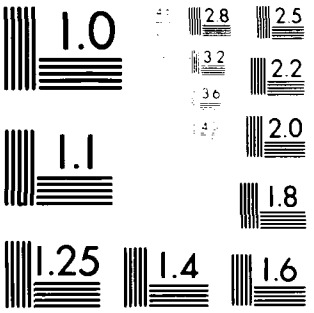
AD-A097 028 STANFORD UNIV CA DEPT OF PSYCHOLOGY F/G 5/10
IMPROVING TEAM PERFORMANCE AND PARTICIPATION VIA COMPUTER-MEDIA--ETC(U)
MAR 81 P G ZIMBARDO, J LINSENMEIER, L KABAT N00014-78-C-0425
UNCLASSIFIED TR-Z-81-01 NL

1 OF 1
AD A
097028

END
DATE
FILMED
4-81
DTIC


1.0
2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6

LEVEL II

(12)

STANFORD UNIVERSITY

Department of Psychology

AD A097028

DTIC
ELECTE
MAR 30 1981
S D
E

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DTIC FILE

81 3 27 010

LEVEL II (12)

Improving team performance and participation via computer-mediated turn taking and informational prompts

Philip Zimbardo Joan Linsenmeier Peter Smith
Stanford University

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

Accession For
NTIS GRA&I ☒
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A

DTIC
E

ONR Technical Report: Z-81-01
March, 1981

Approved for public release;
Distribution Unlimited

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) (14) TR-Z-81-01

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER
Technical Report Z-81-01

2. GOVT ACCESSION NO.
AD-A097028

3. RECIPIENT'S CATALOG NUMBER

4. (6) TITLE (and Subtitle)
Improving team performance and participation via computer-mediated turn taking and informational prompts.

5. TYPE OF REPORT & PERIOD COVERED
(9) Technical Report

6. PERFORMING ORG. REPORT NUMBER

7. (10) AUTHOR(s)
Philip G. Zimbardo, Joan Linsenmeier, Loren Kabat & Peter Smith

8. (15) CONTRACT OR GRANT NUMBER(s)
ONR N00014-78-C-0425

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Professor Philip G. Zimbardo
Psychology Department, Stanford University
Stanford, California 94305

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
NR 170-866

11. CONTROLLING OFFICE NAME AND ADDRESS
Office of Naval Research (Code 452)
Organizational Effectiveness Research Programs
Arlington, Virginia 22217

12. (11) REPORT DATE
Mar[redacted]81

13. NUMBER OF PAGES
-34-

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)
(12) 40
Office of Naval Research
Stanford University, Stanford, CA 94305

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

PROBLEM-SOLVING	COMPUTER MEDIATION	SURVIVAL PROBLEMS
TEAM EFFECTIVENESS	TURN-TAKING RULES	INFORMATIONAL PROMPTS
GROUP DECISION-MAKING	ENHANCED PARTICIPATION	SHYNESS
TELECOMMUNICATIONS	SIMULATION GAMES	WOMEN'S TEAMS

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The coordinated problem-solving behavior of four-person groups of previously unacquainted individuals was investigated using a novel methodological paradigm. Group discussions during a simulated survival game were mediated by a computer program that resolved conflicts among group members in their requests to talk. Under a first-in/first-out (FIFO) rule, the first person to make a request was given the first opportunity to talk. When discussions were governed by an equal timesharing (EQTS) rule, conflicts among requesters were resolved by allowing the person to speak first who had spoken least up to

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED 403110

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19. Keywords (continued)
COMMUNICATION APPREHENSION HUMAN SYNERGISTICS
VERBAL BEHAVIOR

20. Abstract (continued)

that time. A second independent variable studied was the use of informational prompts consisting of periodic computer displays of the total participation time for each group member. In addition to examining the role of these factors in problem-solving, we also focused on an individual difference variable that typically biases level of participation, namely shyness, or communication apprehension.

These variables were shown to influence each of three major types of outcome variables, extent of participation, perception of group process, and quality of team performance.

