of the amount of requesting and talking done by moderately shy individuals, they also were more likely than the others in our study to request in vain, i.e., to indicate a desire to speak and to have the computerized system fail to grant that request. Any negative feelings resulting from the fact that they frequently had no chance to contribute the ideas that they were willing to share may have disrupted their performance.

Besides feeling frustrated and wishing that others might stop talking and let them have a turn, moderately shy individuals may have experienced one other negative emotion while waiting to speak. These shy individuals habitually feel uncomfortable speaking in group settings and are normally reluctant to do so. When they know they may soon be called upon to publicly share their ideas, they are likely to experience anticipatory anxiety. They will engage in excessive self-monitoring of their thoughts and feelings, worry about the value of their contributions, wonder if their responses will seem appropriate to their teammates, and so forth. This anticipatory anxiety can interfere with the ability to remember (Brenner, 1976; Hatvany & Zimbardo, 1978), and memory deficits would clearly make one less able to use optimal problem solving strategies on our experimental task.

While the experimental paradigm used in this study yielded interesting findings and raised intriguing questions, our experience using it with experimental teams and our examination of the results made a number of weaknesses apparent. Several of these weaknesses relate to the specific task on which team members were asked to work. The logic-problem task turned out to be uninteresting to many participants. They often felt little need to discuss their strategies, and no interaction among team members was explicitly required. Participants seemed to vary greatly in their perceptions of their own competence at the task, and differences in perceived competence in this particular context may in some cases have over-ridden general tendencies to participate in group discussions. In addition, participants unfamiliar with this type of task often found it to be quite confusing at first. This would, of course, tend to exacerbate differences in perceived competence.

Some of the difficulties with our experimental paradigm relate to details of the experimental procedure and design. The consequences of the EQTS rule may have been influenced by the fact that all participants knew beforehand that it would be used. Because it is a relatively unusual approach to conflict resolution, participants may have guessed that its effects were of primary interest to us, and this awareness may have affected their behavior. Another problem with the physical procedure is

the presence of "cross-talk"; while only the chosen person was supposed to speak at any given time, in actuality there was no way to enforce this rule. With respect to the experimental design, members of real-world teams are rarely all similar to each other in level of shyness. While the behavior of homogeneous teams is of theoretical interest, interactions in heterogeneous teams have more relevance for understanding the behavior of natural work teams in real-world settings. A second design problem is that this study provided no information on changes in participation that might occur in teams using an alternative to the EQTS rule.

Finally, an important weakness of this study is the lack of data on participants' psychological reactions. For example, we have hypothesized that moderately shy individuals may have experienced negative feelings which were detrimental to their task performance, but we have no information on how they actually felt. This study also yielded no information on team members' perceptions of their influence in the team, nor of the roles which different members played. These feelings, too, would be expected to mediate the effects of particular communication environments on participation and task performance, especially among individuals who continue to work together over a period of time on a series of different tasks.

To remedy the weaknesses discussed above, we made several important changes in our experimental paradigm before collecting additional data. For example, we used a more involving task on which the need for interaction with teammates was also more evident. Participants were unaware of the procedure for resolving conflicts in their desire to participate, and the EQTS rule was explicitly compared to a more usual conflict resolution technique. The members of each team varied with respect to level of shyness. In addition, we added a group process questionnaire to be filled out by participants at the end of the experimental session. This yielded information on participants' own feelings about what happened in their teams during group discussions as well as feedback on their personal reactions to the task and setting.

Introduction to Study Two

Our second study, designed to remedy problems with our initial study and extend its findings, was described in an earlier technical report (Zimbardo, Linsenmeier, Kabat, & Smith, 1981). Before conducting this study, we first searched for tasks which participants would find more involving than the logic problems used in Study One. We eventually chose two tasks in which team members were told to imagine that they had been in a plane crash and were asked to make decisions which would maximize their chances of survival. Pretests indicated that team members often became very involved in these tasks. Requiring that they reach agreement on certain decisions necessitated their involvement in group discussions as well.

While searching for a new task, we also developed a new and improved telecommunication system. Each subject station included a set of earphones and a microphone, and, in this study, no more than one microphone at a time could be activated during team discussions. Thus

only the individual chosen by the system as the next speaker could speak and be heard by the others. Two different turn-taking rules were programmed into our new system. Team members were provided with special "request to talk" buttons which they pressed whenever they wanted to speak. The buttons were linked to a computer which resolved conflicts whenever more than one request button was pushed. One approach to doing this was to use the EQTS rule introduced in Study One. Under this rule, whenever no one was speaking and more than one person wished to do so, the individual who had spoken least thus far was given an opportunity to make a contribution. In this second study we compared the EQTS rule to a first-in/first-out (FIFO) rule. Under this new rule, the person who had pressed the request button first was given a chance to speak. This rule might be expected to work against shy individuals who feel less certain that they have something worthwhile to say and thus more hesitant about trying to get a chance to say it. Like turn-taking rules in a natural setting, it gives an advantage to those who are not-shy. In addition, Stodolsky (1979) has noted that groups operating under a FIFO rule can be considered equivalent to natural, unconstrained groups for the purpose of statistical analysis.

Despite the tendency for people to participate unequally in group discussions, there may at the same time be a norm favoring equality of participation. In a related vein, people may want to feel that their right to speak is the same as that of everyone else, even if they choose not to participate (Bales, 1954). Merely letting people see how closely this norm is being adhered to may increase its influence over their communication. People faced with clear evidence that they are monopolizing the conversation may try to talk less, and those who can see that they have not yet contributed their "fair share" may come to talk more. Thus a new variable, first investigated in this study, was whether or not team members were provided with up-to-date informational prompts. These video-displayed messages contained information on what percentage of the time each group member had talked thus far. This is an especially important variable of practical significance since providing such information is within the capabilities of various telecommunication systems currently in operation.

In Study One, the four members of each team were homogeneous with respect to shyness. In order to increase the similarity of our experimental teams to real-world work teams, this was not the case for our second study. Instead, we set up our research teams so that each team contained both shy and not-shy members. We could thus look at differences in the behaviors of shy and not-shy people working together and also see how our experimental manipulations altered these differences.

The three independent variables in this study, then, were turn-taking rule, presence of informational prompts, and individual shyness level. Teams composed of two shy and two not-shy individuals worked on two decision-making tasks, one under the first-in/first-out turn-taking rule and one under equal timesharing. Half of the teams received informational prompts containing information on the participation levels of each team member during each team discussion. The other half were not provided with this information. As in Study 1, we collected data on the extent to which people participated in team discussions and the quality of team decisions.

The introduction of a group process questionnaire filled out by team members after working on each task provided us with an additional type of data. In this study we were able to collect information on team members' own perceptions of and reactions to the interactions in their teams.

Method

Subjects and experimenters

Sixteen four-woman teams participated in this study. The sixty-four women were currently or previously enrolled in an introductory psychology class at Stanford University. Prior to serving in our experiment none of the four women in a given team were well acquainted with one another. For their participation, the women received either \$3.00 plus credit towards their course research requirement, or \$6.00, if course credit was not desired. Two female students served as experimenters for this study.

Procedure

When the four women scheduled for a session had arrived at the laboratory, the experimenter greeted them and explained that they would be working together on two survival problems: deciding how best to survive in a desert environment and how best to survive in the arctic. The women were urged to imagine that the simulated situations they would be discussing were real, i.e., that the decisions they made would actually influence their own chances of survival. As an incentive for becoming involved in the process of team decision making, subjects were also told that a cash prize would be awarded to the team that made the best decisions. Each woman was then assigned a subject number between 1 and 4.

Next, participants were informed that they would be communicating using a computerized telecommunication system, and the rules for using this system were explained to them. After the experimenter answered any questions concerning these rules, she seated the women at their subject stations. The women were always seated in numerical order, with Subject 1 at one end and Subject 4 at the other. The experimenter identified for each woman the equipment she would be using and had each put on a headset with which she would be able to communicate verbally with the others. Then the experimenter started the computer program which printed further instructions and information on participants' display screens. The sequence of activities involved working on the first survival task, answering a set of questions about the dynamics within the group and one's own participation, working on the second survival task, and, finally, answering another set of questions on the team's performance and interactions. A debriefing session followed in which subjects' questions were answered and additional information was provided. The experimental sessions lasted approximately 2 hours.

The Computerized Telecommunication System. The major hardware for the computerized system consisted of four subject stations wired to a PDP 11/34 computer. Each subject station contained a terminal (a CRT display screen and a keyboard), a microphone-earphone headset, and a discussion signal box. The laboratory arrangement enabled subjects to communicate

with one another only through their computer terminals (written messages) or their microphones and earphones (oral messages).

The terminal display screens were used to display general information about the problems that team members were to work on and to present them with specific questions. Participants responded to these questions by typing their answers on their terminal keyboards. These responses were automatically recorded in a computer file.

During certain segments of the experimental session, team members held oral discussions of the problem at hand. The discussion signal boxes were used during these time periods. Each person's signal box contained two buttons, a request button and a talk button. Participants were instructed to hold down their request buttons whenever they wished to speak to their teammates.

Whenever the computer determined, according to preprogrammed rules unknown to the participants, that a person requesting to speak should be permitted to do so, the message "Subject #X, you may talk now" appeared on her screen (The "X" was, of course, replaced with her subject number.) After receiving this notification that her request to speak had been granted by the computer, the subject pressed her talk button in order to activate her microphone. When a person's microphone was activated, all other team members could hear what she was saying through their earphones; any comments made by the other team members could not be heard since only one person's microphone could be activated at a time.

Team members were told beforehand how long each discussion period would be, and the computer displayed information on each person's screen indicating how much discussion time remained. Participants were also informed that they could speak for a maximum of one minute per turn without being interrupted, and whenever a woman was speaking, her display screen showed how much of that minute remained. Her microphone was automatically turned off if she was still speaking at the end of the one-minute period.

During the group discussions the computer produced a sequential file which documented the occurrence of each of the following events:

- (a) a request button is pressed
- (b) a request button is released to cancel a request
- (c) a request to speak is granted by the computer
- (d) a talk button is pressed
- (e) a talk button is released

For each occurrence of each event, the computer record included information on who produced the action, i.e., which team member pressed or released a button, and when it occurred.

Experimental tasks. The two survival problems worked on by each team followed a similar format. When the experimenter started the computer program, a summary of the instructions for using the computer-mediated telecommunication system appeared on participants' screens. Next, they read a description of a desert or arctic survival

situation (presented in counterbalanced order across experimental groups). These situations and the questions asked about them were based on exercises prepared by Eady & Lafferty (1975) and Lafferty & Webber (1978) of Human Synergistics.² Team members were asked to imagine that they and their teammates had been in a plane that had crashlanded in the desert (or subarctic) and that they were the only survivors. They were given information about the circumstances of their crash, their location, and the surrounding environment. When all subjects had signalled that they were ready to proceed, each display showed a list of eight problems facing the group and asked that the subject choose and rank the four most important. The next display was a list of six strategies the team might follow; each member selected the one that she thought would give the team its best chance of survival. The next display was a list of ten items supposedly salvaged from the wreck; after this display had been on her screen for 60 seconds, each subject had to rank the items according to how much each could contribute to the team's survival. Participants indicated their decisions by entering on their computer keyboards numbers corresponding to the appropriate problems, strategies, or items. All participants worked alone up to this point. (The situation descriptions and problem, strategy, and item choices used in this research are contained in Appendices 2 and 3).

When all team members had finished ranking the ten items, information displayed on their screens indicated that they would next have 500 seconds to discuss their decisions with their teammates. They read that no one would be allowed to speak for more than one minute at a time and were reminded to use their request and talk buttons to indicate when they wished to speak and to activate their microphones when their requests were granted. A list of the ten items then appeared on the screen and remained there throughout the discussion period. Each participant's microphone was activated according to the rules appropriate for the particular experimental condition.

At the end of the discussion period, participants were asked to indicate their current feelings about which four problems were most crucial, which one survival strategy seemed most promising, and how the ten items should be ranked. Then they had three more minutes to discuss their item rankings. Again, team members followed the button-pressing rules, and turn taking was controlled by the computer in accordance with each group's experimental condition. After this discussion period the message on the display screens indicated that participants would have to agree on the rankings of each of the ten items. They were asked to indicate which was most important, second most important, and so forth, and each question was repeated until all participants had entered the same response. During this period all participants could talk whenever they wished. The only constraint during this open discussion period was that all participants reach agreement on which item should be assigned the rank in question within one minute after that consensus was requested.

After team members had entered their common rankings of all ten items, their display screens were cleared, and they were asked to complete a self-report questionnaire about the dynamics in their group. The questionnaire included such questions as: "How much did you influence the team's final decision?" "How much did you enjoy this survival situation

task?" and "Did your group have a leader?" When all team members had completed this questionnaire, the entire experimental procedure was repeated using the other survival situation.

Debriefing. Upon completion of all tasks related to the second situation, the experimenter collected the experimental forms. Questions about the experiment were solicited and the aims of our study discussed. (In order to avoid making shy participants feel uncomfortable or self-conscious, our interest in shyness was not mentioned.) Participants were also given the information provided by Human Synergistics on what experts recommended doing in each of the survival situations. Finally, they were urged not to share this information with others who might participate in our research and were thanked and paid, or given credit, for their own participation.

Independent variables

The design of this study included three independent variables: (a) shyness (or communication apprehension), (b) turn-taking rule, and (c) informational prompts.

Shyness At least a month before participating in our study, each woman filled out a questionnaire asking whether or not she thought of herself as shy, and to what degree. Each also completed the McCroskey PRCA used in Study One. Teams were formed so that each contained two women who considered themselves shy and also scored above their class median in communication apprehension, indicating they were relatively uncomfortable about speaking in public. The other two women on each team viewed themselves as not-shy and were relatively low in communication apprehension. Subjects were not aware of the shyness levels of the participants nor of the fact that we were studying the effects of communication apprehension on team problem-solving.

Turn-taking rules. Each team was exposed to two different rules determining who would be selected to talk during the computer-mediated group discussions. In their discussions of one situation, each team was governed by the FIFO rule; whenever more than one woman wished to speak, the one who had made her request first was given the first opportunity. During group discussions of the other situation, the more democratic EQTS rule was used to resolve conflicts in turn-taking requests. Half the teams were constrained by the computer to follow the FIFO rule for the desert survival situation and the EQTS rule for the arctic situation; the other half were governed by the FIFO rule for the arctic discussions and the EQTS rule for the desert ones. Crossed with this variable, half the teams were exposed to the FIFO rule first and then the EQTS rule, while the others encountered EQTS before FIFO. This counterbalanced order of type of rule and survival situation was randomly determined for each of the sixteen teams.

