UNIVERSITY OF ARIZONA
39001013414019

Group Communication Through Computers

Volume 3
Pragmatics and Dynamics

Jacques Vallee
Robert Johansen
Hubert Lipinski
Kathleen Spangler
Thaddeus Wilson
Andrew Hardy, Consultant

INSTITUTE FOR THE FUTURE

R-35

A final report of research conducted under Grant GJ-35 326X
from the National Science Foundation, Division of
Mathematical and Computer Sciences

GROUP COMMUNICATION THROUGH COMPUTERS

Volume 3: Pragmatics and Dynamics

QA
76.9
C66
G7
V.3

Jacques Vallee
Robert Johansen
Hubert Lipinski
Kathleen Spangler
Thaddeus Wilson
Andrew Hardy, Consultant

Supported by:

National Science Foundation
Grant GJ-35 326X

Institute for the Future
2740 Sand Hill Road
Menlo Park, California 94025

October 1975

Report R-35

SEP 18 78

". . . I sit down at the terminal and all of these people talk to me in little letters that run across the face of the CRT faster than I can read them! I can easily distinguish personalities and moods, although my view of the people behind them may be somewhat warped. I tend to regard them as little people who, when they speak, open their mouths and make little letters run across my CRT. . . . Other than that, they are very much like me or you."

- A FORUM User

TABLE OF CONTENTS

LIST OF FIGURES vii

LIST OF TABLES. xi

LIST OF PROPOSITIONS xiii

PROJECT STAFF AND ACKNOWLEDGMENTS xv

OVERVIEW OF THE REPORT. xvii

I. INTRODUCTION: ANALYTICAL FRAMEWORK 1

Characteristics of Computer Conferencing 4

A Case History Approach to Evaluation 8

II. CASE HISTORIES: FIVE STYLES OF COMPUTER CONFERENCING 19

Style 1: The Notepad 21

Style 2: The Seminar 24

Style 3: The Assembly 30

Style 4: The Encounter 34

Style 5: The Questionnaire 51

III. THE DYNAMICS OF COMPUTER CONFERENCING 57

Basic Communications Variables In Computer Conferencing 59

The Dynamics of Learning. 68

IV. CONCLUSION: FIVE SCENARIOS 83

Style 1: When a Scientific Discipline Goes "Network" 87

Style 2: Conferencing Unlimited, Inc. 91

Style 3: The "Meeting Without Travel" of the World Future Society. 94

Style 4: An International Crisis Management Network. 97

Style 5: Alaska Mineral Wealth Forecasts, Inc. 99

APPENDIX: PROPOSITIONS ABOUT COMPUTER CONFERENCING 103

GLOSSARY: 169

BIBLIOGRAPHY 173

LIST OF FIGURES

Page

Figure 1 Major Steps in Project Development 5

Figure 2 Schedule of FORUM Conferences. 14

Figure 3 Growth Curves for the CCITT Conference (C12) 28

Figure 4 Synchroneity of Message Sending in Conference C12. 29

Figure 5 Growth Curves for the BNL Conference (C18) 32

Figure 6 Distribution of Participation in the NISS Conference (C19). 36

Figure 7 Sample Map for Simulation of Freeway Planning. 38

Figure 8 Map of Nations for CRISIS Simulation 40

Figure 9 Percent of Private Messages Sent and Received by Each Nation in CRISIS-1 (C27) 43

Figure 10 Private Message Exchange in CRISIS-1 (C27) 44

Figure 11 Percent of Messages Sent and Received by Each Nation in CRISIS-2 (C28). 46

Figure 12 Private Message Exchange in CRISIS-2 (C28) 47

Figure 13 Growth Curves for the Two CRISIS Simulations (C27 and C28). 48

Figure 14 Sample Transcript from the Circum-Pacific Conference (C21). 53

Figure 15 Summary of Projections in the Circum-Pacific Conference (C21) 54

Figure 16 Taxonomy of Basic Factors in Computer Conferencing 60

Figure 17 Tasks Performed in 28 FORUM Conferences. 65

Figure 18 Content Categories in the CCITT Conference (C12) 79

Figure 19 Theoretical Limits on Word Transmission in FORUM Conferences. 109

Page

Figure 20 Theoretical Limits on Group Size in FORUM Conferences. 111

Figure 21 Use of Time in Four Synchronous Conferences. 113

Figure 22 Probability Distribution for Session Duration in FORUM Conferencing. 115

Figure 23 Session Durations for Synchronous and Asynchronous Session in Conferences C2, C12, and C16 117

Figure 24 Character Transmission Rates in Synchronous/ Asynchronous and Public/Private Modes. 119

Figure 25 Public Participation Rates for Four Synchronous Conferences (Showing Actual Rates and the Best Fitting Straight Line) 124

Figure 26 Public Participation Rates for Three Asynchronous Conferences (Showing Actual Rates and the Best Fitting Curve) 125

Figure 27 Word Transmission in 17 FORUM Conferences. 127

Figure 28 Cost of 28 FORUM Conferences 128

Figure 29 Portion of Workday Spent in Computer Conferencing for Five Conference Styles 133

Figure 30 Distribution of Participation of Six Users Across a 24-Hour Period 135

Figure 31 Participation Map for Seven Parts of the BNL Conference (C18) 137

Figure 32 Participation Map Showing Changes in Participation Patterns in Conference C12 and C13 138

Figure 33 Total Public and Private Message Sending in 17 FORUM Conferences 140

Figure 34 Participation Map for the NISS Conference (C19). 143

Figure 35 Participation Map for CRISIS-2 (C28) 146

Figure 36 Interaction Process Analysis of Public and Private Messages by World Press in CRISIS-1 (C27). . . . 148

Page

Figure 37 Interaction Process Analysis of Public and Private Messages by Axiom in CRISIS-1 (C27) 149

Figure 38 Adaptation Growth for Nine Participants in CRISIS-2 (C28). 153

Figure 39 Growth of Entry Types in Three FORUM Conferences 155

Figure 40 Relationship Between Previous Computer Experience and Attitudes toward the Medium. 164