Sixty-four college women participants were assigned to sixteen four-person groups. Each group included two shy and two not-shy women. Every group discussed one survival task under FIFO rules and a second task under EQTS rules. Groups were always required to reach a consensus. Half of the groups received informational prompts during both survival tasks; the others got no such prompts.

Among the effects found for prompts are:

1. equalizing the amount of talking among shys and not-shys by reducing the high level of participation of the not-shys while increasing that of the shys;
2. increasing the time shys are willing to spend requesting (waiting for) a turn to talk;
3. balancing shys' and not-shys' views of their personal influence on other members of the group (the not-shys typically feel more influential);
4. increasing the number of not-shy group members who report "listening to others" as their primary contribution, while making shys less passive and more likely to initiate task relevant actions or provide social-emotional inputs;
5. leading to a higher quality of team performance on the major problem-solving measure.

The EQTS turn-taking rule had its most profound effect by enhancing team problem-solving performance. This effect was strongest when EQTS was coupled with the opportunity to receive informational prompts. In general, shy subjects also appear to enjoy performing under the EQTS rule more than the FIFO rule (when prompts are available).

If this pattern of results is sustained in our research in progress (with mixed-sex groups and also with experienced teams), we may be able to propose training procedures that improve group morale and team performance via more democratic participation of all team members.

****

Improving team performance and participation via computer-mediated turn taking and informational prompts[1]

Philip G. Zimbardo Joan Linsenmeier Peter Smith

Stanford University

Loren Kabat

Health Sciences Center

State University of New York at Stony Brook

Abstract

The coordinated problem-solving behavior of four-person groups of previously unacquainted individuals was investigated using a novel methodological paradigm. Group discussions during a simulated survival game were mediated by a computer program that resolved conflicts among group members in their requests to talk. Under a first-in/first-out (FIFO) rule, the first person to make a request was given the first opportunity to talk. When discussions were governed by an equal timesharing (EQTS) rule, conflicts among requesters were resolved by allowing the person to speak first who had spoken least up to that time. A second independent variable studied was the use of informational prompts consisting of periodic computer displays of the total participation time for each group member. In addition to examining the role of these factors in problem-solving, we also focused on an individual difference variable that typically biases level of participation, namely shyness, or communication apprehension.

These variables were shown to influence each of three major types of outcome variables, extent of participation, perception of group process, and quality of team performance.

Sixty-four college women participants were assigned to sixteen four-person groups. Each group included two shy and two not-shy women.

Every group discussed one survival task under FIFO rules and a second task under EQTS rules. Groups were always required to reach a consensus. Half of the groups received the informational prompts during both survival tasks; the others got no such prompts.

Among the effects found for prompts are:

1. equalizing the amount of talking among shys and not-shys by reducing the high level of participation of the not-shys while increasing that of the shys;
2. increasing the time shys are willing to spend requesting (waiting for) a turn to talk;
3. balancing shys' and not-shys' views of their personal influence on other members of the group (the not-shys typically feel more influential);
4. increasing the number of not-shy group members who report "listening to others" as their primary contribution, while making shys less passive and more likely to initiate task relevant actions or provide social-emotional inputs;
5. leading to a higher quality of team performance on the major problem-solving measure.

The EQTS turn-taking rule had its most profound effect by enhancing team problem-solving performance. This effect was strongest when EQTS was coupled with the opportunity to receive informational prompts. In general, shy subjects also appear to enjoy performing under the EQTS rule more than the FIFO rule (when prompts are available).

If this pattern of results is sustained in our research in progress (with mixed-sex groups and also with experienced teams), we may be able to propose training procedures that improve group morale and team performance via more democratic participation of all team members.

Many situations arise daily that call for the concerted efforts of individuals to formulate group solutions to their common problems. Some groups rely primarily on perceptual-motor skills and operate directly on the environment. By contrast, the task of other groups is to process information in symbolic representations of their environment. Among the purposes of these latter teams are usually: threat appraisal, reward seeking, situation assessment, planning, decisionmaking and control. When such teams are subunits of a larger organization, their performance can have far reaching consequences for both individuals and purposes beyond their immediate group. For example,"each Navy ship comprises several closely integrated teams that contribute to command decisionmaking" (Thorndyke & Weiner, 1980). Each ship itself is a higher order team when functioning as part of a particular fleet operation. Thus actions of individuals must be coordinated so they become smoothly functioning teams that can contribute effectively to satisfaction of personal, team and institutional goals. Because of the degree to which team performance can influence organizational effectiveness, we need to know more than we currently do about what determines how well teams perform their tasks.