Informational prompts. Finally, during the computer-mediated group discussions half of the teams saw displays on their screens indicating what percentage of the time each of the four team members had spoken thus far; the percentage associated with each team member was the number of seconds for which she herself had spoken divided by the total amount of

speaking done by the group (and then multiplied by 100). Each person was identified by subject number in this display, and the display was updated each time a person finished speaking. The other half of the teams were not provided with this informational prompt. Teams were randomly assigned to either the Prompts or the No Prompts condition.

Dependent variables

Three types of data were generated during each experimental session: participation, performance, and perceptions. The first data set reflects each participant's activity during the group discussions. Data of this sort include information on how long each person spoke, how many times she spoke, how often she requested to speak, and how long these requests typically lasted. The second set of data is derived from participants' decisions about the viability of the survival strategies, the seriousness of the problems, and the value of the various available items. The decisions made by each team were compared to those recommended by experts in the fields of desert and arctic survival. Lastly, additional data come from participants' responses to the group dynamics questionnaire, i.e., their perceptions of roles within the group, their feelings about their own contributions, and so forth.

Results

The participation, performance, and perception measures in this study were analyzed using a two-way analysis of variance with one between-groups factor (prompts) and one within-groups factor (rule). Mean responses of the four members of each team, the two shy members, and the two not-shy members were also analyzed. To assess the interaction of our experimental manipulations with participants' shyness level, an additional analysis of variance was conducted in which the measures to be analyzed were the differences between the average responses of the shy and not-shy members of each team.

Initial examination of the data indicated that changes in turn-taking rule had few effects. A ready explanation of this is the fact that the rule in operation rarely affected whether a shy or a not-shy individual was given an opportunity to speak. The equal timesharing rule could alter usual patterns of participation and benefit shy individuals only when: (1) both a shy and a not-shy person had requested to speak, and (2) the not-shy person had pressed her request button first. Then our EQTS rule, unlike the FIFO rule, would have favored the shy person's request--an atypical experience for shys in social situations. As it turned out, there were only an average of seven instances per group discussion of each survival situation when the computer system had to determine who could speak. In the remaining instances, the person whose microphone was activated was the only one who had indicated a desire to talk at that time. Furthermore, only a few of these seven instances involved the special circumstances required for the turn-taking rule to affect whether a shy or not-shy woman spoke next.

Because the turn-taking rule had few effects, we collapsed across the two rules in our analyses of most variables, thereby focusing only on the effects of informational prompts and individual differences in shyness.

Turn-taking rule will be mentioned only in conjunction with those dependent measures for which this variable made a difference.

Effects on participation

Three behavioral effects validate our selection procedure for assigning individuals to shy and not-shy categories. In the literature on shyness, a commonly reported finding is the reluctance of the shy to initiate verbal interaction (Brodts & Zimbardo, 1981). In our simulated survival setting, the same result occurred: 78% of the time the first person to talk during a game was a not-shy participant. On only seven of thirty-two possible occasions did one of the shys break the silence ($\chi^2(1) = 9.03, p < .01$).

Also, as might be expected, shys talked less often than did not-shys. The mean number of talking turns for shys was 4.90, while not-shys talked an average of 7.06 times per game. This significant difference ($t(7) = 2.51, p < .05$) occurred under the more usual condition of no external prompts. When informational prompts were introduced, differences in verbal output between the two groups were eliminated; the mean for not-shys was 4.09, while that for shys was 4.00. Thus the interaction of shyness and prompts was marginally significant ($F(1,14) = 3.83, p < .07$).

A similar pattern emerged for the measure of how many seconds people spent talking. Without prompts not-shys talked a minute more than shys, on the average: 167 vs. 102 sec. ($t = 2.34, df = 7, p < .10$). However, the presence of prompts had the dual effect of reducing talking time of the not-shys to 136 sec. while increasing talking time of the shys to 128 sec., a marginally significant trend ($F(1,14) = 2.77, p < .15$). Among both shys and not-shys prompts led to an increase in how long an average talking turn lasted. Without prompts team members talked for an average of 22.6 sec. each time they had a chance to speak. With prompts each turn lasted an average of 33.6 sec. ($F(1,14) = 18.02, p < .001$).

Not only did shys talk less often, for a shorter duration than their not-shy peers, but they also spent less time requesting to talk—when not prompted to do so. This pattern was reversed, however, when prompts were introduced into the communication system, as can be seen in Table 1.

Insert Table 1 about here

This dramatic increase in request time of the shys, which nearly doubled how long they kept their request buttons depressed, is, of course, significant ($F(1,14) = 9.82, p < .01$). The increase in request time of the not-shys under the informational pressure of the prompts is smaller, but still significant ($F(1,14) = 5.60, p < .05$). The difference in the size of these increases is reflected in a marginally significant prompts by shyness interaction ($F(1,14) = 2.75, p < .15$). Similarly, when we look at whether people were requesting to speak or were passive while

their teammates were talking, both shys and not-shys were more likely to be requesting to speak (in the "waiting stack") when prompts were provided than when they were not ($F(1,14) = 8.28, p < .05$), and the difference was greater for shys than for not-shys.

In contrast to this pattern of differences is the similarity between shys and not-shys in their number of requests to talk. Without prompts not-shys made an average of 10.56 requests vs. 9.84 for the shys. The presence of prompt information markedly suppressed the number of requests to talk in both groups, down to an average of only 6.22 for not-shys and 6.28 for shys. This decline in request frequency due to prompts is statistically significant ($F(1,14) = 38.44, p < .001$). Since people made fewer requests with prompts, but spent more time requesting, the average request lasted longer with prompts than without them (37 vs. 14 sec., $F(1,14) = 24.97, p < .001$). Similarly, with prompts, people had to wait for more of their teammates to speak before their requests were granted ($F(1,14) = 35.68, p < .001$). We should point out, though, that these waits were generally quite short. Indeed, in many cases no one requested to speak until the current speaker had finished talking, and then the first request made was granted as soon as the computerized system had processed this information.

Participants sometimes failed to keep pressing their request buttons until their requests were granted (or discussion time ran out). Prompts affected how frequently team members changed their minds and cancelled their requests; they increased the percentage of instances in which participants continued to request a chance to speak until that request was granted. This greater request perseveration occurred especially among team members who were shy. The difference was marginally significant for both shys and not-shys under the EQTS rule, but only for shys when the FIFO rule was in effect, leading to a marginally significant three-way interaction of prompts, rule, and shyness level ($F(1,14) = 2.28, p < .15$).

One final effect of prompts was to lead to a slight decrease in the total amount of talking done in the entire group, or, looked at another way, an increase in the amount of silent time when no one was speaking (from 140 to 164 sec., $F(1,14) = 2.30, p < .15$). This was probably an artifact of the way in which our computerized system functioned. Because it took time, in the prompts conditions, for the system to display the appropriate information on participants' screens, more time tended to elapse before the system could perform its other functions. This same explanation accounts for why total discussion times were slightly longer in the prompts conditions (694 vs. 681 sec. for what was intended to be the 680 sec. combined time for one discussion lasting 500 sec. and a second discussion lasting 180 sec.). Because more demands were placed on the system in the prompts condition, it took longer to register and respond appropriately to the fact that the specified discussion time had run out.

Effects on performance

One very important effect that our experimental interventions had upon team problem-solving was to improve the quality of final decisions

about the rankings of items essential for survival. Each team's set of ten ranks was scored relative to expert rankings of these items (using norms provided by Human Synergistics: Eady & Lafferty, 1975; Lafferty & Webber, 1978). Team decisions were superior when prior discussions had been governed by our computer-mediated equal timesharing rule rather than by the first-in first-out rule. A comparison of whether each team performed better under EQTS or FIFO yielded a nearly significant statistical difference, $p < .06$ (one-tailed, sign test). The mean score of 21.4 for EQTS solutions was better than that of 24.2 for FIFO solutions ($t = 1.376$, $df = 15$, $p < .10$, one-tailed; lower team scores are better).

Prompts, like equal timesharing, also favorably influenced the quality of team decisions regarding survival item rankings. With prompts the average team score was 20.9, and without prompts average scores were poorer, $X = 24.8$, ($F(1,14) = 3.00$, $p < .15$).

If we contrast the experimental condition where there is maximum intervention, EQTS plus prompts, with the condition most resembling natural field circumstances for group problem-solving, FIFO without prompts, a dramatic effect can be seen in Table 2. The very best

Insert Table 2 about here

decisions were made in teams operating under the computer-mediated equal timesharing algorithm along with periodic displays of information about how much or little each member had spoken. The worst performance occurred when discussions were essentially unaltered by the experimental constraints of turn-taking rule and prompts, that is, in the FIFO, no prompts condition. This significant difference ($t = 2.163$, $df = 14$, $p < .05$) provides the strongest support for the prediction that our novel methodological paradigm would enhance the quality of team decisions by altering participation patterns.

In contrast to their effects on team rankings of the ten items, our experimental manipulations had no effect on the quality of post-discussion strategy and problem choices. One reason for this may be that these provide much less sensitive measures of quality. For example, using the system provided by Human Synergistics, strategy scores can range only from 1 to 4, while item ranking scores can range from 0 to 50. A second contributing factor may be that team members were never asked to reach a consensus on these questions. With no externally imposed pressure to conform, we would expect less emphasis on these questions during group discussions and less influence of the group discussions on individual members' choices. This difficulty was remedied in our subsequent studies.

Effects on perceptions of group process

Most subjects expressed considerable enjoyment of their work on the problem-solving tasks (overall mean of 4.04 on a 5-point scale where 5 = very much enjoy). The not-shys showed little variation from this high

baseline regardless of rule or prompt condition. However, the shys enjoyed the task least of all under no prompts-equal timesharing, $\bar{X} = 3.88$, and most of all under prompts-equal timesharing $\bar{X} = 4.44$ ($F(1,14) = 8.51$, $p < .05$ for the three-way interaction of prompts, rule, and shyness; $F(1,14) = 4.93$, $p < .05$ for the effect of prompts on the task enjoyment of the shys under EQTS).

Several questionnaire items were designed to assess the degree to which team members felt they had influenced their teams' decisions. Analysis of responses to these questions yielded few significant effects and the patterns of responses were not entirely consistent. However, most differences which emerged suggested that prompts lessened how influential not-shy team members felt themselves to be while at the same time increasing feelings of influence among team members who were shy. For example, not-shys tended to rate the value of their contribution as greater without prompts than with them ($\bar{X} = 3.84$, vs. 3.44 , $F(1,14) = 2.13$, $p < .20$). Shys felt the team decisions reflected their own contributions to a greater extent when prompts were present than when they were not ($\bar{X} = 3.56$ vs. 3.31 , $F(1,14) = 1.93$, $p < .20$). Prompts interacted with shyness level when the EQTS rule was in operation for this question and two others, one asking participants how much attention their teammates paid to their contributions, and a third asking how much they felt they influenced their teams' final decision. For all three questions, shys saw themselves as having more impact under prompts, while not-shys rated their own impact as greater in the no prompts condition (F values ranged from 2.58 to 3.72 , with all p -values less than $.15$).

A general tendency for not-shy individuals to see themselves as more influential is reflected in subjects' responses to a question about who, if anyone, contributed most to the team's decision process. Not-shys were more likely to say that they were among those contributing most than to say other people played a larger role than they. In contrast, shys were no more likely to say that they were among the major contributors than to say that they were not included in this subgroup. These patterns were slightly stronger in the groups which did not receive informational prompts. These non-significant trends should be viewed against the general tendency for about half the participants in both categories to perceive all team members as contributing equally. A measure of actual influence on team decisions suggests that participants were accurate in their perceptions of the relative influence of shys and not-shys. The more closely a person's initial rankings of the survival items resemble the final rankings agreed upon by the team, the more influence that person can be said to have had. Using this index of influence, not-shys were the more influential members twice as often as shys in the absence of prompts, but no more often than shys when prompts were provided.

In addition to asking participants to evaluate their own influence on team decisions, we also asked them to evaluate the degree to which their own opinions were affected by the statements of their teammates. Without prompts, shys and not-shys felt about equally influenced by others ($\bar{X} = 3.38$ for shys vs. 3.60 for not-shys on a 1-5 scale, a non-significant difference), while with prompts, not-shys saw themselves as significantly less influenced by others ($\bar{X} = 3.50$ for shys vs. 3.03 for not-shys, $F(1,14) = 6.06$, $p < .05$). Turn-taking rules also affected responses to

this question. On the average, team members felt more influenced under EQTS than under FIFO ($\bar{X} = 3.30$ vs. 3.45 , $F(1,14) = 7.61$, $p < .05$). The lowest ratings of others' influence were given by not-shys in the FIFO-prompts condition ($\bar{X} = 2.88$). While prompts reduced the tendency for not-shys to participate more than shys, they also made more obvious any differences which remained. Especially during the early period in group discussions, before our manipulations could take effect, not-shys were likely to spend more time talking than shys. Their lower ratings of the influence on them under prompts may be due to the fact that prompts let not-shys clearly see that they were doing more talking and less listening than others.

When asked about the nature of their primary contribution to the team, about half (47 percent) reported it was offering new information. As can be seen in Table 3, a majority of participants (66 percent) saw providing task relevant input (i.e., new information or critical feedback) as their major contribution. The more passive role of listening was mentioned by 23 percent of the respondents, and 11 percent felt their main activity was to improve the social-emotional climate in the team by encouraging others, making jokes, etc.

Insert Table 3 about here

There are two interesting effects of our treatments on perception of group process which are worthy of our attention, despite the small cell sizes involved. First, informational prompts reduced the number of shys who saw listening as their most important activity while increasing the number of not-shys who gave this response. Second, the overall profiles of shys and not-shys are more similar with prompts than without them.

The perception of group leadership was altered considerably by the nature of the turn-taking rule in operation. Among those subjects who specified a particular person as the group leader (almost 70% did not), the person named was not-shy 85% of the time under the FIFO rule. However, one effect of the equal timesharing rule was to "democratize" the leadership ($\chi^2(1) = 5.38$, $p < .05$), as can be seen in Table 4. Similarly, under FIFO there were 9 teams in which at least one member identified a not-shy person as the leader, while a shy person was seen as leader in only 1 team ($\chi^2(1) = 4.9$, $p < .05$). Under EQTS, on the other hand, shy and not-shy individuals emerged as leaders in nearly the same number of teams (5 for not-shys and 6 for shys).