LIST OF TABLES

		Page
Table 1	Conferences Conducted on the ARPA Network	12
Table 2	Distribution of FORUM Conferences Among Five Styles of Computer Conferencing	16
Table 3	Private Messages Sent in Three CRISIS Simulations	50
Table 4	Overview of 28 Conferences.	106
Table 5	Comparison of Public and Private Message Sending in Synchronous and Asynchronous Modes for Three Conferences	120
Table 6	Basic Statistics for Public and Private Message Sending in Conferences for which Statistics Are Available	122
Table 7	Comparative Costs for Two Computer Conferences and Estimated Costs for Comparable Face-to-Face Meetings.	131
Table 8	Summary Display of Correlations in Public and Private Message Sending, along with Other Basic Statistics	141
Table 9	Comparison of Chairperson and Facilitator Behavior.	144
Table 10	Comparison between Analysis of C27 and Results Obtained by Bales and Hare for Face-to-Face Groups.	156
Table 11	Responses to Questions about Feelings of Pressure in Computer Conferencing.	158
Table 12	Responses to Questions about Feelings of Interpersonal Interaction in Computer Conferencing	162
Table 13	Rotated Factor Matrix for Responses to Semantic Differential Questionnaire before Conference C12.	166
Table 14	Comparison of Preconference and Postconference Responses on Two Semantic Differential Scales	167

LIST OF PROPOSITIONS

Page

Proposition 1. Theoretical Limits on Word Transmission Rate 108

Proposition 2. Theoretical Limits on Group Size 110

Proposition 3. Use of Time in a Computer Conference 112

Proposition 4. Duration of Sessions 114

Proposition 5. Synchroneity and Duration of Sessions 116

Proposition 6. Synchroneity and Character Transmission Rate 118

Proposition 7. Synchroneity and Length of Public and Private Entries 121

Proposition 8. Synchroneity and Participation Rates 123

Proposition 9. Growth of Word Transmission 126

Proposition 10. Costs of Computer Conferencing 128

Proposition 11. Computer Conferencing as a Travel Substitute 130

Proposition 12. Effect of Computer Conferencing on Use of Workday . 132

Proposition 13. Effect of Computer Conferencing on Flexibility of Working Hours 134

Proposition 14. Mapping of Participant Behavior 136

Proposition 15. Private and Public Message-Sending Patterns 139

Proposition 16. Participation Patterns of Group Leaders 142

Proposition 17. Influence of Role on Participation 145

Proposition 18. Interaction Patterns across Tasks 147

Proposition 19. Measurement of Typing Ability 150

Proposition 20. Influence of Typing Ability on Time Spent in the Conference 151

Page

Proposition 21. Learning to Use Computer Conferencing 152

Proposition 22. Evolution of Conference Content 154

Proposition 23. Difficulty of Control 156

Proposition 24. Conferencing Pressure 157

Proposition 25. Influence of Feelings of Pressure on Length of Entry 159

Proposition 26. Influence of Professional Motivation on Participation 160

Proposition 27. Sense of Personal Interaction 161

Proposition 28. Previous Computer Experience and Attitudes toward the Medium 163

Proposition 29. Preconference Attitudes 165

Proposition 30. Difference between Pre- and Postconference Attitudes 167

PROJECT STAFF AND ACKNOWLEDGMENTS

Responsibility for direction of this project has been divided between Roy Amara (project supervisor) and Jacques Vallee (principal investigator responsible for the direction of system design and experimental programs). The programming effort was primarily performed by Hubert M. Lipinski and Richard H. Miller. Social research design has been the responsibility of Robert Johansen. Robert Randolph, Arthur Hastings, Andrew Hardy, and Garry Shirts have contributed directly to the work described in this volume. Thaddeus Wilson has defined the role of conference facilitator through his responsibility in user services and data analysis. Several other Institute staff members also contributed to this research, notably Kathleen Spangler who deserves special credit for her editing of our manuscript. Margaret Chula, Judy Flathman, Carreen Jensen, and Jeanne Muzzicato have all contributed to the typing and artwork.

Outside the Institute, we would like to extend our special thanks to Fred Weingarten, Walter Sedelow, and Granger Morgan at the National Science Foundation, Gerald Askevold and Allen Clark at the U.S. Geological Survey, Brad Gibbs at NASA-Ames Research Center, Samuel Morris and Leonard Hamilton at Brookhaven National Laboratory, Lawrence Day and James Kollen at Bell Canada, Gerd Wallenstein at San Jose State University, Olaf Helmer at the University of Southern California, John Ferguson at Lilly Endowment, Inc., Martin Elton and his colleagues at the Communications Studies Group of University College, London, England, and Peter Kirstein who made it possible for us to run conferencing experiments with sites in Great Britain. A special mention is due our colleagues who have read this document in draft form and given us their helpful comments, notably Roxanne Hiltz, Roger Pye, and Dean Havron.

The users of FORUM deserve much of the credit for making the system a living reality. Although we cannot list all their names, may they find here our sincere thanks.

OVERVIEW OF THE REPORT

This document constitutes the final report in our investigation of computer-based interaction among experts. Two earlier reports have described the design of the FORUM system, which served as the basis for our investigation, and the social assessment methodology which we developed to study the system's use. The present report is an analysis of the patterns of use which we have observed in 28 FORUM conferences involving scientists and engineers as real-world subjects.

Basic to our analysis has been the notion that computer conferencing is not a simple exercise in computer software design, but rather a significant medium for human communication. We have engaged in the software development, not as a primary objective, but in order to create and evaluate a tool which we felt was necessary to improve expert interaction. This orientation explains our strong interest in some aspects of the medium and our frank skepticism about other aspects.

The initial chapter of this report introduces computer conferencing as a medium of communication and provides a description of the analytical approach we have developed. An overview of 28 FORUM conferences--ranging from staff meetings and "collective notepads" to forecasting and crisis management simulations--is also provided.

In Chapter 2, a series of conferencing case histories illustrate five styles of computer conferencing: (1) the notepad, (2) the seminar, (3) the assembly, (4) the encounter, and (5) the questionnaire. We have found that we could best describe the patterns of interaction in computer conferencing in terms of these five styles.