The quality and utility of team decisions depend on at least four classes of factors: task, communication medium, personal, and social. Task factors include difficulty, novelty, structure, feedback and time-stress. The medium incorporates variations in communication patterns and information transmission, such as face-to-face or via telecommunication. Among the many personal factors are individual differences in skills, motivation, expectations and response style. Roles, rules, group composition and prior training history are

important aspects of the social dimension of group problem-solving.

The present research addresses the question of how to improve the quality of team decision-making within a paradigm that provides information about all four of these factors. We begin with the operating assumption that procedures which balance and equalize participation levels within a team will also lead to better quality group products and more positive group attitudes.

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). 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 group members to take the initiative, while they themselves either follow or reject plans proposed by the more active members. In some cases, such individuals make immediate social comparisons within their group, 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 group 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 the presence of a group 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. Again, an individual may sometimes anticipate that his or her contributions to a group discussion will not be well received and, therefore, decide not to make the contributions. Alternatively, a "nonconscious ideology" (Bem & Bem, 1970) based on exposure to certain social and cultural conditions may lead an individual to adopt a passive and deferential style of interacting in particular settings.

What are the consequences of this self-censoring, this failure 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 share their ideas with the others. But, as Bales points out, there is another side to this. "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 group member to simply have an idea or possess information that will be useful to the group as a whole. If the idea or information is not presented, or not presented forcefully enough, it 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 "groupthink" solutions that may be nonoptimal, or even pathological (Janis, 1972). 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). These byproducts may prove especially beneficial in a team which interacts repeatedly over an extended period of time.

In the study to be presented here, a specially designed electronic telecommunication system was used to test the effectiveness of two techniques for equalizing the participation of team members in decision-making discussions. Groups were formed so that each contained some members who were normally outspoken in group situations and others who were more apprehensive about voicing their thoughts. The latter type

of individual was designated as shy, and the former as not-shy. "Shy" seems to be a highly appropriate label for people with low levels of participation in conversations with peers (cf. Hayes and Sievers, 1972) and, in fact, our preliminary research showed that those who feel less comfortable speaking in groups typically view themselves as shy. Furthermore, shy individuals have been found to denigrate excessively their own worth, to conform more to the attitudes of dominant members of their groups, and to have lower morale in business and military settings (Zimbardo, 1977 and subsequent unpublished studies).

The norms and standard operating procedures present in most groups for determining "who talks when" may work to the disadvantage of shy individuals. One normally gains the floor in a group setting through a variety of verbal and nonverbal techniques, e.g., raising one's hand or interrupting the current speaker. Shy people may feel less comfortable engaging in such behaviors and/or be less aware of or skilled in techniques for doing so effectively. Typically those who are not shy initiate public responding sooner and in bolder ways that are more likely to be recognized by others. Thus, their requests to talk are more often transformed into actual talking opportunities.

Using our electronic system we were able to compare the effectiveness of two different rules for determining who was given an opportunity to speak. 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. Under the first-in/first-out rule, the person who had pressed the request button first was given a chance to speak as soon as an opening occurred. This rule might be expected to work against shy

individuals who feel less certain that they have something worthwhile to say and thus feel 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. The second rule used in our study, an equal timesharing rule, was more democratic. Under this rule, whenever noone 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.

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 (Bales, 1954). Merely letting people see how closely this norm is being adhered to may increase its influence. 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 share may come to talk more. Thus another variable in this study (not previously investigated) 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 group process variable to study since providing such information is within the capabilities of various telecommunication systems currently in operation.