Insert Table 4 about here

Several intriguing findings emerged involving perceived tension and frustration. The EQTS rule resulted in less feeling of frustration than

did the first-in/first-out rule among both shys and not-shys ($\bar{X} = 1.8$ vs. 1.6, $F(1,14) = 8.40$, $p < .05$). Prompts made shys both feel more frustrated and perceive more tension in the team. This result contrasts with the somewhat reduced level of tension reported by not-shys in the presence of prompts and the lack of change in their reported frustration. ($F(1,14) = 2.62$, $p < .15$ for the joint effect of shyness and prompts on frustration; $F(1,14) = 2.38$, $p < .15$ for the effect on perceived tension.)

Discussion

Discussion of these results, along with speculation about the psychological nature of the turn-taking rules and informational prompts, will be presented following the third study in this research report.

Introduction to Study Three

The third study in our research program was conducted with the following objectives: (a) to replicate (with methodological refinements) the effects of our equal timesharing rule and informational prompts on the participation, performance, and perception of group dynamics within problem-solving teams; (b) to improve the experimental setting for the research; and (c) to investigate the influence of gender (sex-role) differences on our measures of computer-mediated team problem solving. The modifications in the experimental paradigm, operational procedures, and research setting are described in detail in the method section.

Our previous two studies demonstrated that shyness is a chronic dispositional trait that can lead to low levels of participation in team interactions. However, we found that the inhibitory effects of shyness can be modified when shy subjects perform under conditions that provide greater encouragement and opportunity to get involved in the team process. We next wanted to use our research paradigm to explore another population where participation in team activities may be typically inhibited and to give remedial aid within our computer-mediated turn-taking system. We sought to answer two interrelated questions. Do the effects of sex-role stereotyped attitudes and behavior constrain participation rates in problem-solving teams? Are there manipulable situational variables that can alter any consistent asymmetry in participation between males and females working together on our tasks?

With the increasing involvement of women in military service as well as in the work force, it becomes imperative to create conditions that facilitate their fullest participation in decision-making and problem-solving activities. However, it has been our observation (along with many others) that women tend to defer to men in mixed-sex discussion groups. There appear to be a substantial number of women who follow a traditional female pattern of low participation in task-oriented groups which include males of equal ability and experience (see Zimmerman & West, 1975; Henley & Thorne, 1975; Kramer, 1973; Key 1972).

Low participating women also tend to allow men to take the initiative in structuring the content of the conversation, in formulating the nature

of the problem, and in general, in controlling the domain of the conversation. Research by Ross, Amabile & Steinmetz (1977) clearly demonstrates that individuals who are put in the role of controlling the conversational domain (by random assignment) are judged as more intelligent than those arbitrarily assigned to the role of respondent. Thus, where women elect to allow males to initiate conversations and to take a primary role in team discussions, they place themselves at a disadvantage. This should have an adverse effect on team morale, individual sense of self-efficacy and probability of promotion within a work system. Moreover, it prevents the team from benefitting fully from the unique skills and knowledge of its female members.

We studied these phenomena within our computer-mediated telecommunication system. In everyday conversations the first-in first-out algorithm usually is in force and should favor male dominance. We hoped that our equal-time algorithm and our procedures for displaying participation rates would serve to balance participation more equitably across sexes. Such procedures should help to better utilize the talents of women, increase their morale, and result in greater problem-solving efficiency for their teams.

Method

Subjects and experimenters

Sixty men and sixty women participated in the study. All participants were currently enrolled in an introductory psychology course or had been enrolled in that course during the previous school term. Each received either \$4.00 or credit toward a course research requirement in return for participating. Two female students and one male student served as experimenters for this study.

Procedure

The procedure for this study was a refinement of that used for Study Two. Participants discussed the arctic or desert survival situation using the same computerized telecommunication system as before. However, there were also a number of procedural differences between the two studies. Modifications introduced in Study Three included the following:

1. Randomly assigning participants to subject stations. (In Study Two Subjects #2 and #4 were always shy, while Subjects #1 and #3 were not.) This eliminated the possibility of a confounding of shyness and position effects. For example, internal analysis of some Study Two data suggested that identifying an individual as Subject #1 could affect her behavior, leading her to talk more. If Subject #1 were always not-shy and talked more, a position effect might be interpreted as an effect of shyness.

2. Shortening the length of the experimental session to approximately one hour and having each team discuss only one survival situation. (In Study Two each team worked with two different situations. This was sometimes tiring for participants, and a 2-hour session also made the scheduling of experimental sessions more difficult.)

3. Using only the EQTS rule to determine who should speak when more than one team member wished to do so. (In Study Two both the FIFO and the EQTS rule were used; now we wanted to focus only on the EQTS rule as we varied other aspects of the situation and the team's composition).

4. Having participants pick a survival strategy to follow before asking them to decide which four problems are most serious. (In Study Two participants were asked to evaluate the problems first, and several stated that they thought the strategy choice should proceed this since the seriousness of the problems was dependent upon which strategy they chose.)

5. Specifying that team members should reach agreement on one strategy and four problems during their first discussion of the survival situation; displaying a list of possible strategies and problems on their screens during this discussion; and checking for agreement at the end of the discussion. (In Study Two participants were never asked to agree with their teammates on these issues, nor were the various options displayed during their discussions.)

6. Not giving participants details about the ten salvaged items, nor asking for their rankings, until after the first discussion; specifying that team members should reach agreement on their rankings during the second discussion; and checking for agreement at the end of this discussion. (In Study Two participants learned about the ten items before the first discussion and, therefore, discussed their rankings during both discussion periods.)

7. Lengthening the second discussion to 500 seconds. (In Study Two it lasted for only 180 seconds. This alone could prevent certain participants from entering the discussion since three people each speaking for their allotted time of 60 seconds would use up the entire 180 second period. It also made differences in the dynamics during the first and second discussions of each situation more difficult to interpret.)

8. Having the computer program progress from one display of information to the next as soon as all four subjects indicated, by typing a special character, that they were ready to proceed. (In Study Two most displays remained on the CRT screens for fixed periods of time.)

9. Slightly rewording the cues which told team members when they had been granted an opportunity to speak and when their microphones had actually been activated. (The message "you may talk now" used in Study Two led some participants to begin speaking right away, before pushing their talk buttons to activate their microphones. The new version read, instead, "you may talk next" and also cautioned people not to actually begin speaking until a "Begin to talk" message appeared on the screen.)

10. Displaying the subject number of the current speaker on participants' screens throughout their group discussions. (In Study Two team members sometimes could not tell whose comments they were hearing.)

11. Rewording portions of the group process questionnaire and having the questions displayed on participants' computer screens. Participants then answered the questions by typing responses on their

terminal keyboards. (This eliminated the need for team members to switch from working at their terminals to using pencil and paper. It also removed the need for the research staff to add the questionnaire responses to computer files after the experimental sessions had been completed.)

12. One other important change in our research should be mentioned. The initial experimental sessions of Study Two were carried out in the noisy, over-cooled room which housed our laboratory computer. By the time Study Three was conducted, we were in a more comfortable, more isolated room equipped with four permanent subject stations. Participants sat in separate walled booths and were unable to see each other or to engage in any nonverbal communication. This increased the similarity of our system to real-world situations in which people at widely separate physical locations are hooked up to a telecommunication network and can communicate only through the channels provided by that system.

Experimental session sequence

With these changes incorporated, the experimental session proceeded as follows. First, the experimenter greeted the four participants and told them about both the task they would be working on and the computerized system they would be using. Next, they were seated at their subject stations and asked to put on their headsets. Their screens displayed a review of the instructions for using the system, followed by a description of the situation in which they were to imagine themselves. Then each participant individually made decisions about which one of six possible strategies to follow in the situation and which four of eight specified problems were most serious. Next came a 500-second discussion during which team members discussed their decisions in order to reach a consensus; at the end of the discussion, the group consensus was recorded.

Participants then saw a display describing the ten items supposedly salvaged from the crash. After 60 seconds had elapsed (during which they reflected upon the value of the items), they gave their individual rankings of the importance of these items. They were then given 500 seconds to discuss and agree on the rankings, and during this discussion each participant saw all four members' individual rankings displayed on his or her screen. Next came an unconstrained, open discussion period during which participants had to indicate their team's consensus about the rankings of the items. They were allowed a maximum of one minute to decide on each response. Finally, team members worked on their own to complete the group process questionnaire and then left their subject stations to discuss the study further with the experimenter.

Documentation of the improved version of our experimental paradigm is included in the appendices to this report. Appendix 1 shows the instructions given to participants before they began working on our experimental tasks. Appendix 2 includes the computer displays which participants viewed while working on the arctic survival situation. Alternate stimuli for the desert situation are contained in Appendix 3. Finally, Appendix 4 contains photographs of subjects working in our telecommunication setting.³

Independent and dependent variables

The design of this study included three independent variables: (a) subject gender, (b) shyness, or communication apprehension, and (c) informational prompts. Gender was both a between-teams and a within-teams variable. Of the 30 participating teams, one third were all-male, one third contained only women, and the final third were mixed-sex (each consisted of two women and two men). Each group also contained two individuals who were shy and two who were not. In the mixed-sex teams, one man and one woman were shy, while the other man and woman were not shy. The measures of shyness were identical to those used in Study Two.

Teams were randomly assigned either to receive or not receive informational prompts and to discuss either the arctic or the desert survival situation, subject to two constraints. Within each set of ten groups sharing the same sex composition, five received informational prompts and five did not. Also, within each of these sets of five groups, three discussed the arctic survival situation, while two worked on the desert survival task. The wording and operation of the informational prompts display matched those in our earlier study.

As in Study Two, three different types of data were available for each experimental session: team members' patterns of participation in group discussions, the quality of the decisions they made, and their responses to the group process questionnaire.

Results

Most of the data collected in this study were analyzed using a two-way analysis of variance with prompts and team composition (all male, all female, or mixed sex) as the primary factors. Average responses of each team's two shy members, of its two not-shy members, and of the team as a whole were analyzed. Again, to assess the interaction of our other variables with shyness, differences between the shy and not-shy members within each team were analyzed. Since each team participated in two separate 500 second discussions, each team member actually received two scores for each participation variable, one for the first discussion and another for the second. A repeated-measures analysis of variance carried out on these participation measures enabled us to detect differences in patterns of responses during the two time periods. Finally, in order to investigate further gender differences in our telecommunication setting, we compared the responses of the male and female members within our mixed-sex teams.

Effects on participation

Analysis of differences in the amount of time shy and not-shy team members spent talking indicated that prompts affected shy and not-shy individuals differently ($F(1,24) = 2.92, p < .10$). Prompts exerted a suppressing effect upon the more verbally fluent not-shy team members and a slight facilitating effect on the shys. However, the highly significant prompts by team type interaction ($F(2,24) = 7.09, p < .01$) indicated that the effects of introducing informational prompts depended upon the

sex composition of the team. As shown in Table 5, the predicted pattern of an increase in talking time among shys and a decrease among not-shys with the introduction of prompts occurred only within all-female teams. A parallel finding occurred for the number of talking turns which team members took ($F(2,24) = 6.64, p < .01$ for the prompts by team type by shyness interaction). Among the female teams the size of the effect generated by prompts was substantial; prompts lowered the not-shys' talking and raised that of the shys, increasing the difference between them by an average of 127 seconds. Within the all-male teams, on the other hand, shys talked less with prompts than without them. One

 Insert Table 5 about here

anomalous cell in this data set makes interpretation of the results difficult; the shys in teams without prompts talked more than any other group in the study. Within mixed-sex teams the talking times of both shys and not-shys decreased with prompts.

A striking pattern appears when we look at the amount of talking done by the male and female members of mixed-sex teams. In nine of the ten teams the women spoke less than the men. Overall, women did 40 percent of the speaking; they talked for an average of 142 seconds each, while the corresponding figures for men were 60 percent and 210 seconds. This sex difference is statistically significant ($t(9) = 3.49, p < .001$). Similarly, in 80% of these teams, the first person to speak was a man. In addition, women in all-female teams tended to talk more than women in teams with men (even taking into account the fact that there was always a fixed amount of discussion time to use up), while men tended to talk more in mixed-sex teams than in teams containing men only. When they started to talk, male team members took longer talking turns than female team members ($\bar{X} = 25.87$ sec. for all-male teams, 20.30 for all-female teams, and 21.46 for mixed-sex teams, $F(2,24) = 2.98, p < .07$).

All participants talked significantly more during the second discussion than during the first ($\bar{X} = 85$ vs. 92 sec., $F(1,24) = 18.51, p < .001$). This is likely to be a consequence of their becoming more comfortable with our telecommunication system and more skilled in its use. Within all shyness and team-type conditions, participants spoke longer on each talking turn during the second discussion than during the first ($\bar{X} = 20.7$ vs. 24.2 sec., collapsing across all other variables, $F(1,24) = 14.61, p < .001$).

In this study, as in our previous ones, we measured not only how much people actually talked, but also how long they spent requesting a chance to speak. A marginally significant discussion by prompts interaction ($F(1,24) = 4.18, p < .07$) indicated that the largest amount of requesting was done by shy team members during the second discussion within the prompts condition. Shys in the no prompts condition spent 90 seconds requesting during their first discussion and 78 during their second, while the corresponding figures in the prompts condition are 96

and 123 seconds. This suggests that, over time, prompts encouraged shys to request more. However, the pattern of responses becomes much more difficult to interpret when we look at the marginally significant four-way interaction of prompts, team type, discussion period, and shyness on total time spent requesting to speak ($F(2,24) = 2.81, p < .10$).

Analysis of the number of separate requests which people made indicated that, as with our previous studies, they made fewer requests in the prompts condition than without prompts ($\bar{X} = 12.68$ vs. $16.13, F(1,24) = 5.78, p < .05$). They also made fewer requests during the second discussion than during the first ($\bar{X} = 7.97$ vs. $6.43, F(1,24) = 17.56, p < .001$). A significant team type by shyness interaction indicated that in all-female teams shys made fewer requests than not-shys, while the trend within the other teams was in the opposite direction.