Chapter 3 describes the dynamics of the medium, focusing on such basic elements in group communication as individual and group characteristics (including skills and attitudes), medium characteristics, and tasks to be performed. The dynamics of learning to use the medium--and particularly the role of the conference facilitator--are described in detail.

The final chapter provides no definitive conclusion, but instead explores the use of computer conferencing in the future through five scenarios. Paralleling the five styles of computer conferencing, these scenarios outline likely uses of the medium in 5 to 10 years, including its potential impact on scientific disciplines, on government and organizations, and on some aspects of business. They represent cautious extrapolations from the admittedly limited data at our disposal.

Our statistical findings are presented in the appendix in the form of 30 "propositions" about computer conferencing.* These reflect our current knowledge about the theoretical limitations of the system; the typical patterns of interaction (e.g., duration, frequency, length of messages); the effects of synchronous versus asynchronous use of the medium; variations in costs and use of time in computer conferencing; and skill requirements. The propositions also include descriptions of user reactions to computer conferencing, based on the results of interviews and questionnaires.

During the development and use of FORUM, over 150 persons in the United States, Canada, and England--many of them without any previous exposure to computers--have participated in our computer conferences. (Of them, about 40 took part in more than one conference.) It is on their work and their reactions that this report is based. The trends we have found are already being extended in new systems inspired by the same concept. They open the door to a new phase of evaluation as computer conferencing becomes more broadly available.

---

*Conference transcripts, questionnaires, and detailed data not presented in this report may be obtained directly from the Institute by contacting the authors of this report.

I. INTRODUCTION: ANALYTICAL FRAMEWORK

I. INTRODUCTION: ANALYTICAL FRAMEWORK

Over the past three years, the Institute for the Future has engaged in the development and analysis of a new medium of communication known as computer conferencing. Our approach has combined both theoretical and operational research. The *theoretical* aspects have included research into advanced file structures that could be shared in real time, the analysis of synchronous and asynchronous group interaction on a computer network (ARPANET), the formulation of a taxonomy for electronic group communication, and the development of social evaluation procedures. The *operational* research has involved the design and implementation of a full-scale computer-based conferencing system called FORUM,* the compilation of a data base of user performance statistics and user reactions, and the development of training and facilitation procedures.

The project originally grew out of an interest in improving the process of structured expert interaction, but it soon expanded into the larger horizon of computer-based group communication, with "experts" representing a significant, but narrow subset of users. This evolution is reflected in three distinct and clearly identifiable phases of our research:

PHASE ONE — Development and initial testing of an interactive system for eliciting information from experts.

PHASE TWO — Expansion of the FORUM system to a *medium for group communication*, studied through exploratory field tests.

PHASE THREE — Systematic exploration of FORUM's social effects, supported by questionnaires, interviews, and extensive usage statistics.

---

*A commercial version of FORUM is now available on a commercial computer network and is known as PLANET-1.

For each of these three phases, our research activity has addressed both the theoretical and operational levels, as indicated in Figure 1. The medium of communication which has emerged from the project is a new technology, with developed methods for social evaluation as its application becomes more widespread.

CHARACTERISTICS OF COMPUTER CONFERENCING*

The FORUM system functions as an interpersonal communications medium for a variety of activities, including planning and forecasting, group conferencing, joint writing projects, electronic notepads (in which messages are stored in a computer instead of on paper), social simulations, and questionnaires. It allows geographically separated people to communicate either simultaneously or on a delayed basis. (We call these two basic usage modes "synchronous" and "asynchronous" conferencing.) Participants do not need any technical expertise or even previous experience with computers, though they do use a standard computer terminal. With such a medium of communication, time and distance barriers are reduced, familiar visual cues no longer exist, each person's "memory" of what has been said is accurate and complete, and everyone may speak at once or "sit back and listen." All of these characteristics combine to create social conditions that differ from face-to-face communication in at least three important ways: (1) the physical environment; (2) the limits of time and space; and (3) the various communication structures which are allowed.

Physical Environment. Unlike face-to-face gatherings, FORUM interaction is usually characterized by the physical isolation of each participant.** Alone with his terminal, each computer conferee depends on an unseen computer to communicate with his colleagues. All "conversation"

---

*A more general version of this discussion has been published in J. Vallee, R. Johansen, and K. Spangler, "The Computer Conference: An Altered State of Communication?," *The Futurist*, June 1975.

**In some cases, FORUM has been used for group-to-group communication, with up to six people clustered around each terminal.