The three independent variables in this study, then, are turn-taking rule, presence of informational prompts, and individual shyness level. Groups 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 groups were given informational prompts containing information on the participation levels of each individual. The other half were not provided with this information. The three classes of dependent variables included:

1. Participation in discussions. We recorded how often, and for how long, each team member spoke during the group discussions. We also recorded how long individuals spent pressing their "request to talk" buttons.
2. Perceptions of group dynamics. Group members were asked to assess their own and others' contributions to the group, as well as their satisfaction with their group experience.
3. Quality of decisions. Group decisions were compared to those made by experts on the topics under discussion.

The primary goal of this research program is to uncover means of improving the quality of group decisions. We believe that this can be achieved in part through widening the group's participatory base by decreasing the degree to which certain individuals dominate group discussions. Equalizing participation levels of typically passive and typically assertive individuals should lead these two groups to feel equally important to the team. Increased identification with the team can, in turn, come to exert powerful social influences on the group process, promoting perseverance, competitive motivation, interpersonal attraction, and personal satisfaction. We expected that use of the equal timesharing rule and informational prompts would reduce differences in participation levels among group members, improve group decisions, and lead to more favorable perceptions of the group experience.

The ideal, then, is to have a team which when faced with a decision-making task utilizes the skills and expertise of all of its members to reach the best possible decision as efficiently as possible. An optimal group process will lead to the development of positive attitudes toward the team experience and the other group members. Such conditions are likely to minimize the deleterious influence of certain individual difference variables (e.g., shyness) and improve the quality of future team performance.

Method

Subjects. Sixteen four-woman groups participated in this study. Most of the sixty-four women were enrolled in introductory psychology classes at Stanford University (a few were students previously enrolled in that course). Prior to serving in our experiment none of the four women in a given group were well acquainted with one another. For their participation, subjects received either $3.00 plus credit towards their course research requirement, or $6.00, if course credit was not desired.

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 subarctic. 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 decisionmaking, subjects were also told that a cash prize would be awarded to the team that made the best decisions on each of the problems. Each woman was then assigned a subject number between 1 and 4, which she was told to remember.

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 of the row of subject stations and Subject #4 at the other end. 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 problem, answering a set of self-report questions about perceptions of the dynamics within the group and one's own participation, then working on the second survival task, and finally answering another set of questions on the group's performance and interactions. A debriefing session followed in which subjects' questions were answered and additional information 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 group members were to work on and to present them with specific decisions which they were to make. Participants indicated their decisions by typing their answers to specific questions on their terminal keyboards. These responses were automatically recorded in a computer file.

During certain segments of the experimental session, group 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 depressed her talk button in order to activate her microphone. When a person's microphone was activated, all other group members could hear what she was saying through their earphones. During this time the other three group members could not be heard since only one person's microphone was activated during a given talk turn.

Group 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 duration 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 record of each occurrence 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., who pressed or released a button, and when it occurred.

Experimental tasks. The two survival problems worked on by each group 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 each participant's screen. Next, they read a description of the desert or subarctic 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, 1979, of Human Synergistics.) Group 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 subjects 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 group might follow; each subject selected the one that she thought would give the group its best chance of survival. The next display was a list of ten items supposedly salvaged from the wreck; each subject ranked the items according to how much each item could contribute to the group'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, thus yielding pre-measures of individual decisions.

When all group 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, group 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 group members had entered their common rankings of all ten items, their display screens were cleared, and they were asked to complete a 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 group 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 (but not our interest in shyness). 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 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 prompting.

Shyness or reticence

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. An additional questionnaire was used to determine how apprehensive or reticent each woman was about speaking in front of other people (the McCrosky Personal Report of Communication Apprehension, McCrosky, 1970). Our groups were formed so that each contained two women who considered themselves shy and also scored above average in communication apprehension, i.e., were relatively uncomfortable about

speaking in public. The other two women in each group 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 group 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 group was governed by a first-in/first-out (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, a more democratic, equal timesharing (EQTS) rule was used to resolve conflicts in turn-taking requests: Whenever more than one woman wanted to speak, the one who had spoken least thus far was allowed to speak first. Half the groups were constrained by the computer to follow the FIFO rule for the desert survival situation and the EQTS rule for the subarctic 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 groups 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 groups.