As a consequence of how much time people spent requesting to speak and how many requests they made, average response lengths were longer during the second discussion than during the first ($F(1,24) = 14.25, p < .001$). Requests were also longer with prompts than without them ($F(1,24) = 4.45, p < .05$), and a marginal prompts by shyness interaction suggested that prompts increased the average request lengths of shy team members most ($F(1,24) = 3.28, p < .10$). Prompts doubled the mean request length among shys from 11.3 to 23.5 seconds ($F(1,24) = 6.28, p < .05$), while raising it from 18.1 to 25.0 seconds among not-shys. Significant discussion by prompts interactions were found for analyses of both average request lengths and the average number of talking turns people had to wait through before their own requests were granted. These results indicated that the difference in request lengths with and without informational prompts was especially large during the second discussion.

While people often continued holding their request buttons until they got to speak (or the discussion time ended), sometimes they changed their minds, released their buttons, and cancelled their requests. Analyses of the proportion of requests which people cancelled yielded two significant three-way interactions: prompts by discussion by shyness ($F(1,24) = 7.47, p < .05$) and prompts by team type by shyness ($F(2,24) = 5.28, p < .05$). The first of these interactions reflects the finding that prompts led shys to cancel fewer requests and not-shys to cancel somewhat more during the second discussion, but not the first. The second interaction reflects the fact that, collapsing across the two discussion periods, prompts decreased the proportion of requests cancelled by shys in our all-female teams, while increasing the proportion cancelled by their not-shy teammates. This pattern did not hold in all-male teams, where prompts had little effect, or in mixed-sex ones, where prompts led both shys and not-shys to cancel slightly fewer requests.

As in our earlier studies, prompts had one effect on group discussions which may in part be an artifact of our design. Because of the amount of activity by group members and the demands placed on the computerized system, discussion times were slightly longer with prompts than without them ($\bar{X} = 1007$ vs. 1004 sec., $F(1,24) = 4.02, p < .07$). In addition, in prompts conditions there was more time when no one was speaking and everyone was presumably thinking about the task or waiting

for the system, or a teammate, to respond ($\bar{X} = 328$ vs. 271 sec., $F(1,24) = 3.06$, $p < .10$).

Effects on performance

Analysis of the strategy and problem choices and item rankings agreed upon by each team yielded no significant effects of our independent variables on the quality of decisions.

Effects on perceptions of group process

As in our previous studies involving survival tasks, participants in this study generally enjoyed their experience with it ($\bar{X} = 3.9$ on a 5-point scale). Not-shy participants tended to enjoy the prompts condition more than the no prompts condition ($\bar{X} = 4.2$ vs. 3.8, $F(1,24) = 3.5$, $p < .10$). There was also a tendency for all-female teams to enjoy the experience most and all-male teams to enjoy it least ($F(2,24) = 1.8$, $p < .20$), and the same pattern occurred for responses to a question asking participants how involved they felt in the task. On the other hand, within our mixed-sex teams, females felt less involved than males and enjoyed themselves less. Similarly, within these ten teams, all but one male said they could imagine themselves actually being in the survival situation they had discussed, while eight women (40%) said that they couldn't imagine actually being in the situation.

Our prompts manipulation had no effect on the quality of the decisions which teams made. However, it did affect how good team members thought their decisions were. A prompts by shyness interaction ($F(1,24) = 4.71$, $p < .05$) indicated that shys were more pleased with the team decisions in the no prompts condition ($\bar{X} = 4.4$ for prompts and 4.7 for no prompts), while the reverse was true for not-shys ($\bar{X} = 4.5$ vs. 4.2). However, a marginally significant prompts by team type by shyness interaction ($F(2,24) = 2.34$, $p < .15$) reflected the fact that it was actually only within all-male teams that shys judged team decisions to be better without prompts than with them.

A series of questions on the group process questionnaire dealt with participants' perceptions of their own role in their team. A similar pattern emerged on questions asking how much team decisions reflected their own contributions, how valuable their own contributions were, and how much influence they felt they had. The relevant means for the three-way prompts by team type by shyness interaction ($F(2,24) = 3.94$, $p < .05$) for the first of these questions are shown in Table 6. Within

Insert Table 6 about here

all-female teams, shys felt more influential with prompts, while not-shys felt less so. However, in mixed-sex teams the opposite pattern occurred, and in all-male teams prompts lowered the responses of shys and had no effect on those of not-shys. Within the mixed-sex teams, females seemed

to feel less influential than males when prompts were present, but not in the no prompts condition. This probably reflects the fact that when informational prompts were publicly displayed, it became very clear to women that they were doing less speaking than their male teammates.

One questionnaire item asked team members to categorize their main contribution to the team. Our prompts manipulation had no consistent effect on responses to this question, but a clear sex difference emerged. Within all-male teams, 82% of respondents said their main contribution was an active, task-relevant one (giving information, asking questions, or offering constructive criticism). Only four men (10%), all of them shy, said their main contribution was to listen to others. On the other hand, five shy and six not-shy women (28% in all) in the all-female teams said their main contribution was listening, and just 59% chose more active, task-relevant activities. Similarly, within the mixed-sex teams, 79% of the males and 58% of the females said their main contribution was an active, task-relevant one, while 10% of the males and 32% of the females said that listening was the most important thing they did.

Another questionnaire item asked team members not about their own influence within the group but about how much they were influenced by others. Prompts did not affect responses to this question. However, a team type by shyness interaction ($F(2,24) = 3.24, p < .07$) reflected the fact that within all-male and all-female teams, shys felt somewhat more influenced than not-shys, while the reverse was true in mixed-sex teams. When asked who, if anyone, contributed most to their team, most participants responded that the contributions of the four team members were about equal. There was little overall difference between the responses of shy and not-shy individuals.

In another pair of questions dealing with influence within the team, respondents were asked if their team had a leader and, if so, which team member played that role. One clear effect of prompts was to markedly increase the likelihood that the person seen as the leader would be shy. Without prompts, four people named a shy person as a leader and eleven named someone who was not shy. With the addition of prompts, the number naming a shy leader increased to ten, while the number naming a not-shy leader decreased to one. The pattern for the number of teams in which a shy versus a not-shy member was named as leader shows the same result.

Members of all-female teams seemed more likely than members of all-male teams to say that their team had a leader. There were only two all-female teams, but six all-male teams, in which no one at all did so. However, within the ten mixed-sex teams, females were unlikely to be seen as leaders. Ten participants in these teams named a male as the apparent leader, while only two named a female.

Participants were also asked to evaluate the general influence of our telecommunication system. They were asked whether it helped or hurt the team and whether it affected their own degree of participation in the team's decision process. Analyses of responses to these questions yielded few effects of our independent variables. The only significant effect ($F(2,24) = 4.54, p < .05$) was a complex three-way interaction of prompts, team type, and shyness.

Finally, participants indicated how much tension they perceived in their team and how much frustration they themselves felt while working on team tasks. Members of all-female teams generally felt the most tension and those in all-male teams the least ($\bar{X} = 2.0$ for all-female teams, 1.9 for mixed-sex teams, and 1.5 for all-male ones, $F(2,24) = 3.23$, $p < .07$). A marginal team type by shyness interaction ($F(2,24) = 2.72$, $p < .10$) indicated that shys felt more tension than not-shys in mixed-sex teams, less than not-shys in all-female teams, and the same amount as not-shys in all male teams ($\bar{X} = 2.2$ vs. 1.6 for mixed-sex teams, 1.8 vs. 2.0 for all-female, and 1.6 vs. 1.5 for all-male). In addition, within mixed-sex teams, females felt less tension than males without prompts, but more tension with them.

The relevant means contributing to a two-way prompts by shyness interaction ($F(1,24) = 4.10$, $p < .07$) on ratings of frustration are shown in Table 7. Prompts appear to have increased the frustration felt

Insert Table 7 about here

by shys and decreased that felt by not-shys, and that was generally true within all team types. Within mixed-sex teams, prompts increased the frustration felt by women and decreased the frustration felt by men. Thus, the presentation of informational prompts tends to make people who usually dominate a discussion feel less frustration, while at the same time causing greater feelings of frustration among those who usually contribute least.

General Discussion and Conclusions

The results of these exploratory studies along with others in our program (see Linsenmeier & Zimbardo, 1982) encourage us to anticipate a fruitful union of social psychology and computer technology. As teleconferencing becomes more widely utilized to link remote members of problem-solving teams, issues of human communication and group process will require parity with the traditional task and systems variables.

The present research has pointed up the important influence that personal and social characteristics of team members can exert on task solutions. Moreover, the tendencies of dispositional traits, such as shyness or gender differences, to suppress or enhance verbal participation in team discussions can be modified by experimental interventions. The introduction of more democratic turn-taking rules along with informational feedback (prompts) regarding extent of individual participation have been shown to alter team participation, perception of team dynamics, and the quality of team performance. An experimental approach to studying computer-mediated message systems holds much promise for improving the process and product of problem-focused work teams. However, more sophisticated methodological approaches will be necessary in designing future therapeutic or remedial interventions which take account of the complex interactions of variables operating at dispositional, social, ecological, and system levels.

Experts in the field of computer-based message systems have noted the pressing need for research on the human dimension of the person-machine message system. "Much of the needed research," argues Uhlig (1977), "is really psychological, dealing with how human beings can and should interact with this medium." Despite recent technical advances in voice processing and other physical improvements in computer network functioning, Uhlig further notes the need to develop proper computer communication "etiquette." Team members must learn—and our research should help teach them—how to interact most effectively in socially appropriate ways within the boundary conditions set by the medium. The use of computer-mediated algorithms to resolve turn-taking conflicts deserves further systematic study since it can reduce learned inhibitors that ordinarily prevent the fullest participation of some individuals in their teams' problem-solving efforts (cf. Stodolsky, 1976, 1981).

Before outlining some future research directions that are suggested by the present studies, certain features of our experimental interventions, methodology, and results deserve some discussion.

Turn-taking

Speech exchange systems are organized to encourage two primary outcomes: only one person speaks at a time and over time different parties become speakers. In ordinary conversation there is considerable variability in turn-taking properties, such as the distribution of turns, their duration, and content, and the elapsed time between turns. Turn-taking mechanisms exert considerable constraints upon all speech exchange systems. In debate, turns are pre-allocated and their duration standardized; in ceremony, turn content is also fixed by custom.

Existing power differences within a group of speakers are reflected in the asymmetry of their turn-taking patterns (see Zimmerman & West, 1975). Dominance is manifested and maintained by establishing a kind of "turn-taking economy" in which some speakers assert the right to speak more often and for longer (and to interrupt or to signal others to speak). Thus turns are a valued commodity sought by those who wish to exert influence on the beliefs, opinions, and decisions of listeners (see Sacks, Schegloff, & Jefferson, 1974). On the other hand, turns may be avoided by those who wish to show deference to others, believe they have nothing of significance to say, or lack the skills or motivation to seize a turn from more assertive speakers.

It is this learned style of reticence versus assertiveness in turn-taking among members of problem-solving teams that we have attempted to alter by computer-mediation. In the absence of some form of systematic intervention, asymmetries in turn-taking emerge as a function of differences in level of shyness, gender, and, we expect, social class and race as well. To the extent that a more balanced distribution of talking turns is desirable, then usual patterns of their inequitable allocation must be disrupted.

We have assumed that democratic participation of all (or most) team members has advantages to the team over more restricted autocratic control by the few speakers who "naturally" assume control of the turn-taking procedure. Balanced participation takes fuller advantage of a wider range of experiences and of the knowledge and skills of more members. It also increases feelings of self-worth and morale among those speakers who are usually restricted in other conversational environments, while relieving the ordinarily dominant speakers of the obligation or burden of administering the turn-taking system. The social-emotional climate of the group, represented in part by feelings of group cohesiveness, should also be enhanced by more democratic participation in discussions that seek solutions to problems facing the team.

Our computer-mediated turn-taking system introduced the following interventions into the conversational patterns of problem-solving teams: (a) standardizing and simplifying the means by which a potential speaker's desire to talk is expressed (by pressing a talk-request button) and recognized by the system; (b) having talk turns determined by a preprogrammed speaker-selection algorithm rather than by verbal skills and strategies of participants; (c) limiting the maximum size of talk turns (to one minute); (d) eliminating interruptions during talk turns; and (e) providing information to all members on both the total discussion time remaining and the maximum time remaining for each speaking turn.

In addition to these basic interventions experienced by all participants engaged in problem-solving via teleconferencing, an equal timesharing algorithm was also used throughout. This EQTS rule resolved simultaneous requests for a talk turn by allocating the turn to the team member who had spoken least thus far. Study Two compared this EQTS rule with the FIFO rule that more typically operates in conversations.

In our first study, request time was directly and negatively related to shyness level; as shyness increased, participants spent less time requesting to talk. However, this correlation existed only during the initial problem-solving task. The EQTS rule disrupted this pattern so that, over trials, the moderately shy requested more talk turns and talked more than did those who were dispositionally assertive. Those who were very shy were unaffected by the presence of the EQTS rule since their frequency of talk requests was so low that there were few request conflicts to be resolved by computer mediation.

When FIFO and EQTS rules were directly compared in Study Two, anticipated differences did not emerge, in part because the EQTS rule was not activated very often to resolve conflicts among simultaneous requests to talk. There were not as many occasions as we had anticipated when there was a waiting stack of requesters whose priority would be determined by the EQTS rule. This may have occurred to some extent because participants were not made aware of the operation of the EQTS rule (as they were in Study One). Thus reticent subjects would be unlikely to make many requests initially, and would learn to increase their frequency of requests only as they experienced reinforcement for doing so. But the relatively short discussion time available limited this learning opportunity. We must also note that whenever requests to talk are not granted, that constitutes an extinction trial which should increase the frustration of would-be speakers and lower their motivation to request subsequent turns.

Another limitation on the effectiveness of the EQTS rule was the "down time" introduced by our computer-mediated talk turn system. Whenever no one was speaking, our PDP 11/34 system searched the waiting stack to see if anyone was requesting to speak, determined whose priority was highest, presented a CRT display to the chosen speaker instructing that person to press his/her talk button, checked that the button was pressed, activated the person's microphone, and then presented a final CRT display informing the person that he/she could now talk via the intercom system. The delay imposed by the time taken to proceed through all these steps may have dampened some of the eagerness of members to "jump in" with suggestions. It definitely imposed a more formal, slower procedure upon any spontaneous desire to speak one's mind. The restricted time in which a final group decision had to be reached and the imaginary survival scenario being enacted should have promoted high task involvement--which was then counteracted by the relative inefficiency of our system for transforming requests into talking turns. Future research and teleconferencing systems must incorporate more rapid procedures for allocation of turns.