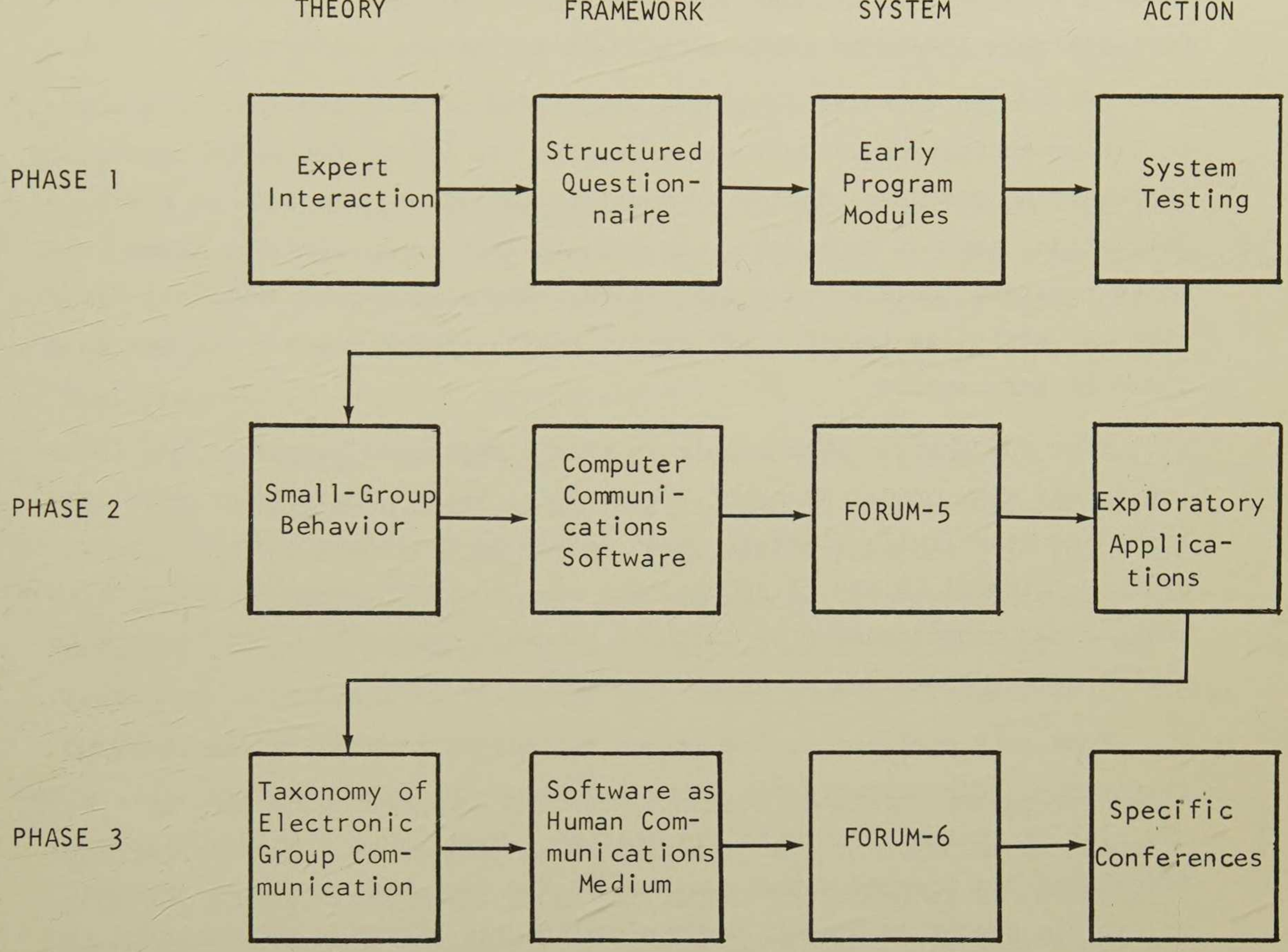


Figure 1. Major Steps in Project Development

must be typed on a computer terminal with a standard typewriter keyboard. As a result, accessibility and reliability of terminals, typing skills, and writing skills--factors which are not even considered in face-to-face meetings--all influence communication in a computer conference.

The remote keyboard situation also hints at some interesting changes in the communication rituals among people. In a computer-based conference, there are no gestures, facial expressions, or vocal cues such as pitch, intonation, pauses, or stress. In face-to-face communication, these cues often regulate the flow of a discussion; they also convey emotional feelings and attitudes toward other participants. FORUM greatly narrows this field of information.

Time and Space. When people in widely separated locations can interact at any time of day or night, their "real world" concepts of time and space are drastically altered. Most people have already had their sense of distance altered by the telephone, but on a computer network, FORUM further reduces the consciousness of distance since it typically costs no more to "talk" across thousands of miles than across 10 feet.

Even more striking is the unique "suspended time" of a computerized conference. Participants may enter and leave the discussion at will, without risk of losing touch with the meeting. Time zones disappear since discussion can proceed without regard to the fact that one user is about to eat his supper in London, while a California user has just arrived at his office. If the Londoner unexpectedly joins the discussion while the Californian is busily entering his ideas, this "presence" suddenly adds a dimension of intimacy which restores the awareness of space and time.

Freedom from the constraints of time and distance can naturally reduce the *obligation* to communicate. In computer conferencing, the balance between motivation and lack of demand to communicate is strikingly different from face-to-face interaction. Thus, the interaction patterns might also be expected to evolve quite differently.

Communication Structures. Computer-based conferencing allows a great deal of control of communication structures. For example, users may send *public* messages, which are entered into the transcript and available to

all, or *private* messages which are sent to specific individuals and seen only by them. Functionally, the private message enables colleagues to "whisper" in the midst of a discussion without any breach of etiquette. In content, the public messages tend to be more formal than private messages, and more closely related to the discussion topic, while private messages include more personal interaction, sometimes quite unrelated to the main topic of group discussion.

Anonymous messages permit participants to state their views without divulging their identities--a possibility which does not exist in face-to-face meetings. Conferees have used this feature to express unpopular opinions, voice grievances, or make jokes in a way which is usually not possible.

A FORUM conference can vary from an open-ended discussion--in which the topic is simply introduced and the discussion evolves without prescribed direction--to a carefully preorganized discussion. In these more structured conferences, the FORUM program becomes a many-roomed meeting hall, dividing the conference into activities according to topic. For still more structured needs, FORUM will administer questionnaires or secret ballots and report the results.

In some ways, even the most unstructured computer conferences are more structured than face-to-face communication. But in other ways, FORUM provides greater freedoms. It is difficult, for example, to compel a FORUM user to direct his comments. It is impossible to either shout down or interrupt any other person in a computer-based "meeting." And finally, all participants may "talk" at the same time; the computer simply records the entries according to the time at which the user began typing. This ability to make simultaneous entries in a computer conference compensates for potential limitations in typing ability. All participants can be thinking, reading, or typing based on their own preferences and abilities.

Given all of these alterations--physical isolation, dependence on the computer, suspension of time and space, reduced obligation to communicate, and a new set of communication structures--it is not surprising that computer conferencing might actually establish a state of communication in which

the realities of face-to-face communication are distorted and significantly new patterns of interaction emerge. These new patterns, which are the subject of this report, represent a major departure from the concept of "electronic mail" or "message exchange," which are usually examined solely from the standpoint of software performance. Accordingly, we have assumed the view that computer conferencing is a unique medium of communication to be analyzed as such.