Informational prompts

Finally, during the computer-mediated group discussions half of the groups saw displays on their screens indicating what percentage of the time each of the four team members had spoken thus far. Each person was

identified by subject number in this display, and the display was updated every few seconds throughout the discussion period. The other half of the groups were not provided with this informational prompt.

Dependent variables. Three types of data were generated during each experimental session: participation, perceptions and performance. The first data set reflects the kind and degree of 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 comes from a participant's responses to the group dynamics questionnaire, i.e., her perception of roles within the group, personal contributions, etc. Finally, there is the data on problem-solving performance based upon decisions about the viability of survival strategies, the seriousness of problems, and the value of the various available items. The decisions of each group were compared to those recommended by experts in the fields of desert and arctic survival.

Results

The study described in this report is intended to be the first in a series of ongoing studies. Preliminary analysis of this initial set of data indicated that several intriguing relationships and patterns of differences failed to reach traditional levels of statistical significance. The primary data for these analyses are data for groups as a whole, rather than data for individuals. Since this study involved only sixteen groups and we are now testing additional groups with a similar paradigm, we are delaying more complex analyses (discriminant function analysis, path analysis, etc.) until data for more groups are available. We can then combine the data from these additional groups with the data described here in order to yield larger cell sizes and better tests of our more complex hypotheses. For the present, dependent variables which may be related in interesting ways are examined independently of one another.

Initial examination of our data indicated that changes in turn-taking rule had few effects. A ready explanation for this null effect is the fact that there were few instances per group in which the rule in operation 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 both a shy and a not-shy person had requested to speak and the not-shy person had pressed her request button first. Then our system 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 be effective. In the others, two not-shy women both wanted to speak, or a shy individual's request preceded that of a not-shy individual, and so forth.

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.

Participation effects

Three behavioral effects validate our selection procedure for assigning subjects 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 (Brodt & 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 ($\chi^2 = 9.03$, $p < .01$).

Also, as might be expected, shys talked less often than did the not-shys. The mean number of talking turns for the shys was 4.90, while the not-shys talked an average of 7.06 times per game. This significant difference ($t = 2.51$, $df = 7$, $p < .05$) 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: not-shy $\overline{X} = 4.09$, shy $\overline{X} = 4.00$; p = ns. Thus the interaction of shyness and prompts was marginally significant ($t = 1.96$, $df = 14$, $p < .10$).

Comparable findings were noted for the measure of mean seconds spent talking. Without prompts not-shys talked a minute more than shys, on the average, 167 vs. 103 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 ($t = 1.66$, $df = 14$, $p < .15$).

Not only do shys talk less often, for a shorter duration than their not-shy peers, but they also spend less time requesting to talk when not prompted to do so: not-shy $\overline{X} = 146$ sec., shy $\overline{X} = 127$ sec. This not significant difference is reversed when prompts are introduced into the communication system, as can be seen in Table 1.

Table 1

Mean seconds spent requesting to talk

	No prompts	Prompts
Not-shy	146	198
Shy	127	233

This dramatic increase in request time of the shys, which nearly doubles the duration of time they keep their request button depressed, is highly significant ($t = 3.16$, $df = .14$, $p < .01$). The increase in request time of the not-shys under the informational pressure of the prompts is smaller, but still significant ($t = 3.27$, $df = 14$, $p < .05$).

In contrast to this pattern of differences, is the similarity between shys and not-shys in their <u>number</u> of requests to talk. Without prompts not-shys make 10.94 requests vs.10.34 for the shys. The presence of prompt information markedly suppresses requests to talk in both groups down to an average of only 6.25 requests for each of them. This decline

in request frequency due to prompts is highly significant ($t = 7.87$, $df = 14$, $p < .001$).

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, $\bar{X} = 4.44$ ($t = 2.22$, $df = 14$, $p < .05$).