The effects of the EQTS rule on performance were mixed. In Study One, where moderately shy people came to participate most of any group under the EQTS rule, their task performance was poorest. In contrast, the highest quality of team effectiveness was found in Study Two among teams that performed under computer-mediated conditions of EQTS, with the addition of prompts. Before discussing the role of prompts, two differences between these studies should be mentioned. In Study One the teams were homogeneous with regard to shyness level. Thus when each of the moderately shys began to request more than they ordinarily would (and

initially did) many of their requests were granted, giving them the unfamiliar opportunity to talk without interruption. But many of the increasingly frequent requests of any given team member were also ungranted since some others were given talk turns first. Because their task involved complex logic and memory for useful cues, we would expect poorer performance as a result of any conditions that interfered with full attention to the information processing activities required by this task. Frustrations and tension due to ungranted requests and the novelty of having access to the floor might be expected to limit attentional focus on the cognitively demanding task.

In Study Two, the survival task did not require the same close monitoring of the visual CRT display, and the task was more a matter of judgment than logical inference. In addition, the heterogeneous composition of the teams meant that half the members (the not shy) were likely to have high self-esteem, to generate initial suggestions and not be as adversely affected by ungranted requests as shys in Study One. Each team contained individuals who were accustomed to expressing their ideas and who were less likely to be distressed by a novel communication system which at first seemed to let them dominate but then, over time (as the shys began to participate more), granted fewer of their requests to speak.

We wonder what would happen to participation and group process if the nature of the computer-mediation rule in operation were made explicit to members of heterogeneous work teams. Future studies might attempt to do so and then, over time, fade out the rule to determine whether new distributions of turn taking were dependent on the EQTS rule for their maintenance or only for their activation and emergence.

Prompts

We were surprised to discover the substantial influence that prompts exerted across a range of process and outcome measures. In Study Two, when prompts were combined with the EQTS rule, the highest quality of team decision making resulted. In general, providing objective, "on-line" feedback about the extent of each member's participation served to suppress requests and talking by those who ordinarily dominated group discussions, while simultaneously acting as a stimulator for those members who tended to be passive listeners. Prompts altered the self-perceived role of shy team members; instead of seeing "listening" as their main contribution to their team, they saw themselves as playing a more active role, proposing solutions and structuring the discussion. In addition, as they participated more, shys felt more influential, and they enjoyed the EQTS condition with prompts more than any other experimental treatment.

The effects of prompts were more variable in Study Three, changing with the gender composition of teams. As in Study Two (which used female teams), among female teams in Study Three, prompts increased talking by the shy while decreasing talking by the not-shy. Moreover, perceived feelings of social influence corresponded to these effects of prompts on verbal participation; shy females felt more influential while not-shy females felt less so when in the prompts condition. We have no simple explanation for why prompts should have had an adverse effect upon talking

and feelings of influence among the shys in male and mixed-sex groups. Moreover, prompts made females in mixed-sex groups feel less influential.

Across all conditions of Study Three, the presence of prompts decreased the number of requests and also increased the average length of each request, significantly so for the shy. Time spent requesting by the shy increased over time with prompts, but decreased in their absence. In addition, the motivating effect of prompts on the shys was revealed by their increased perseverance; during the second discussion, they were less likely to cancel requests for talk turns when prompts were present.

Prompts may be thought of as analogous to group biofeedback. Prompts offer each person information about his or her responding, along with an opportunity to raise or lower participation and receive new feedback about the relative extent of each person's contribution. But unlike the usual biofeedback paradigm with a single subject's responding monitored, we are dealing with multiple feedback to four subjects. Each subject's goal is not to maximize talking time, but to effect some optimal level of personal participation while neither monopolizing the discussion time nor allowing other team members to do so.

Some people are naturally able both to participate in discussions and to keep track of the distribution of talking turns. For them, our prompts intervention would serve merely as an external validity check. There are others, though, who usually do not engage in that macro analysis of relative extent of participation, or who do so with some systematic bias, such as over- or under-estimating how much they themselves have talked. For those team members the objective feedback on individual contributions should generate tension among those whose low level of participation is made public and thus undeniable. Moreover, the implicit pressure to increase one's participation is both an incentive to take a more active role within the team and also a potential stressor. Prompts imply that low participators should depart from their customary base rate and engage in verbal behavior they ordinarily avoid because it is anxiety inducing.

Prompts may also signal to everyone the dominance of one subset of team members (such as males in mixed-sex groups) over another (females)—to the distress of those who are not contributing as fully as others. Among high frequency participators, prompts will inhibit requests for turns only if they accept the value of democratic participation and assess the potential contributions of the low contributors as likely to be worthwhile. If these two conditions are not present, prompts simply assure the dominant participators that they are taking verbal control of the conversation--and of the team.

Unfortunately, we were not able to introduce several planned variations in the nature of our prompts. Among those interventions that deserve systematic evaluation is the use of motivational prompting messages specifically designed to increase the participation of those who talk least during group discussions. Messages displayed only on the screens of these low participators may praise them when they do speak, either for the quality of their contributions or for the mere act of participating. Other messages may directly suggest that they request additional opportunities to speak. "You have not been heard from for a

while, Subject X. Do you have something to say now?" would be one of the positive inducement messages. It seems essential to introduce interventions which not only raise the gradients of approach (to taking a talk turn), but also lower avoidance gradients, if tension is to be reduced while participation is increased. In a similar vein, "suppression prompting" messages displayed solely on the screens of those who participate most may suggest that they allow their teammates more opportunities to participate. A suppression message might be: "Let's give some of the others more of a chance to talk, Subject X, to see if they can contribute to the group as you have."

It also seems worthwhile to study situations where each individual gets private feedback only on his or her own extent of participation. Participants would learn what percentage of the talking they themselves had done, but would not be explicitly told how much their teammates had contributed. Giving informational prompts that show only a single subject's relative participation percentages to him or her (probably the most or least frequent participator) might clarify our present findings. It would help to determine whether the bi-directional effects we have found stem from an interactional process wherein a reduction or increase in the responding of any group member is compensated for by others even in the absence of prompts specifically addressed to them.

Another experimental variation might introduce explicit participation norms for a team and then provide feedback on the approximation of members' behavior to those norms. For example, within a four-person team the participation norms might be that no one speaks more than a third of the time and no one less than a fifth of the time. The prompts might then indicate that the team as a whole is within that normative range or else reveal the individuals who are outside of those normative boundaries.

This variable of informational prompts has, to our knowledge, not been systematically studied before. It certainly merits further investigation, especially given the ease of operationalizing it.

Participation and performance

The use of the EQTS rule and also prompts within a computer-mediated teleconferencing system did change the extent of participation among team members. However, increased participation did not necessarily improve the quality of team decision making. Talking more does not mean talking better. Low participators may have simply enjoyed the opportunity to have increased access to talking turns without having more to contribute to the solution of the team's problem. Put differently, extending the distribution of talking turns may have a positive impact on the quality of team decisions only when reticent members with relevant expertise or special knowledge can be induced to talk more. Giving low-frequency participators information useful to the team will be of value only if they are also encouraged to share that information (as Aronson, 1978, has demonstrated with his "jigsawing" technique for distributing available information among team members). In subsequent research we have found that team solutions were best when one team member had been given extra information and also a high status role that increased her usually low level of participation and team influence (Linsenmeier & Zimbardo, 1982).

Participation is also affected by the nature of the task and by system constraints. Our survival tasks may have been less suitable for female involvement than male. The limited discussion times and forced decisions engendered a strong task focus among all team members while minimizing social-emotional aspects of normal group interaction. The highly structured nature of the task and formal operational rules probably functioned to reduce the usual effects of dispositional variables, such as shyness, on participation. They also prevented individuals from assuming roles subsidiary to that of the task-solution generator, roles such as critic, supporter, morale enhancer, etc.--especially given the time pressures present. With repeated team contact over time, interventions that alter participation rates gradually might be more likely to balance the distribution of talking turns, raise morale, lower tension, and also improve team performance.

Shyness and gender effects

Despite the suggestion that the structure of our task and procedures may have weakened participation differences between shy and not shy team members, and between females and males, nevertheless, important differences were found. The shy, as compared to their not-shy teammates, were found to: spend less time requesting talk turns, talk less, and rarely speak first. Females, when in mixed-sex teams, spoke less than did males and rarely initiated the discussion. While females in all-female teams spoke more than those in mixed-sex teams, males spoke more when in mixed-sex teams. These gender differences cannot be attributed solely to the masculinity of the survival task because all-female teams enjoyed the task more than any other type of team. It was only when they were in mixed-sex teams that female talk involvement was lowered and their enjoyment of the task reduced. We assume that this reflects learned patterns of dominance by males and deference by females when in task-oriented teams with members of the other sex.

As part of their learned response styles, males also tend to be active controllers, while females are more willing to be passive listeners. Over eighty percent of the males in all-male teams perceived their major contribution to be of an active, task-relevant nature, while less than sixty percent of the females in all-female teams responded similarly. In both all-female teams and mixed-sex teams nearly a third of the women adopted the role of passive listener to the input of others. Lower levels of participation by the shy and by women not only limit their potentially valuable contributions to team products, but also lessen the chance that they will be perceived as valuable team members in terms of their influence or leadership role.

Future research on the participation and performance of women in mixed-sex groups would benefit from separating sexual gender from sex-role stereotyped reactions. This could be done using sex role inventories (such as that of Bem, 1974, or Spence & Helmreich, 1978).

Suggested future research directions

Natural teams

In the present research the "team" paradigm is basically similar to that employed in almost all research on small-group problem-solving and decision making. Typically, teams are constructed ad hoc for a specific artificial task, come together as strangers for a limited time period and work on a task with minimal intrinsic motivation as well as without any expectation of significant costs for failure or gains for success. The task is often of an abstract, cognitive nature without personal relevance to the individual or the team beyond its intellectual challenge. The individuals have neither a past history as a unit nor the expectation of any common, shared future. Thus, it is likely that their commitment, empathy, rivalry, and many other social and personal attributes are quite different in quality and intensity from those in natural teams. Such teams may differ in fundamental ways from "natural teams," so much so that generalizations from the laboratory may yield little of value to our understanding of how to improve the performance of real-life teams. Once formed, many real work teams have a "life" that extends beyond attaining the solution to a single problem. The members work together over an extended time period; they may socialize together and be called upon to deal with personal problems of group members that are unrelated to their official task designation.

What is needed in future basic research and in "operations-focused" research are well-controlled experimental studies in which on-going teams are faced with a variety of problems over an extended period of time. Before a team is called upon to work on the solution of any particular problem, they should have previously interacted sufficiently long to have developed a sense of themselves as a group, as a distinctive functional unit. This means that a "social-emotional" climate will have at least been started. Members will have established some evaluation of each other's strengths, weaknesses, and personal characteristics.

The tasks should have a high degree of "mundane realism." They should simulate important features of real-life tasks facing different types of operational teams. Some of these tasks are repetitive "jobs" requiring coordinated efforts in a non-stressful setting without time pressures. Other tasks should be comparable to those faced in a high action setting, that is, characterized by: the stress of time pressures, uncertainty as to relevant parameters of the problem, and needs to integrate familiar information and practiced routines with novel inputs and creative solutions. There should be action-consequences of such decision making and rewards and penalties attendant upon the outcome of the recommended team action.

In such an extended time, repeated-task paradigm, one would be able to study processes and problems rarely addressed in the current literature on small groups. This longitudinal, in-depth analysis would allow the study of: (a) loyalty to the group; (b) sub-group coalitions; (c) development of social support systems; (d) emergent group norms; and (e) emergent leadership patterns.

In real life, teams are not stable over extended periods of time. Their composition changes due to sickness, promotion, transfer, and a variety of other reasons. An unanswered question is: How do on-going groups cope with changes in composition and structure? Beyond handling the stress of changing group composition is the stress groups face due to changing performance standards, job expectations, and so forth. Only an extended, repeated-measurements design would be able to address such issues.

We believe that our computer-mediated laboratory configuration could (with some modifications) be utilized to provide on-going teams with a range of simulated problems that are ego-involving and also tap important dimensions of social psychological and cognitive functioning. (Our preliminary attempts to study natural teams met with unanticipated difficulties and had to be abandoned. However, within a military context, such groups could be formed more readily and studied within a restricted locale and over a period of months).

Priority rules and communication socialization

By having members estimate the significance or value of each message they plan to transmit, and also each one received, researchers could study subjective values, members' level of confidence or "chutzpa," and disparities between self and other evaluations. With a system that can visually display on a CRT each potential speaker's name and the priority he/she feels is appropriate for his/her message, plus a waiting list of others who want the floor and their priority estimates, we could study how individual participation is affected by a number of new variables. Among these are relative differences in priority estimates and the number and "stature" of those in the waiting stack. In addition, these variables could be experimentally manipulated independent of their actual levels through false feedback.

In such a study we could utilize an operational definition of self-esteem as the discrepancy between an individual's stated priority level for each message request and the group's aggregated judgment of the value of these delivered messages. Through experimenter-moderated feedback, we could teach subjects to give socially appropriate priority estimates—one operational definition of communication etiquette. Furthermore, subjects could be pre-trained in the use of the major priority functions contained in Roberts Rules of Order (point of order, information, clarification, etc.), established on scales of 1-10 priority. This training would teach system users to distinguish between the social function of their message and its specific content, semantic features, or personally relevant significance. Such ongoing interactions could also be seen as a communication socialization procedure in which members learn to view their contributions from the perspective of others.

Another communication feature that could be investigated is the latency of responding. The system could impose "thought time-outs" before activating microphones and allowing participants to speak. Shy people seem to tolerate silence better than do the not shy. The latter are often motivated to say anything rather than to suffer the silence. By imposing

a system rule for silence tolerance, impulsive reactions by the not shy (and thus their greater total participation) should be suppressed.

Our three years of research on the utility of computer-mediated variables for enhancing participation, perception and performance outcomes of problem-solving teams has made us aware of the great potential of this paradigm. It can be used for investigating many issues in small group interaction and communication. Modes of persuasion and influence could be studied along with the communication of information. Measures of stress could be added profitably to the design in order to assess stress levels of different team members at given points in time during the problem-solving sequence. Low participants could be studied further in order to identify the sources of their inhibition, be they communication skills deficits, status concerns, low self-esteem, or chronic response styles of deference to assertive others. Remedial training procedures could then be instituted within the computer-based message system by silently introducing various mediational functions (and fading them out without the awareness of participants).