A CASE HISTORY APPROACH TO EVALUATION

The social aspects of communications media have rarely been evaluated, and starting points are not easy to find.* However, the computer conferencing medium itself provides two powerful analytic tools for evaluating its social characteristics: (1) an up-to-date machine-readable transcript of every computer meeting and (2) usage statistics gathered automatically and unobtrusively by the computer, revealing patterns of communication among individuals, groups, and subgroups. Each of these points deserves elaboration.

The Transcript. A complete transcript of the public entries in every computer conference is always available, current, and machine-readable. This transcript is recorded exactly as it is typed, and members can automatically review the record by subject, author, and date, both during and after the conference. The possibilities for analyzing the content of the

---

*We estimate that there are about 50 active researchers in the world today who are doing work directly related to social evaluation of media for group communication. The theoretical basis for this work is rich, but scattered. While research on small-group interaction in face-to-face situations offers a sizable input, the theoretical foundations for group communication through electronic media are not well developed. For a more complete discussion of this subject, see Jacques Vallee; Robert Johansen; Robert H. Randolph, Consultant; and Arthur C. Hastings, Consultant; *Group Communication through Computers, Volume 2, A Study of Social Effects*, Institute for the Future, Research Report R-33, November 1974. For more detail on the theoretical issues and current activities of other research groups, see Robert Johansen, Richard H. Miller, and Jacques Vallee, "Group Communication through Electronic Media: Fundamental Choices and Social Effects," *Educational Technology*, August 1974.

discussion are thus greatly improved over most other media. Using one analytic technique, for example, we have broadly classified entries by content, identifying them as regulatory comments dealing with the group process, comments on the substantive topics in the conference, humor, novel ideas, and similar classifications. In this way, it has been possible to evaluate a group's ability to focus on a particular task and also to study the actual allocation of time.

The transcript allows a tracking of specific discussion topics over time, and we have identified a strong tendency for "threads" or "chains of thought" to occur in the conference transcript. These topic threads are frequently labeled ("re comment 13,"), but the tie is sometimes only implicit, requiring readers to review the earlier proceedings to find out what has been said on a particular topic. The review process is supported by the FORUM program: a participant can, for example, request the computer to search for any entries which mention a particular word, such as "energy." In general, our analysis of topic threads shows that it is possible to discuss several topics at the same time, occasionally dropping one thread and then picking it up again later.

In addition to tracking the content of discussions, the roles of different participants can be studied. We have found, for instance, that some persons tend to introduce many new ideas, while others are best at developing them, and still others function as synthesizers. The roles can vary greatly among persons and conferences, but we have noticed an apparent tendency for the "provocative" and "synthesizing" roles to be mutually exclusive. The "provoker" seems to push the discussion forward into new areas of thought, while the synthesizer ties the loose strands together. By examining the content patterns of a FORUM conference, then, one can usually identify both key persons and key ideas.

Usage Statistics. The computer itself can unobtrusively map many dimensions of the interaction that may or may not be evident from the transcript.* The ability to map these interaction patterns within a

---

*Statistics about interaction are gathered with no information about the content of the conference; conferees must grant their permission before we can make any comparison of these interaction patterns and content of the conference.

conference may be the most powerful analytic tool available for any current communications medium. This capability of the FORUM program means that some of the detailed coding and painstaking observation that social psychologists must typically carry out in analyzing small groups can be done automatically here, without disturbing the normal communication process. Private message statistics, for example, may indicate the formation of subgroups, cliques, or coalitions. Similar statistics allow us to trace individual participation characteristics from one conference to another as a function of topic or task. In addition to individual characteristics of participation, we can evaluate group characteristics with growth curves. When plotted for the content categories, these curves can indicate if and when the conference has made a transition from the procedural questions inherent in any meeting to the solution of substantive issues.

Given these tools for analysis, our research approach has been to collect a series of case histories. Over the period from May 1973 to December 1974, we have conducted 28 conferences with FORUM. Four successive generations of computer conferencing systems (FORUM-3, -4, -5, and -6)* have been used in these conferences, which varied in task type from staff meetings and note exchange to crisis resolution; in length, from a few hours to four months; and in group size, from three persons to several dozen. These conferences are listed in Table 1. Their time distribution over the course of the project is shown in Figure 2. The overall case study effort has represented about 1,500 user hours and a total of 9,000 entries.**

In the early stages of this project, it seemed that a controlled exploration of computer conferencing might be possible. Indeed, if computer

---

*For a complete description of the development of the FORUM system, see Jacques Vallee, Hubert M. Lipinski, and Richard H. Miller, *Group Communication through Computers, Volume 1, Design and Use of the FORUM System*, Institute for the Future, Research Report R-32, July 1974.

**In addition to this material, we have created many conferences for purposes of demonstrations, system tests, and special tasks that were not directly related to the analysis of FORUM usage and are not considered in this report.

conferencing is defined narrowly (for example, as a response elicitation mechanism), such controlled experimentation is readily conceivable. However, since we have viewed computer conferencing as a new medium of communication, it has become clear that highly controlled social evaluation would be inappropriate for such a broad exploration. Instead, it has been our view that computer conferencing could best be studied *in vivo*, and our efforts have been aimed at shortening the delay between laboratory development and substantive application. Accordingly, we have designed a case history method to be sensitive to the broader possibilities of the medium.

The focus of the experimental* effort, then, has evolved over the period of our research from informal, unstructured field tests of the early system to prestructured, substantive conferences and, finally, to carefully monitored social simulation conferences. We have not tried to derive any "hard" observations concerning the long-term social and managerial aspects of teleconferencing; nor have we attempted to set up a laboratory-style investigation of its implications in terms of small-group dynamics. The former aspect is one our future research will address; the latter still raises delicate methodological issues that we have discussed at length in a previous report.**

The 28 experimental conferences *have* provided us with a set of case histories to which we can refer in describing the specific characteristics of the medium and the behavior of its users. In addition, they provide a basis for preliminary generalization about the nature of computer conferencing. Specifically, they lead us to identify five styles of computer conferencing which reflect the the duration of the conference, the synchronous or asynchronous nature of the interaction, the degree of interpersonal interaction and structure, and the purpose. These can be characterized as follows: (continued on page 15)

---

*The term "experimental" is used in this report only in the general sense of a test or trial carried out to explore the potentials and effects of computer conferencing. In regard to specific conferences, other terms are used to describe the degree of control achieved in the evaluation effort. For reasons which are described in this report, we have not used controlled experimental techniques to date, though we plan to move in this direction in specific cases in the future.