Another effect of prompts was to reduce not-shy subjects' judgments of the value of their own contributions to their teams' decisions. Without prompts the not-shys' evaluation ($\bar{X} = 3.84$) was higher than with prompts ($\bar{X} = 3.44$). In addition, without prompts, not-shys saw their contributions as more valuable than shys saw the contributions they themselves had made ($\bar{X} = 3.84$ vs. 3.28; $t = 2.35$, $df = 7$, $p < .10$), and this shy/not-shy difference was eliminated by prompts.

A similar pattern was found for the measure of how much subjects felt they had influenced their team's final decisions. Again, the highest ratings of personal influence were given by not-shys who had discussed the problem without prompts, and the not-shy/shy difference without prompts ($t = 2.12$, $df = 7$, $p < .10$) was eliminated when prompts were given. The usual tendency for not-shy individuals to see themselves as more influential is also reflected in subjects' responses to a question about who, if anyone, contributed most to the group'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 subjects in both categories to perceive all team members as contributing equally. A measure of actual influence on group decisions suggests that subjects 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 group, 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.

When asked about the nature of their primary contribution to the group, about half (47 percent) reported it was offering new information. As can be seen in Table 2, a majority of subjects (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 of the group by encouraging others, making jokes, etc.

Two interesting effects emerge 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.

Table 2

Frequency with which subjects see different behaviors as their primary contribution to the group (% are of category total)

	Task relevant (new info., criticism)	Passive (listening)	Social-Emotional (improving group climate)	
No prompts				
not-shy	24 (29%)	3 (10%)	5 (36%)	n=32
shy	20 (24%)	10 (33%)	2 (14%)	n=32
Prompts				
not-shy	18 (21%)	10 (33%)	4 (28%)	n=32
shy	22 (26%)	7 (23%)	3 (21%)	n=32
	n = 84	n = 30	n = 14	n=128

The perception of group leadership is altered considerably by the nature of the turn-taking rule in operation. Among those subjects who specify a particular person as the group leader (60% do not), the person named is not-shy 85% of the time under the FIFO rule. However, one effect of the equal timesharing rule is to "democratize" the leadership ($\chi^2 = 5.38$, $p < .05$), as can be seen in Table 3. Similarly, under FIFO there were 9 groups 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 group (χ^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 groups (5 for not-shys and 6 for shys).

Table 3

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

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

Several curious findings emerged around issues of perceived tension during the group discussion and frustration while reaching the team decision, as shown in Table 4. The equal timesharing rule resulted in less feeling of frustration than did the first-in/first-out rule among both shys and not-shys ($t = 1.754$, $df = 15$, $p < .10$). Prompts made shys

Table 4

Mean ratings of perceived personal frustration and tension as a function of turn-taking rule and prompts

	Frustration				Tension	
	FIFO	EQTS	Prompts	No Prompts	Prompts	No Prompts
not-shy	1.8	1.6	1.7	1.7	1.7	1.9
shy	1.9	1.7	2.0	1.6	2.1	1.7

feel more frustrated that did playing the simulated survival games without prompts ($t = 1.520$, $df = 14$, $p < .15$). This result contrasts with the somewhat reduced level of tension reported by the not-shys in the presence of prompts compared to no prompts.

Task performance

The most important effect that our experimental interventions had upon group problem-solving was improving the quality of the 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). Group decisions were superior when prior discussions had been governed by our computer-mediated equal timesharing rule rather than by the FIFO rule. A comparison of whether each group performed better under EQTS or FIFO yielded a near significant statistical difference, $p < .06$ (one-tailed, sign test). The mean score of 21.4 for EQTS solutions was somewhat 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, favorably influenced the quality of group decisions regarding survival item rankings. With prompts the average group score was 20.1, and without prompts group average scores were poorer, $\bar{X} = 24.8$ ($t = 1.732$, $df = 14$, $p < .07$, one-tailed).

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 5. The very best decisions occurred in groups 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, the FIFO, no prompts condition. This significant difference ($t = 2.163$, $df = 14$, $p < .05$) provides perhaps the

Table 5

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

	FIFO	EQTS
Prompts	22.0	19.8
No Prompts	26.5	23.0

strongest support for our novel methodological paradigm designed to enhance the quality of team decisions by altering participation patterns during small group problem solving.