Ethnic and racial group membership are likely to operate as do shyness and gender differences. They, too, need to be studied within a standardized paradigm such as that which could be provided by an improved version of our computer-mediated message system. This system could then go beyond precise diagnosis of participation asymmetries to retraining team members by giving them experience in a controlled turn-taking "economy" with appropriate feedback. In addition, the system could be used as an evaluation instrument to determine the effectiveness of other, standard training procedures for promoting assertiveness or leadership skills.

With improvements in the speed of message handling, varied tasks, and rapid, on-line data analysis, this laboratory model should prove to be a powerful tool for studying small team communication and problem-solving. The long range goal of such future research will be to inform us of basic principles necessary for effective utilization of computer networks, teleconferencing, and other forms of machine-mediated interactions among people. If we are on the way to a "wired world," we will need to know much more than we do presently about how best to wire people to each other in order to obtain desired consequences for both those individuals and the institutions to which they belong. The research we have conducted constitutes a modest step along that path.

References

- Bales, R. F. Interaction process analysis: A method for the study of small groups. Cambridge, Mass.: Addison-Wesley, 1950.
- Bales, R. F. In conference. Harvard Business Review, 1954, 32(2), 44-50.
- Bavelas, A., Hastorf, A. H., Gross, A. E., & Kite, W. R. Experiments on the alteration of group structure. Journal of Experimental Social Psychology, 1965, 12, 55-70.
- Bem, S. The measurement of psychological androgyny. Journal of Consulting and Clinical Psychology, 1974, 42, 155-162.
- Brenner, M. W. Memory and interpersonal relations. Unpublished doctoral dissertation, University of Michigan, 1976.
- Brillouin, L. Science and information theory. New York: Academic Press, 1962.
- Chapanis, A. Interactive human communication. Scientific American, March 1975, 232(3), 36-42.
- Duncan, S. Some signals and rules for speaking turns in conversations. Journal of Personality and Social Psychology, 1972, 23, 283-292.
- Eady, P. M., & Lafferty, J. C. The subarctic survival problem. Plymouth, Michigan: Human Synergistics, 1975.
- Feehrer, C. Human factors in teleconferencing. In S. E. Goldin & P. W. Thorndyke (Eds.). Improving team performance: Proceedings of the Rand Team Performance Workshop. Santa Monica: Rand, 1980.
- Gerard, H. B. Some effects of status, role clarity, and group goal clarity upon the individual's relations to group process. Journal of Personality, 1957, 25, 475-488.
- Hare, A. P. Handbook of small group research. New York: The Free Press, 1976.
- Hatvany, N., & Zimbardo, P. G. Memory deficits as a function of evaluative anxiety among shy persons. Unpublished manuscript. Stanford University, 1978.
- Haythorn, W. A. The influence of individual members on the characteristics of small groups. Journal of Abnormal and Social Psychology, 1953, 48, 276-284.
- Henley, N., & Thorne, B. Sex differences in language, speech, and nonverbal communication. In B. Thorne & N. Henley (Eds.). Language and sex: Difference and dominance. Rowley, Mass.: Newbury House, 1975.

- Janis, I. L. Victims of groupthink: A psychological study of foreign-policy decisions and fiascos. Boston: Houghton Mifflin, 1972.
- Janis, I. L., & Mann, L. Decision making. New York: Free Press, 1977.
- Johansen, R., Vallee, J., & Collins, K. Learning the limits of teleconferencing: Design of a teleconference tutorial. In M. C. J. Elton, W. A. Lucas, & D. W. Conrath (Eds.). Evaluating new telecommunications services. New York: Plenum, 1978.
- Johansen, R., Vallee, J., & Spangler, K. Electronic meetings: Technical alternatives and social choices. Reading, Mass.: Addison-Wesley, 1979.
- Kelly, L. A rose by any other name is still a rose: A comparative analysis of reticence, communication apprehension, unwillingness to communicate, and shyness. Human Communication Research, 1982, 8, 99-113.
- Key, M. R. Linguistic behavior of male and female. Linguistics, 1972, 88, 15-31.
- Kramer, C. Women's speech: Separate but unequal? Quarterly Journal of Speech, 1973, 60, 14-24.
- Lafferty, J. C., & Webber, T. The desert survival problem II. Plymouth, Michigan: Human Synergistics, 1978.
- Leavitt, H. J. Some effects of certain communication patterns on group performance. Journal of Abnormal and Social Psychology, 1951, 46, 38-50.
- Linsenmeier, J. A. W., & Zimbardo, P. G. Effects of system and social variables on gender differences in communication and team decision making. ONR Technical Report Z-82-02. Stanford University, 1982.
- Maier, N. R. F., & Solem, A. R. The contribution of a discussion leader to the quality of group thinking. Human Relations, 1952, 5, 277-288.
- Mansbridge, J. J. Time, emotion, and inequality: Three problems of participatory groups. Journal of Applied Behavioral Science, 1973, 9, 351-368.
- Markel, N. N. Coverbal behavior associated with conversation turns. In A. Kendon, R. M. Harris, & M. R. Key (Eds.). Organization of behavior in face-to-face interaction. The Hague: Mouton, 1975.
- McCroskey, J. C. Special reports: Measure of communication-bound anxiety. Speech Monographs, 1970, 37, 269-277.

Newsweek, Reach out - and see someone. July 19, 1982, p. 51.

Parks, M. R. A test of the cross-situational consistency of communication apprehension. Communication Monographs, 1980, 47, 220-232.

Riecken, H. W. The effect of talkativeness on ability to influence group solutions to problems. Sociometry, 1958, 21, 309-321.

Ross, L., Amabile, T., & Steinmetz, J. Social roles, social control and biases in the social perception process. Journal of Personality and Social Psychology, 1977, 37, 485-494.

Sacks, H., Schegloff, E. A., & Jefferson, G. A. Simplest systematics for the organization of turn-taking for conversation. Language, 1974, 50, 696-735.

Shaw, M. E., & Penrod, W. T. Validity of information, attempted influence, and quality of group decisions. Psychological Reports, 1962, 10, 19-23.

Spence, J. T., & Helmreich, R. L. Masculinity and femininity: Their psychological dimensions, correlates, and antecedents. Austin: University of Texas Press, 1978.

Stodolsky, D. Machine-mediated group problem-solving: Therapy, learning, performance. (Doctoral dissertation, University of California, 1976). Dissertation Abstracts International, 1976, 37, 149-B (University Microfilms No. 76-19, 633).

Stodolsky, D. Group problem solving with automatic mediation. Paper presented at the Association for Development of Computer-Based Instructional Systems convention, San Diego, Feb.-Mar. 1979.

Stodolsky, D. Automatic mediation in group problem solving. Behavior Research Methods and Instrumentation, 1981, 13, 235-242.

Stodolsky, D., Bascom, L., & P. Zimbardo. Automatic facilitation of dialogue in shy and not shy problem-solving teams. Paper presented at the Western Psychological Association convention, San Diego, April, 1979.

Thorndyke, P. W., & Weiner, M. G. Improving training and performance of Navy teams: A design for a research program. Office of Naval Research Report, R-2607-ONR, July 1980.

Uhlig, R. P. Human factors in computer message systems. Datamation, May 1977, 120-126.

Williams, E. Experimental comparisons of face-to-face and mediated communication: A review. Psychological Bulletin, 1977, 84, 963-976.

Ziller, R. D. Scales of judgment: A determinant of the accuracy of group decisions. Human Relations, 1955, 8, 153-164.

Zimbardo, P. G. Shyness: What it is and what to do about it. Reading, Mass.: Addison-Wesley, 1977.

Zimbardo, P. G., Linsenmeier, J., Kabat, L., & Smith, P. Improving team performance and participation via computer-mediated turn taking and informational prompts. ONR Technical Report Z-81-01. Stanford University, 1981.

Zimmerman, D. H., & West, C. Sex roles, interruptions and silences in conversations. In B. Thorne & N. Henley (Eds.). Language and sex. Rowley, Mass.: Newbury House, 1975.

Footnotes

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² We thank the staff of Human Synergistics for permission to use these materials.

³ The program that was used to run this experiment is available from the author, Peter G. Smith, Ph.D., Building 420, Stanford, CA., 94305. The program runs using the UNIX version six operating system. You must have a valid UNIX license from Bell Laboratories to receive a copy of the program.

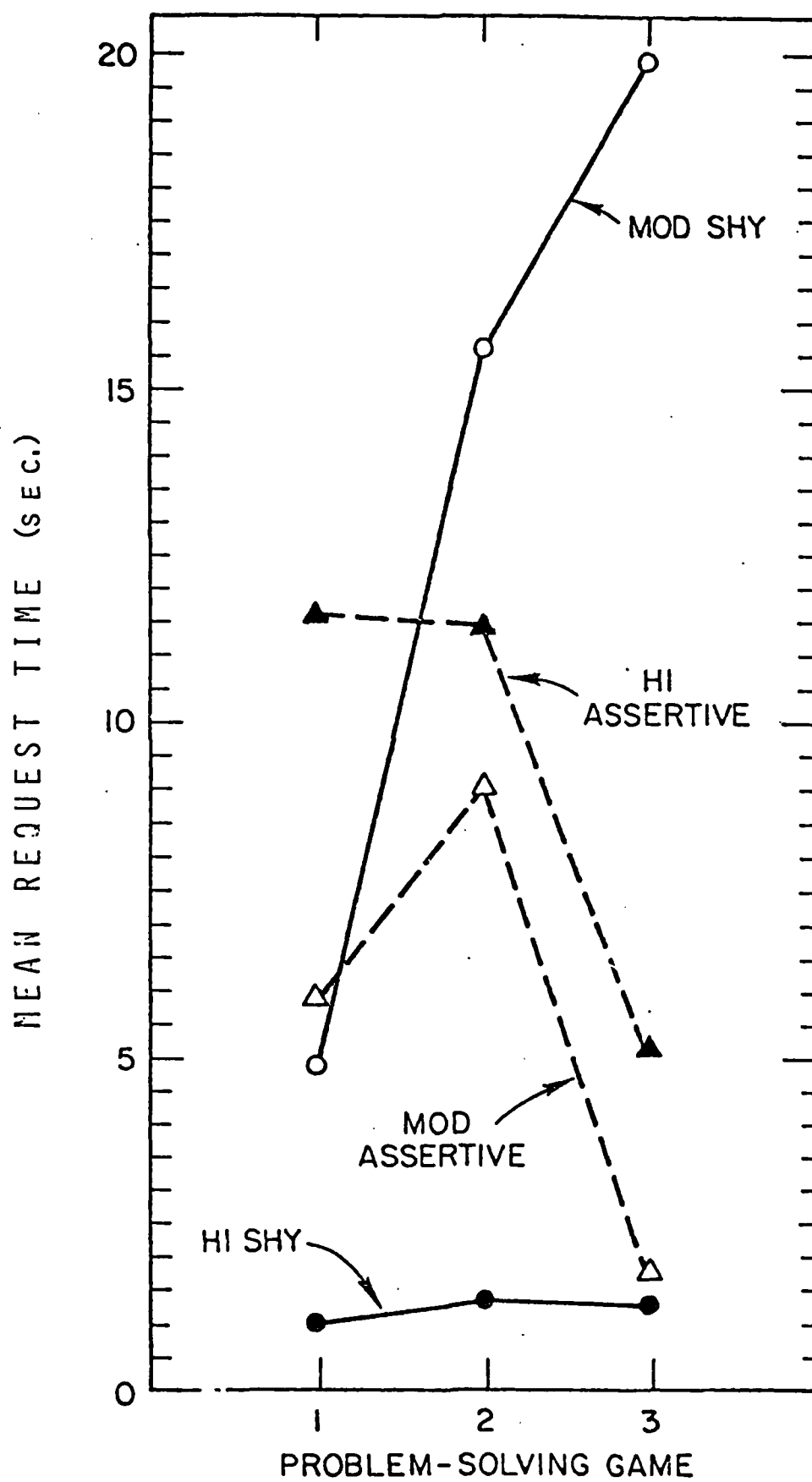


Figure 1.

Table 1

Mean seconds spent requesting to talk

	No Prompts	Prompts	Difference
Shy	128	233	-105
Not-shy	146	198	- 52
Difference	-18	+35	

Table 2

Mean score on item rankings as a function of prompts and
turn-taking rule (lower scores are better)

	FIFO	EQTS
No Prompts	26.5	23.0
Prompts	22.0	19.8

Table 3
 Perceptions of primary contributions
 to the group
 (percentages were calculated within each contribution category)

	NATURE OF CONTRIBUTION		
	Task relevant (new info., criticism)	Passive (listening)	Social-Emotional (improving group climate)
No prompts			
Shy	20 (24%)	10 (33%)	2 (14%)
Not-shy	24 (29%)	3 (10%)	5 (36%)
Prompts			
Shy	22 (26%)	7 (23%)	3 (21%)
Not-shy	18 (21%)	10 (33%)	4 (28%)
	(n = 84)	(n = 30)	(n = 14)

Table 4

Frequency of perceiving the group leader to be a person who is
shy or not-shy as a function of turn-taking rule

		Leader is:		
		Not-shy	Shy	Difference
Rule	FIFO	17 (85%)	3 (15%)	+70%
	EQTS	9 (45%)	11 (55%)	-10%

Table 5

Mean time spent talking (in seconds)

	Male Teams			Female Teams			Mixed Teams		
	Shy	Not-shy	Diff.	Shy	Not-shy	Diff.	Shy	Not-shy	Diff.
No Prompts	191	180	-11	130	236	+106	172	190	+18
Prompts	161	184	+23	177	156	-21	161	179	+18

All Teams

	Shy	Not-shy	Diff.
No Prompts	164	202	+38
Prompts	166	173	+7

Table 6

Mean ratings of the degree to which their team's decisions
reflected their own contributions

(1 = very little, 5 = very much)

	Male Teams		Female Teams		Mixed Teams	
	Shy	Not-shy	Shy	Not-shy	Shy	Not-shy
No Prompts	3.6	3.8	3.3	4.0	3.9	3.3
Prompts	3.4	3.8	3.6	3.6	3.3	3.6

Table 7

Mean ratings of personal frustration

	Shy	Not-shy
No Prompts	1.87	2.02
Prompts	2.07	1.67

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List of Appendices

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- Appendix 2. Computer displays viewed by team members (arctic survival situation).
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Appendix 1. Experimenter's introductory speech.

My name is _____ and I work with Dr. Zimbardo. We'd like to thank you for coming to participate in our study. As you know, we are interested in the ways groups go about solving problems presented to them. Before we actually begin the discussion, let me give you some more information.