**_Group Communication through Computers, Volume 2_.

Table 1. Conferences Conducted on the ARPA Network

C1: A U.S. Geological Survey Conference designed to test the feasibility of linking computer conferencing with large-scale information retrieval systems.

C2 and C3: An Institute staff meeting conference over a six-month period, with the FORUM medium serving as a continuous communication link, even during hours when the Institute offices were closed.

C4: A strategic planning conference held between the Institute for the Future and the staff at an organization which we shall refer to as XYZ; the goal was to investigate the problem of connecting several remote, local groups involved in the planning and coordinating of a major public event.

C5: A 30-day FORUM conference between the Washington State Planning Office in Olympia, Washington, and a consultant working with them in Palo Alto, California.

C6: A conference, jointly arranged with Bell Canada, in which 35 researchers assessed telecommunications as a substitute for physical travel.

C7 and C8: Conferences made available to users who had a specific interest in expressing their reactions to FORUM, in documenting system errors, and in suggesting new features.

C9: A conference involving three persons who were engaged in planning a seminar, writing letters, assigning tasks, and generally accomplishing the goals of their project during a period when the group leader was confined to his home.

C10: A collective notepad conference involving members of the Automatic Programming Group at Information Sciences Institute of the University of Southern California.

C11: A continuing exchange of research ideas with the Communications Studies Group in London, England.

C12: A simulation of an international working group meeting on the future of digital data networks. Eighteen students played the roles of delegates to a Geneva meeting of the International Telecommunications Union and defended actual positions of the countries involved. Negotiation and bargaining behavior were monitored.

C13: A conference running in parallel to C12 to gather user comments and reactions from the students involved, who were supported by communications experts.

Table 1 (Concluded)

C14 and C15: An internal Institute working group; activities devoted to planning future teleconferencing research.

C16: A special conference with CSG (London) to design with them a questionnaire for the assessment of user reactions to electronic media.

C17: A planning conference on policy research in education, linking Institute researchers and the staff of Lilly Endowment, Inc.

C18: An international conference organized by the Brookhaven National Laboratory of the Atomic Energy Commission to study the effects of sulphur pollution on humans. Twenty participants contributed to this activity.

C19: A conference devoted to the study of experiential learning, linking Dartmouth, Stanford, MIT, and other research centers, sponsored by the National Institute of Social Sciences.

C20: An exchange with planners in the Southern California Association of Governments.

C21: A short-term forecasting experiment with the USGS at the occasion of the Circum-Pacific Energy Research Conference, Hawaii, August 1974.

C22 and C23: Staff conferences at the Institute.

C24: An international experiment of brief duration.

C25: A social simulation trial in which participants were asked to use computer conferencing to simulate collaborative planning of a freeway.

C26: A continuation of the conference on policy research in education (C17).

C27: A crisis negotiation simulation where six participants played the roles of national leaders in defending the interests of their countries in a "World Organization" emergency (CRISIS-1).

C28: Another experiment in social simulation with slightly altered rules, involving a range of decisions from total war to peaceful resolution of a conflict involving access to scarce resources (CRISIS-2).