Discussion

Previous shyness research by the senior author (Zimbardo, 1977; Pilkonis and Zimbardo, 1979) has noted the generally lower rate of participation of shys in social, as well as job-related, interations. Additional unpublished data gathered by our research team also suggested that shy naval personnel tend to experience less job satisfaction than do their non-shy peers. A comparable finding was uncovered in an industrial setting. Shy salesmen and managers had generally poorer morale than did not-shy co-workers. They felt that their contributions were not being acknowledged and that they were being passed over for promotions, raises and bonuses. They (and their supervisors) were aware that what they said and did was often less visibly obvious than the comparable actions of not-shy workers. Finally, we have found that shyness is negatively related to leadership effectiveness. Cadets at the U.S. Military Academy at West Point who were shy had much lower ranks than not-shy cadets on a composite index of leadership effectiveness (taken at the end of their first year of training).

Such findings led us to develop the present paradigm for increasing group participation of individual members who are often too reticent to contribute to the group process. Their passivity prevents the group from benefitting from their knowledge, skills or values. Moreover, their minimal level of direct involvement forces the not-shy group members into an excessively active role where they talk and direct rather than sometimes listening and reflecting. It was the guiding assumption of this research that procedures which would serve to homogenize participation levels among typically high and low frequency participators would result in improved problem-solving performance as well as a better sense of group cohesion and morale.

Despite the artificial constraints imposed by the present telecommunications system and the computer-mediated rule system, most group members became involved in the simulated survival tasks and enjoyed their participation. Some of the shy subjects even reported a preference for the anonymity possible in such telecommunications, that obviously is not possible in face-to-face problem-solving situations.

The utility of computer-mediated turn-taking rules for governing small group problem-solving was pioneered by Stodolsky 1976 A pilot study in our laboratory (Stodolsky, Zimbardo, & Bascom, 1978) revealed the potential of this paradigm for modifying participation levels of moderately shy males (but not those extremely shy) when working on logic-based, problem-solving tasks. Their requests to talk increased over time with exposure to the EQTS rule, as did the efficiency and quality of team problem-solving.

The present study reports comparison findings for women working in teams on a quite different type of task. The EQTS rule had the primary effect of improving the quality of final team decisions. It exerted a slight influence on participation and some aspects of group process, when coupled with the presence of informational prompts. The absence of a more substantial boost in participation may be traced to the relatively few occasions when conflicts arose among group members over simultaneous requests to talk (where computer mediation would be invoked to resolve such conflicts). This artifact may be reduced by several strategies: incentives for individual as well as team performance, use of a task with greater "mundane realism", and reduced delay times between subject actions and computer-displayed feedback. Programming improvements and the use of a microprocessor in conjunction with our computer will increase the tempo of the problem-solving interactions in our future work. We plan to

experiment with incentives and alternative tasks as well in order to generate high frequencies of requesting so that the power of computer-mediation may be more effectively assessed. However, it should be apparent that this system is of little value to those whose level of participation is extremely low, i.e., rarely initiate requests to talk.

For this reason we introduced a little studied variable into the design, that of informational prompting. By providing frequent information about the amount of time each group member had participated, we expected to generate a dual effect of suppressing excessive talkers while stimulating infrequent participators. This is precisely what we found. Prompts had rather pervasive effects in altering participation, perception of group process and even quality of group performance, especially in conjunction with the EQTS rule. Prompts eliminated the tendency for not-shys to dominate discussions. They increased request to talk time of the shys, as well as their actual amount of talking. Moreover, the presence of prompts created the perception of more equitable levels of influence among shys and not-shys, as well as altering leadership patterns of these two groups. The basic passive listening posture of the shys and the active task-direction of the not-shys was also modified by prompts. More not-shys began to listen and more shys began to give task relevant information. It is perhaps the better balancing of these roles within groups that mediated the final major effect of prompts: improving the group's decisions about the relative importance of survival items. The optimal conditions found in this study for generating group decision-making outcomes that most resemble those of experts is for discussions to be governed by the EQTS rule while participation is more democratically balanced by the operation of informational prompts.