Your group — the four of you — will be faced with the problem of deciding how best to survive in an arctic situation. We would like you to imagine that the four of you are the actual people faced with this survival problem. That is, you should approach the task as if your "life" or "death" really depended on what you do. Your "life" or "death" will be determined by how well you share information and ideas so that your team can come to a consensus and can make decisions which will enable you to survive.

At the end of the session today, your decisions will be compared to those suggested by experts on survival techniques, so you will be able to see how well you would have done in the actual situation. One other thing I'd like to mention is that, in addition to giving you research credit (or paying you \$3.00) for your participation, we'll be awarding cash bonuses to the teams that do best.

Any questions so far?

For convenience I'll assign you each a subject number. Please remember this number, as it will be referred to in later instructions. (Assign S#'s, following specifications on E's Record Sheet. Then, hand out clipboards and pencils.) Now, please sign the consent form and fill out the confidential subject information form. Actually, most of the information form is already filled out for you. You just have to write 3 numbers. (Wait for Ss to fill out their forms.)

O.K., now let me give you some technical information that you'll need. One of the special features of our research is the use of telecommunication in place of face-to-face conversation. We'll be moving soon to another room where each of you will be seated in front of a video monitor. Each monitor is a computer terminal which is wired to a computer. The situation you'll be discussing will be described in detail on your monitors. You will communicate with the other members of your team, and they with you, by means of your computer terminals and a specially designed intercom system.

There will be some group discussion periods during which you will be able to share your ideas. Whenever you want to talk during group discussions, you have to follow some special rules. First, you must indicate that you want to talk by pressing button R (for request). The R button will be located on a small grey box next to your terminal. It is NOT the R key on the terminal keyboard. In case someone else is talking, you should always hold down button R as long as you still want a chance to say something when your teammate has finished. Sometimes your request will be acknowledged right away, and sometimes you will have to wait awhile for your turn.

When the computerized communication system is ready to accept your input, your video monitor will indicate that it is your turn with the words: "Subject #X, you may talk next." The X will be replaced with your subject number. For example, if you were Subject #1, then when it was your turn to talk, you'd see the message: "Subject #1, you may talk next." Then, while still holding down button R, you should press button T (for talk) in order to have your microphone function. So at that point you're holding down two buttons. You may release button R only when you see the words "Begin to talk" appear on the screen.

Button T will also be located on the small grey box next to your terminal. It is NOT the T on the terminal keyboard. You will not be heard unless you press and hold down button T as long as you are talking. When you release it, your microphone will go dead until the next time you choose to talk. (Demonstrate the procedure using the back of your clipboard.) I'll show each of you your R and T buttons when we go into the other room.

Each time you speak you'll have an upper time limit of one minute. You can stop talking earlier than that if you want to by just releasing your T button, but the computer will always cut you off if you have been talking for a minute. In general, the time you will have to solve the difficult survival problem facing your team will be limited, so you must be alert and respond according to the rules of this special communication system. Your team will be penalized for violations of these rules:

1) You can communicate with the other members of your team only through your terminals and the intercom system.

2) Press and hold down button R when you want to request to talk. Hold it down until the computerized system indicates that it is your turn and you see the words "Begin to talk."

3) Press and hold down button T when you are talking to the others. Be careful not to say anything to your teammates unless the system says you may talk and you are holding down your T button.

I should also point out that you never have to type in anything on your terminal until the system asks you to. If it seems to just be sitting there doing nothing, it's probably just waiting for the others to get to a certain point. For example:

1) Sometimes you'll be told to type the letter "g" to go on, and you'll type "g" and nothing will happen. What's happening is that the program is waiting until all of you have typed "g" and indicated that you're ready to proceed.

2) Sometimes when you have typed a response, the response won't show up on your screen till other people type their responses. Don't type in your answer again. Just be patient and wait.

3) Sometimes you'll know what the next question you'll have to answer will be and you'll know how you want to answer it. That's fine. Just remember your answer. But don't type it in until you're asked to.

If you type too many things, or type when you're not supposed to, the system may malfunction.

Are there any questions about any of this?

Although I'll be in the experimental room to be sure the system is working properly, I won't be able to answer any questions once the session begins. But, of course, you can ask for and receive information during the group discussions from the other members of your team. The four of you will be on your own. All the instructions and information you'll need will be on your monitor, so be sure to pay attention to it. The first thing you'll read on your screens will be a review of the information I've just given you here.

O.K., now why don't you hand me your clipboards, and then we can move on to the other room. It's just around the corner. When we get there, each of you should sit in front of a particular terminal, depending upon your subject number. Subject #1 should be closest to the door, Subject #2 should be next, Subjects #3 next, and Subject #4 furthest from the door we'll go in. Let's go over there and get seated now. (Collect clipboards and go to the terminal room.)

Appendix 2. Computer displays viewed by team members (arctic survival situation).

[MICROPHONES OFF]

One of the special features of our research is the use of telecommunication in place of face-to-face conversation. You will communicate with the other members of your team, and they with you, by means of your computer terminal and your microphone-earphone intercom system.

There will be several discussion periods during the experimental session. Whenever you want to talk during a discussion period, you must indicate that by pressing button "R" (for request). This button is located on the small, grey box which is next to your terminal. It is NOT the "R" key on the terminal keyboard. You can press button "R" when someone else is talking or during silent periods. If someone else is talking, you should hold button "R" down as long as you still want a chance to say something when your teammate has finished.

When the computerized communication system is ready to accept your input, your video monitor will indicate that it is your turn with the words:

"Subject # X, you may talk next" (X will be replaced with your number.)

Then, while still holding down button "R", press button "T" (for talk) in order to have your microphone function. Do not release button "R" until you see the words "Begin to talk" appear on the screen. Button "T" is also located on the small, grey box which is next to your terminal. It is NOT the "T" key on the terminal keyboard. You will not be heard unless you press and hold down button "T" as long as you are talking. When you release it, your microphone will go dead until the next time you choose to talk. Each time you speak, you will have an upper time limit of 1 minute.

The time you will have to discuss the difficult survival problems facing your team will be limited, so you must be alert and respond according to the rules of this special communication system. Your team will be penalized for violations of these rules:

1) You can communicate with the other members of your team only through your terminal and your microphone-earphone intercom system.

2) Press and hold down button "R" when you want to request to talk. Hold it until the computerized system indicates that it is your turn and you see the words "Begin to talk".

3) Press and hold down button "T" when you are talking to the others.

In addition to communicating with your teammates using your microphone, you will also be answering questions by typing responses on your keyboard. At various points during this session, the computerized system will print a question on your screen, and you will be asked to type a response to the question. The system will always indicate when a typed response from you is required. It will never be necessary for you to type anything until you are specifically asked to do so. Even if you know what the next question will be and how you want to respond, wait till the question is asked before typing your answer.

Subject #_, please type the initials of your name (and return)

[MICROPHONES OFF]

THE SITUATION

[You can review the entire situation after it has been displayed by typing "s" on your keyboard.]

It is approximately 2:30 p.m., October 5th and you have just crash-landed in a float plane on the east shore of Laura Lake in the subarctic region of the northern Quebec-Newfoundland border. The pilot was killed in the crash, but the rest of you are uninjured. Each of you is wet up to the waist and has perspired heavily. Shortly after the crash, the plane drifted into deep water and sank with the pilot's body pinned inside.

The pilot was unable to contact anyone before the crash. However, ground sightings indicated that you are 30 miles south of your intended course and approximately 22 air miles east of Schefferville, your original destination, and the nearest known habitation. Schefferville (pop. 5,000) is an iron ore mining town approximately 300 miles north of the St. Lawrence, 450 miles east of the James Bay/Hudson Bay area, 800 miles south of the Arctic Circle, and 300 miles west of the Atlantic Coast. It is reachable only by air or rail; all roads end a few miles from town. Your party was expected to return from northwestern Labrador to Schefferville no later than October 19th and filed a Flight Notification Form with the Department of Transportation via Schefferville radio to that effect.

The immediate area is covered with small evergreen trees (1 to 4 inches in diameter). Scattered in the area are a number of hills having rocky and barren tops. Tundra (arctic swamps) make up the valleys between the hills and consist only of small scrubs.

Approximately 25 percent of the area in the region is covered by long, narrow lakes which run northwest to southeast. Innumerable streams and rivers flow into and connect the lakes.

Temperatures during October vary between 25 and 36 degrees Fahrenheit, although it will occasionally go as high as 50 and as low as zero. Heavy clouds cover the sky three quarters of the time, with only one day in ten being fairly clear. Five to seven inches of snow are on the ground; however, the actual depth varies enormously because the wind sweeps the exposed areas clear and builds drifts three to five feet deep in other areas. The wind speed averages 13-15 miles per hour and is mostly out of the west-northwest.

You are all dressed in insulated underwear, socks, heavy wool shirts, pants, knit gloves and caps, sheepskin jackets, and heavy boots. Collectively, your possessions include: \$153 in bills; \$2.28 in change; 1 pocket knife (2 blades and an awl which resembles an ice pick); and one lead pencil.

Before the plane drifted away and sank, you were able to salvage 10 items. One of your tasks will be to rank these items according to their importance to your survival.

You may assume—

1. the number of survivors is the same as the number on your team;
2. you are the actual people in the situation;
3. all items are dry and in good condition.

To repeat the Situation, type "s". To go on, type "g". You will not have another chance to see the Situation if you type "g".

[MICROPHONES OFF]

First, please decide which ONE strategy will be best for your survival.

- Strategy 1 Start walking out toward the town now.
- Strategy 2 Wait at the crash site until morning and then all start walking out.
- Strategy 3 Send one or two people for help.
- Strategy 4 Stay at the crash site indefinitely.
- Strategy 5 Stay at the crash site for 2 days and then start walking.
- Strategy 6 Stay at the crash site for 4 days and then start walking.

Please type the number of that strategy (and return)

[Error message: Invalid response]

[MICROPHONES OFF]

Now, please decide which four of these problems you feel will be the greatest you face in your efforts to survive. Do not discuss your decisions with your teammates at this point.

- Problem 1 Obtain more fire wood.
- Problem 2 Obtain more food.
- Problem 3 Decide who should go for help.
- Problem 4 Figure out how to navigate.
- Problem 5 Construct signalling devices.
- Problem 6 Construct a shelter.
- Problem 7 Minimize body heat loss.
- Problem 8 Calm down after crash and stay calm.

Is Problem 1 one of the four greatest you will face?
Type "y" for Yes or "n" for No (and return)

[The question is repeated for each of the seven remaining problems; entered responses are displayed to the left of the Problems.]

[Error message: Invalid response
If more than four y's or four n's have been entered, the
error message reads: There must be exactly 4 Y's and 4 N's]

[MICROPHONES OFF]

Your team will now have 500 seconds to discuss and reach agreement on which one strategy to follow and which four problems will be the greatest you face in your efforts to survive. Remember to communicate with your teammates by means of the button pressing rules and to watch your screen for information. Each time you are allowed to talk, you will have an upper limit of one minute to speak. A clock (at the bottom of your screen) will indicate the time remaining.

The discussion may begin as soon as the message "discussion time remaining" appears on your screen.

When the discussion time is up, each member must indicate what the group has decided.

Type "g" to go on

[MICROPHONES ON ACCORDING
TO R AND T BUTTON RULES]

PICK THE BEST STRATEGY:

Strat 1	Start walking out now	Strat 4	Stay at site indefinitely
Strat 2	Wait till morning, then go	Strat 5	Stay at site for 2 days
Strat 3	Send 1 or 2 people for help	Strat 6	Stay at site for 4 days

PICK THE FOUR GREATEST PROBLEMS YOU FACE:

Prob 1	Obtain fire wood	Prob 5	Build signalling devices
Prob 2	Obtain more food	Prob 6	Construct a shelter
Prob 3	Decide who should get help	Prob 7	Minimize body heat loss
Prob 4	Figure out how to navigate	Prob 8	Calm down and stay calm

IN PROMPTS CONDITIONS:

Percent time talked so far:

Subject #1 ____ %
Subject #2 ____ %
Subject #3 ____ %
Subject #4 ____ %

ON SPEAKER'S SCREEN:

Subject #__, you may talk next.
Press your T button. Do not
release your R button until you
see "Begin to talk".

Begin to talk
Your seconds remaining ____

Discussion time remaining ____

ON OTHER SCREENS:

The speaker is Subject #__

Discussion time remaining ____

[This display remains on the screen for 500 seconds.]

[MICROPHONES OFF]

TIME FOR DISCUSSION IS UP

Each team member must now indicate the group's decision by typing in the appropriate strategy number (and return). All of you must give the same response.

Please decide which one strategy will be best for your survival.

- Strategy 1 Start walking out toward the town now
- Strategy 2 Wait at the crash site until morning and then all start walking out
- Strategy 3 Send one or two people for help
- Strategy 4 Stay at the crash site indefinitely
- Strategy 5 Stay at the crash site for 2 days and then start walking
- Strategy 6 Stay at the crash site for 4 days and then start walking

Please type in the number of that strategy (and return)

Responses: _ _ _ _

[If subjects do not all type the same number, the question is reasked, and the experimenter explains what is happening. If subjects cannot reach agreement, the experimenter types "?" on one terminal, and the program proceeds to the next question.]

[MICROPHONES OFF]

Now, each team member must indicate the group's decision by typing "y" for Yes or "n" for No in response to each question about the problems you face.

Please decide which four of these problems will be the greatest you face in your efforts to survive.

- Problem 1 Obtain more fire wood
- Problem 2 Obtain more food
- Problem 3 Decide who should go for help
- Problem 4 Figure out how to navigate
- Problem 5 Construct signalling devices
- Problem 6 Construct a shelter
- Problem 7 Minimize body heat loss
- Problem 8 Calm down after crash and stay calm

Is Problem 1 one of the four greatest you face?
Type "y" for Yes or "n" for No (and return)

Responses: _ _ _ _

[Question is repeated for each of the seven remaining problems; agreed-upon responses are displayed to the left of the problems.]

[If subjects do not all type the same response, the question is asked again, and the experimenter explains what is happening. If subjects cannot reach agreement, the experimenter types "?" on one terminal, and the program proceeds to the next question.]