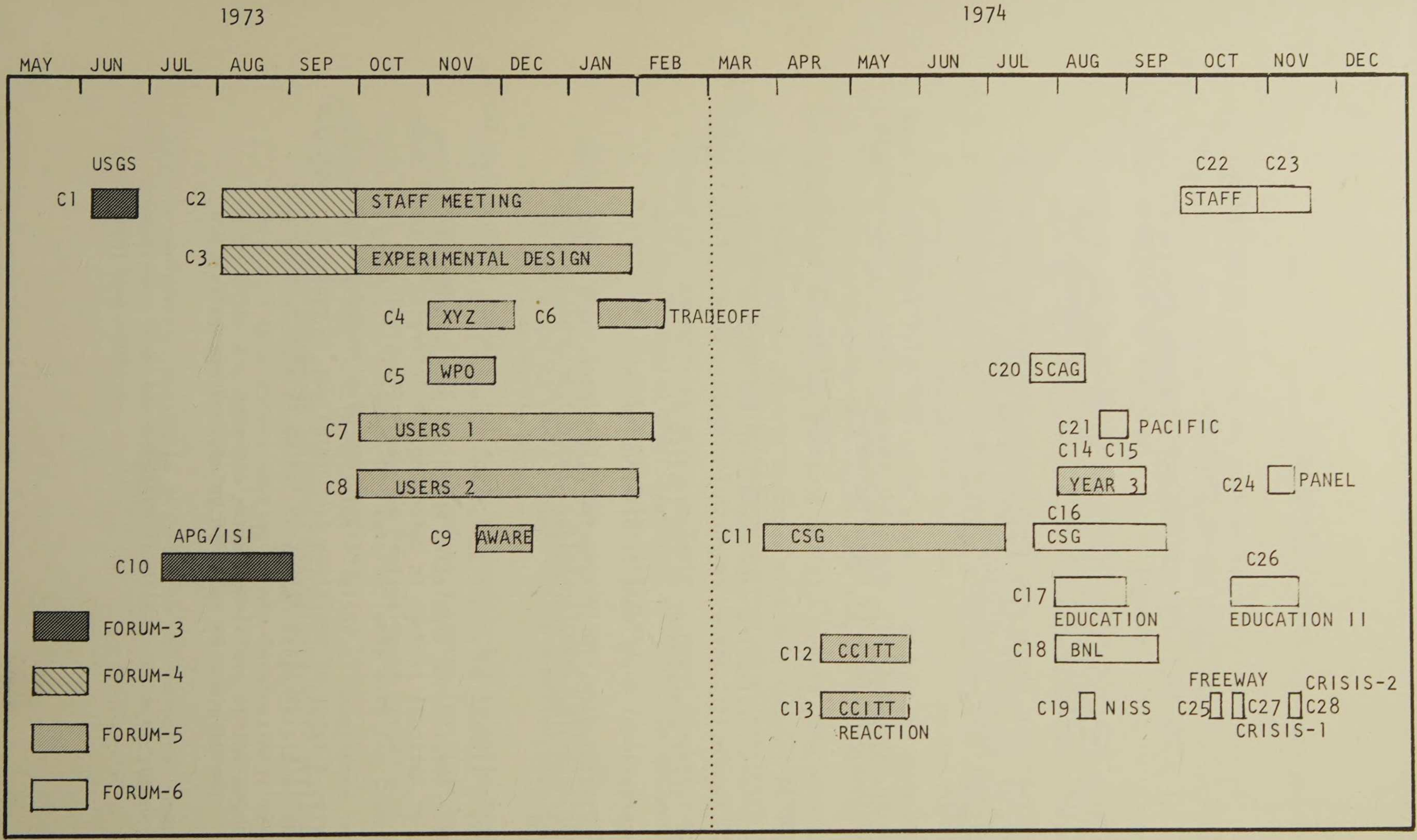


Figure 2. Schedule of FORUM Conferences

- STYLE 1: "The Notepad"

  Style 1 conferencing typically involves unstructured groups and a discussion with multiple topics lasting several weeks or even months. It is almost entirely asynchronous with little interpersonal interaction. The simplest example of this conferencing style is the "notepad" activity of scientific research groups.

- STYLE 2: "The Seminar"

  Style 2 conferencing addresses a specific topic. The most common example is the research seminar or open conference which involves asynchronous usage, possibly with periodic synchronous interaction, and which lasts approximately two weeks to a month.

- STYLE 3: "The Assembly"

  Style 3 conferencing is an extension of Style 2. The group can be very large (up to hundreds or even thousands of users), and multiple topics, all related to a single general theme, are considered in separate parts of an agenda. This is the style of a "general assembly" of a major professional society, in which papers are presented, panels respond to questions from an audience, and general discussion takes place.

- STYLE 4: "The Encounter"

  Style 4 conferencing represents the closest computer analog of a face-to-face meeting, in which participants are synchronously discussing a topic for a short time (usually a few hours), possibly with role assignments among the participants (as in simulation and gaming) and with some degree of intensity.

- STYLE 5: "The Questionnaire"

  Style 5 conferencing involves an unlimited number of participants in a structured question-and-response format. The most common application of this conferencing style is the questionnaire survey, with Delphi and open voting at opposite ends of the spectrum of possibilities. Typically, no direct message exchange is allowed among participants, whose responses are entered anonymously. The conference may last from a few hours to a few weeks.

Table 2 shows the distribution of our 28 conferences among these five styles. Most of the interactions we have observed have been in the first

Table 2. Distribution of FORUM Conferences among Five Styles of Computer Conferencing

	STYLE 1	STYLE 2	STYLE 3	STYLE 4	STYLE 5
CONFERENCE NUMBER	C2,C5,C7,C9,C10 C11,C13,C20,C22 C24,C26	C1,C3,C4,C6,C8 C12,C16,C17,C23	C14,C15,C18	C19,C25,C27,C28	C21
GENERAL PURPOSE	Open discussion;	Topical discussion; task-oriented	Multi-topic discussion; complex subject matter	Topical discussion; task-oriented	Response elicitation according to prescribed format
SYNCHRONEITY (WHEN MORE THAN ONE PERSON IS PRESENT SIMULTANEOUSLY)	Low	Mixed	Mixed	High	Does not apply
QUANTITY OF MESSAGE SENDING PER GIVEN TIME-PERIOD	Low	Moderate	Moderate to Low	High	Does not apply
DEGREE OF INTERPERSONAL INTERACTION (THROUGH BOTH PUBLIC AND PRIVATE MESSAGES	Low	Variable	Variable	High	None
DEGREE OF STRUCTURE	Low	Low	Moderate	Low	High

two styles, but we have also given a significant amount of attention to synchronous meetings and some highly structured activity of Style 5. The dynamics and pragmatics of interaction in each of these styles--as observed in the conferences--are the subject of this report.

II. CASE HISTORIES: FIVE STYLES OF COMPUTER CONFERENCING

II. CASE HISTORIES: FIVE STYLES OF COMPUTER CONFERENCING

STYLE 1: THE NOTEPAD

> *"FORUM was sort of the key that started the interaction. It showed where ideas were coming together or diverging. It kept people out of everybody else's hair. We were able to work independently. I think we got about three times as much work done because of this."*

The "notepad" conference was the first style of computer conferencing to emerge in our study; it was an ideal starting point for the identification of important variables to be examined more closely. Thus, it is not surprising that the majority of our early conferences were of this style.

During the earliest stages of our research, an Institute staff meeting was conducted via FORUM (Conferences C2 and C3). The purpose of these conferences--in which nearly a thousand entries were recorded--was to use the Institute itself as an initial test of computer conferencing in long-term group communication. Also, FORUM was still being developed, and we felt it was important to have direct experience with the medium as it evolved. The use of FORUM was both synchronous and asynchronous, and access was from both home and office terminals. In addition, two staff members who traveled extensively during the period of this conference took terminals along with them on their trips and submitted reports from their activities into the FORUM conference. All of the staff, at one time or another, made entries outside of normal working hours; in fact, 28 percent were made from users' homes after 5:00 p.m. (see Proposition 13).

Other notepad-style conferences were held with groups outside the Institute. Examples include a 30-day conference between the Washington State Planning Office in Olympia, Washington, and a consultant working with them in Palo Alto; a 30-day conference between members of the Institute and the Lilly Endowment to support educational policy research; and a conference among nine members of the Automatic Programming Group at the Information Sciences Institute (ISI) of the University of Southern California (Conference

C10). Of these, the use of FORUM at ISI best characterizes "notepad" conferencing.*

During July and August of 1973, the Automatic Programming Group of ISI was pursuing advanced work in the area of automatic computer programming. The research was exploratory, and the general approach was unstructured. The group used several modes of communication:

1. Formal face-to-face meetings of small topic groups (usually held daily) and of the entire research group;

2. Informal face-to-face meetings (most of the group members had adjoining offices and saw each other daily);

3. FORUM transcripts printed on a high-speed printer and edited before distribution at least every few days; and

4. FORUM in an online environment using cathode ray tube terminals (used mostly for skimming the text of other conferences and inputting reactions to hard-copy transcripts).