Our future research will investigate variations in prompts, group composition, prior group experience and task structure using the computer-mediated turn-taking rules.

Informational prompts can be directed at the two highest or two lowest participators, rather than providing complete information to all members. Or, we may try giving only a single subject's relative participation percentages to him or her. In this way, we can determine whether the bi-directional effects in the present study stem from having available multiple sources of external information or from the interactional process wherein reduction or increase in responding of any group member is compensated for by one or more of the others even in the absence of prompts specifically addressed to them.

Motivational prompts will be employed that direct personal appeals to one or more group members. "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. A suppression message might also be used, such as "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."

Because of the recent changes in the composition of military and industrial work teams to include more mixed-sex and mixed racial and ethnic groups, we plan to study some of these variations using the standard paradigm presented in the present study. In addition, we hope to analyze the effects of turn-taking rules and prompts in groups composed of all high or all low participators, in addition to the mixed-level groups we have been studying.

In real life problem-solving situations, it is rarely the case that groups of strangers come together for the first time to work on important

problems. Usually, individuals have a history of association prior to working on a significant problem-solving task. Out of their prior association, they develop expectations about each other's strengths and weaknesses and even distribute roles informally among the members. Does such a history of team membership help or hinder problem-solving of different kinds compared to that of ad hoc teams composed of strangers? Are such teams more affected by changes in personnel than the ad hoc teams or are they better equipped to respond to change? Our planned research with ongoing teams will help to answer such questions.

In this endeavor we are in accord with the evaluation by Thorndyke and Weiner (1980) that: "the greatest leverage in team performance research can be attained by focusing research on teams [italics ours] that receive and evaluate dynamic information and perform time-stressed decisionmaking." (p.7). By utilizing our highly standardized and objective system for studying inputs to and outputs of team problem-solving, we may accumulate a coherent body of knowledge across diverse studies. We will also be better able to collaborate and cooperate with other independent investigators interested in understanding the dynamics of team performance and developing strategies for increasing team effectiveness.

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, 1, 55-70.

Bem, S. L., & Bem, D. J. Case study of a nonconscious ideology: Training the woman to know her place. In D. J. Bem, Beliefs, attitudes, and human affairs. Belmont, Cal.: Brooks/Cole, 1970.

Brodt, S. E., & Zimbardo, P. Modifying shyness-related social behavior through symptom misattribution. Journal of Personality and Social Psychology, 1981, in press.

Eady, P. M., & Lafferty, J. C. The subarctic survival problem. Plymouth, Mich.: Human Synergistics, 1975.

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.

Hayes, D. P., & Sievers, S. A sociolinguistic investigation of the "dimensions" of interpersonal behavior. Journal of Personality and Social Psychology, 1972, 24, 254-261.

Haythorn, W. A. The influence of individual members on the characteristics of small groups. Journal of Abnormal and Social Psychology, 1953, 48, 276-284.

Janis, I. L. Victims of groupthink: A psychological study of foreign-policy decisions and fiascoes. Boston: Houghton Mifflin, 1972.

Lafferty, J. C., & Webber, T. The desert survival problem, II. Plymouth, Mich.: 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.

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.

McCroskey, J. C. Special reports: Measure of communication-bound anxiety. Speech Monographs, 1970, 37, 269-277.

Pilkonis, P. A., & Zimbardo, P. G. The personal and social dynamics of shyness. In C. E. Izard (Ed.), Emotions in personality and psychopathology. New York: Plenum Press, 1979.

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

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

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., Zimbardo, P., & Bascom, L. Automatic facilitation of dialogue in shy and not shy problem-solving teams. Paper presented at the Western Psychological Association Convention, San Diego, April, 1978.

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.

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.

Footnote

[1]We with to thank Chris Romer for his invaluable assistance scheduling and testing many of the subjects. Aaron Weiss assisted with the design and construction of the subject request-talk apparatus. The computer program was based in part on the general model developed by David Stodolsky (1976). We thank the staff at Human Synergistics for allowing us to use their simulation exercises.

DATE
ILMED
-8