[MICROPHONES OFF]

- Item 1 A gallon of maple syrup
- Item 2 A sleeping bag per person (arctic type down-filled with liner)
- Item 3 A 20' x 20' piece of heavy duty canvas
- Item 4 13 wood matches in a metal screwtop, waterproof container
- Item 5 250 ft. of 1/4 inch braided nylon rope, 50 lb test
- Item 6 An operating 4 battery flashlight
- Item 7 3 pairs of snowshoes
- Item 8 Safety razor shaving kit with mirror
- Item 9 A hand axe
- Item 10 One aircraft inner tube for a 14 inch wheel (punctured)

These are the 10 items which your team was able to salvage. Your task is to rank these items according to their importance for your survival. You will have 60 seconds to look over and think about the items before you have to make any decisions.

After the 60 seconds, you will be asked to indicate your ranks of the items, from most important to least important. When asked, type in the number (and return) of the item corresponding to each rank. Please answer each question as quickly as possible.

Do not discuss your ranks with your teammates at this point.

[This display remains on the screen for 60 seconds.]

[MICROPHONES OFF]

Rank

- Item 1 A gallon of maple syrup
- Item 2 A sleeping bag per person (arctic type down-filled with liner)
- Item 3 A 20' x 20' piece of heavy duty canvas
- Item 4 13 wood matches in a metal screwtop, waterproof container
- Item 5 250 ft. of 1/4 inch braided nylon rope, 50 lb test
- Item 6 An operating 4 battery flashlight
- Item 7 3 pairs of snowshoes
- Item 8 Safety razor shaving kit with mirror
- Item 9 A hand axe
- Item 10 One aircraft inner tube for a 14 inch wheel (punctured)

Please type the number of the most important item (and return)

[The question is repeated for each of the nine remaining ranks (2nd most important, 3rd most important, etc.); entered ranks are displayed to the right of the items.]

[Error message: Invalid response or
That item has already been ranked.]

[MICROPHONES OFF]

Your team will now have 500 seconds to discuss and come to agreement on the ranks of the items. Remember to communicate with your teammates by means of the button pressing rules and to watch your screen for information. Each time you are allowed to talk, you will have an upper limit of one minute to speak. A clock (at the bottom of your screen) will indicate the time remaining.

The individual rankings of each team member will be displayed on your screen. The numbers that appear in each column are the ranks which you assigned to the corresponding item.

The discussion may begin as soon as the message "Discussion time remaining" appears on your screen.

When the discussion time is up, each team member must indicate the group's decision by typing in the appropriate Item number (and return) in response to each question.

Type "g" to go on

[MICROPHONES ON ACCORDING
TO R AND T BUTTON RULES]

Subj. 1 Subj. 2 Subj. 3 Subj. 4

Item 1 maple syrup
Item 2 sleeping bag
Item 3 canvas
Item 4 matches
Item 5 rope
Item 6 flashlight
Item 7 snowshoes
Item 8 shaving kit w/ mirror
Item 9 hand axe
Item 10 inner tube

[Subjects' individual rankings
of the items are displayed here.]

IN PROMPT'S CONDITIONS:

Percent time talked so far:

Subject #1 ____ %
Subject #2 ____ %
Subject #3 ____ %
Subject #4 ____ %

ON SPEAKER'S SCREEN:

Subject #__, you may talk next.
Press your T button. Do not
release your R button until you
see "Begin to talk".

Begin to talk
Your seconds remaining ____

Discussion time remaining ____

ON OTHER SCREENS:

The speaker is Subject #__

Discussion time remaining ____

[This display remains on the screen for 500 seconds.]

[ALL MICROPHONES ON]

TIME FOR DISCUSSION IS UP.

Each team member must now indicate the group's decision by typing in the appropriate item number (and return) in response to each question.

You will have one minute per question.

If you wish, you may continue to talk with one another. However, the communication rules are now changed. There is now open communication. All microphones are on. Anyone may speak without pressing "R" or "T".

Type "g" to go on

[ALL MICROPHONES ON]

Rank

- Item 1 A gallon of maple syrup
- Item 2 A sleeping bag per person (arctic type down-filled with liner)
- Item 3 A 20' x 20' piece of heavy duty canvas
- Item 4 13 wood matches in a metal screwtop, waterproof container
- Item 5 250 ft. of 1/4 inch braided nylon rope, 50 lb test
- Item 6 An operating 4 battery flashlight
- Item 7 3 pairs of snowshoes
- Item 8 Safety razor shaving kit with mirror
- Item 9 A hand axe
- Item 10 One aircraft inner tube for a 14 inch wheel (punctured)

Please type the number of the most important item (and return)

Responses: _ _ _ _

[The question is repeated for each of the nine remaining ranks (2nd most important, 3rd most important, etc.); agreed-upon ranks are displayed to the right of the items.]

[If subjects do not all type the same response, the question is asked again, and the experimenter explains what is happening. No default response is used here. The subjects discuss the items till they reach agreement. In order to speed them up, however, they are led to believe that there is a time limit for each question.]

[MICROPHONES OFF]

[At this point, the group process questionnaire is presented. Each question appears on a separate screen. The screen advances to the next question after the subject types an answer (and return).]

Group Process Questionnaire

Before continuing with the next part of the session, please answer the following questions about the dynamics in your group while you were working on the survival situation task. Type in the number (and return) corresponding to your answer.

1. How much did you enjoy this survival situation task?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

2. How involved were you in the survival situation task?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

3. Can you imagine yourself being in such a survival situation?

- 1 = yes
- 2 = no

Your response:

4. How good do you think your team's decisions were?

- 1 = poor
- 2 = fair
- 3 = acceptable
- 4 = good
- 5 = very good
- 6 = excellent

Your response:

(questionnaire continued on next page)

5. Do you feel your group had a leader?

- 1 = yes
- 2 = no

Your response:

6. If you feel your group had a leader, what was that person's subject number?

- 1 = Subject #1
- 2 = Subject #2
- 3 = Subject #3
- 4 = Subject #4
- 5 = there was no leader
- 6 = there was a leader, but I'm not sure what the leader's number was

Your response:

7. Did all team members contribute equally to the final decision process?

- 1 = yes, all contributed equally
- 2 = no, I contributed more than others
- 3 = no, some other person contributed most
- 4 = no, a sub-group (including me) contributed most
- 5 = no, a sub-group (excluding me) contributed most

Your response:

8. How much did the teams's decisions reflect your contributions?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

9. Of how much value were your contributions to the team's decision-making process?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

(questionnaire continued on next page)

10. In which ONE way did you most contribute to your team?

- 1 = listened carefully to others
- 2 = gave constructive criticism to others
- 3 = gave new information
- 4 = encouraged others to contribute
- 5 = helped create a positive group atmosphere
- 6 = raised pertinent questions
- 7 = none of the above

Your response:

11. Which was the next most important way you contributed to your team?

- 1 = listened carefully to others
- 2 = gave constructive criticism to others
- 3 = gave new information
- 4 = encouraged others to contribute
- 5 = helped create a positive group atmosphere
- 6 = raised pertinent questions
- 7 = none of the above

Your response:

12. To what extent did the others pay attention to your contributions?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

13. How frustrated did you become while reaching the team decisions?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

14. How much tension do you think there was in the group?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

(questionnaire continued on next page)

15. How much did you influence the team's final decisions?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

16. How much were your evaluations of the strategies, problems, and items changed as a consequence of your discussions with the others?

- 1 = very little
- 2 = little
- 3 = some
- 4 = quite a bit
- 5 = very much

Your response:

17. Which team member most influenced your evaluations? (Exclude your own subject number)

- 1 = Subject #1
- 2 = Subject #2
- 3 = Subject #3
- 4 = Subject #4

Your response:

18. How do you feel the special telecommunication system affected the group's problem solving?

- 1 = very detrimental
- 2 = somewhat detrimental
- 3 = no effect
- 4 = somewhat beneficial
- 5 = very beneficial

Your response:

19. How do you feel the special telecommunication system affected your own degree of participation in the group's decision-making process?

- 1 = very detrimental
- 2 = somewhat detrimental
- 3 = no effect
- 4 = somewhat beneficial
- 5 = very beneficial

Your response:

Appendix 3. Alternate stimuli for the desert survival situation.

THE SITUATION

It is approximately 10:00 A.M. in mid August and you have just crash landed in the Sonora Desert in southwestern United States. The light twin engine plane, containing the bodies of the pilot and the co-pilot, has completely burned. Only the air frame remains. None of the rest of you has been injured.

The pilot was unable to notify anyone of your position before the crash. However, he had indicated before impact that you were 70 miles south-southwest from a mining camp which is the nearest known habitation, and that you were approximately 65 miles off the course that was filed in your VFR Flight Plan.

The immediate area is quite flat and except for occasional barrel and saguaro cacti appears to be rather barren. The last weather report indicated the temperature would reach 110 degrees that day, which means that the temperature at ground level will be 130 degrees. You are dressed in light weight clothing — short-sleeved shirts, pants, socks and street shoes.

Everyone has a handkerchief. Collectively, your pockets contain \$2.83 in change, \$85.00 in bills, a pack of cigarettes, and a ballpoint pen.

Before the plane caught fire your group was able to salvage 10 items. One of your tasks will be to rank these items according to their importance to your survival.

You may assume—

1. the number of survivors is the same as the number on your team;
2. you are the actual people in the situation;
3. all items are in good condition.

Strategy Choices

- ___ 1. Start walking now toward the road.
- ___ 2. Wait at the crash site until dark and then all start walking out.
- ___ 3. Send one or two people for help.
- ___ 4. Stay at the crash site indefinitely.
- ___ 5. Stay at the crash site for 2 days and then start walking.
- ___ 6. Stay at the crash site for 4 days and then start walking.

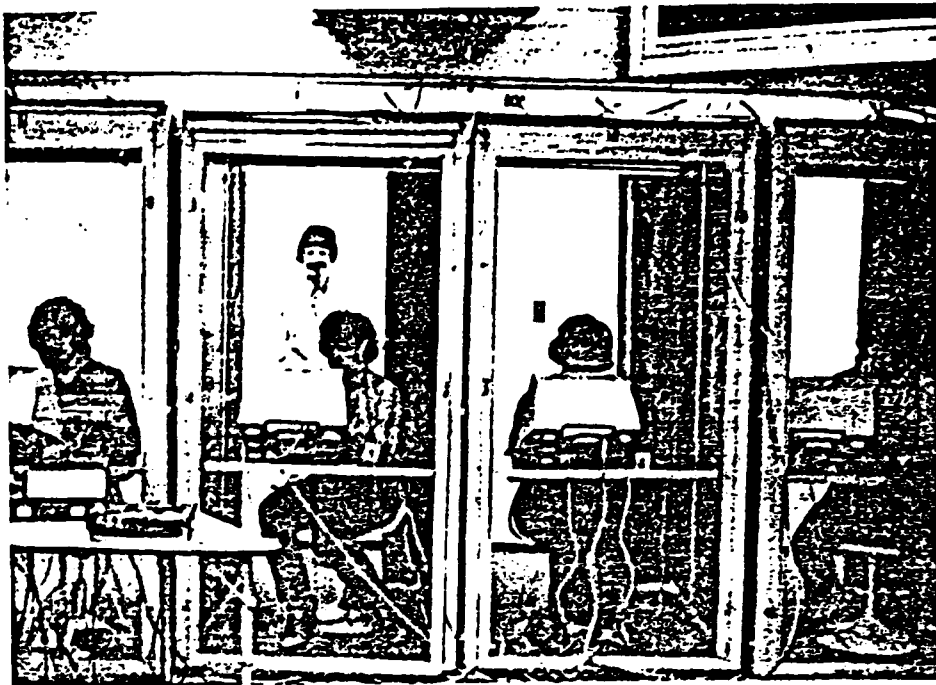
Problem Choices

- ___ 1. Obtain more water.
- ___ 2. Obtain more food.
- ___ 3. Decide who should go for help.
- ___ 4. Figure out how to navigate.
- ___ 5. Construct signalling devices.
- ___ 6. Keep warm at night.
- ___ 7. Minimize body water loss.
- ___ 8. Calm down after crash and stay calm.

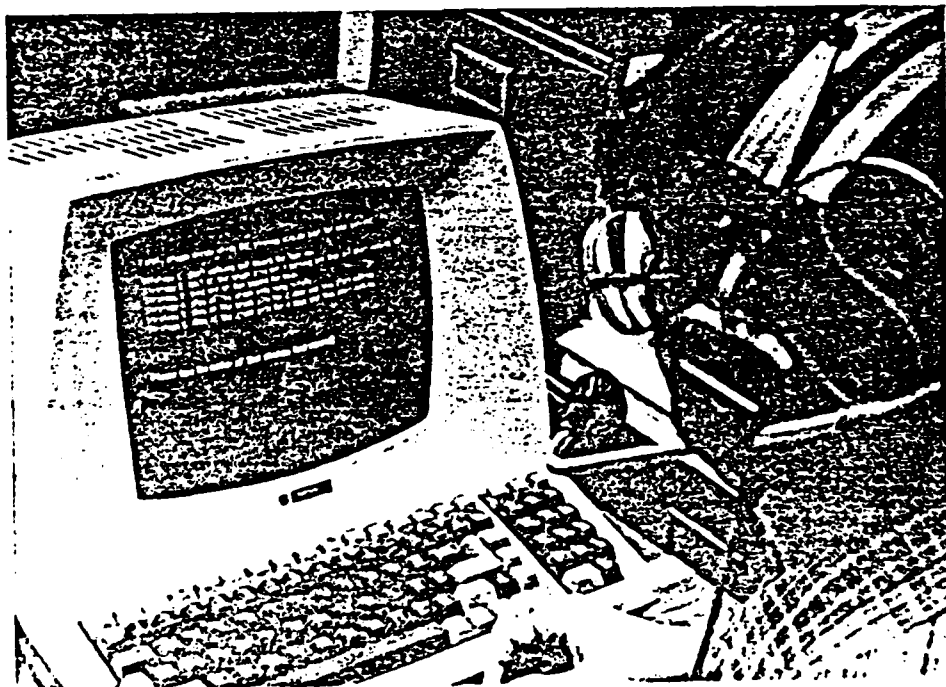
Items to be Ranked

- ___ 1. A flashlight (four battery size)
- ___ 2. A jack knife
- ___ 3. Plastic raincoat (large size)
- ___ 4. Compress kit with gauze
- ___ 5. .45 caliber pistol (loaded)
- ___ 6. A parachute (red and white)
- ___ 7. One quart of water per person
- ___ 8. A pair of sunglasses per person
- ___ 9. One top coat per person

Appendix 4. Photographs of team members in our telecommunication arrangement.



Four team members in adjacent cubicles interacting via intercom and computer terminals (while experimenter observes).



Team member wearing headset receives information on her CRT and prepares to type her response.

END

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