In this environment, the role of FORUM was quite specific and somewhat limited. FORUM was used primarily to store and distribute progress reports, working notes, and thought pieces requiring review and comment. These entries consisted of summarized thoughts, notes of meetings, and synopses, as well as additions, corrections, and comments which referred to the summaries. The notes were not particularly polished, but were generally the "filtered" results of longer, more intense face-to-face meetings. Group members reported:

> FORUM is used as a reference material and doesn't include the arguments involved in getting to a particular point.
>
> Only the good stuff got into FORUM. FORUM was our public relations face.

---

*The FORUM-5 program (with minor modifications) is now used at ISI under the name NCONFER and continues to support research interaction under this notepad style. For a complete documentation of this conference, including user reactions, see Robert Johansen and Richard H. Miller, *Commentary on the Use of FORUM in a Research Environment*, Institute for the Future, September 1973.

Occasionally, a new or rather unfiltered idea was put into FORUM discussions in an attempt to receive feedback and reactions. This feedback, however, was rarely entered into a FORUM discussion.

In supporting these running summaries and synopses, the FORUM notepad was detailed enough (1) to allow communication between groups; (2) to allow a newcomer to the group to read a history and catch up on the research status of the entire group; and (3) to allow the various groups to create reports, papers, and detailed summaries of the work conducted during the period in which FORUM was used.

Style 1 conferences are frequently adjuncts to other modes of communication. In the case of the ISI Automatic Programming Group, the social units with the most cohesion were the small face-to-face groups. These seem to be the places where much of the actual research and intensive communication were done. The groups served as "primary" media, with FORUM acting in a "secondary" (support) capacity by transmitting information from the inside of the small groups to the larger group. This pattern seemed to enhance the work styles of the group members by allowing them to choose the times and intensity of their involvement in the activities of their colleagues.

The style of FORUM usage will always affect the kind of group process which develops. Style 1 conferences tend to be more public and less interactive than other styles of conferencing (Proposition 15). The direct effect of FORUM on group process is thus limited by the notepad style. For the ISI group, very little group interaction occurred via FORUM; its effects were revealed more in the area of group performance than group dynamics. The group members generally felt that FORUM had increased their productivity, though they did not perceive any strong impact on group interaction per se. The one exception to this observation involved effective communication between groups, which everyone felt to be enhanced by FORUM.

The ISI conference lasted approximately 42 days and included an estimated 300 entries.* This low ratio of messages to conference duration** is typical of the notepad style. It reflects the low level of interaction--particularly of synchronous interaction--that characterizes Style 1 conferencing. It further reflects a communication function similar to that of an electronic mail system, except that it supports a group process. Public and private messages are routed to their destination and are stored. Personal interaction is minimal and without formal structure. This is the typical profile of a Style 1 conference.

STYLE 2: THE SEMINAR

> *"FORUM offered people who would never meet the chance to interact on a semi-personal basis--across time and distance barriers."*

Style 2 conferencing introduces more group interaction. Typically, this style resembles a seminar in which 5 to 30 people--who may be strangers--get together electronically for a period of days or weeks to discuss a single subject. Structure is provided, not by the system, but by a chairman who guides the discussion and establishes the agenda, and who may determine when the objectives of the conference have been met. Nine of our test conferences have been in this style (see Table 2). Two of them--Conferences C6 and C12--are particularly illustrative.

Conference C6, entitled "Travel/Communication Tradeoffs," was jointly organized with Bell Canada.*** It was the second generation of a discussion among researchers which had been conducted in previous years by using telephone conference calls. About 35 researchers were involved in this

---

*The conference was run before any monitor program was available for analysis of FORUM conferences.

**Conferences of other styles have included three times as many entries in half the number of days.

***A detailed analysis of this conference by Bell Canada and the Institute is in progress and will be available from the Institute when complete.

FORUM conference, all of whom were in some way engaged in work related to travel/communication tradeoffs, though they were not all previously acquainted. The subject of the conference, which lasted 21 days, was the assessment of telecommunications as a substitute for travel.

The growth curves for public and private messages in Conference C6* show that there were actually more private messages sent than public messages, though the growth curves are not dramatically different. This pattern might be expected to contrast with the interaction in Style 1 for several reasons. The primary objective of most Style 1 conferences is to record information for a larger group, though informally. While anonymous messages might be useful in such situations, private messages are not particularly important. Furthermore, Style 1 conferences tend to link smaller groups of people who are working together closely and who frequently communicate using other media as well. By contrast, Style 2 conferees are not usually in regular contact (they may never have even met each other prior to the conference) and thus may depend more heavily on the private message mode. Also, they may feel restricted in the content of their public messages.

Conference C12 provides a second example of Style 2 conferencing. It was a simulation of a working group of the Consultative Committee of International Telephone and Telegraph (CCITT). CCITT is a powerful standardization organization whose members meet in Geneva on a regular basis. In the actual work of this committee, national delegations come prepared to defend the positions of their countries on subjects such as the interconnection of telephone systems or the standardization of service. Our simulation conference was chaired by Professor Gerd Wallenstein (who is the chairman of one actual CCITT working group). It simulated an international debate on integrated digital networks, using teams of graduate students to defend the actual position papers available from eight major countries. The role of the CCITT secretariat was played by a NASA communications expert. In all, there were 23 participants.

---

*These curves were published as Figure 10 in *Group Communication through Computers, Volume 2*, p. 45.

The conference attempted to answer three substantive questions:

1. What are the merits and demerits of national positions?

2. How many different positions seem to emerge, and how can the most salient differences be described?

3. Is it possible to propose a compromise position that would satisfy different classes of users worldwide? If so, what persuasive arguments may be developed to facilitate the adoption of such a compromise?

The work was organized in the following manner: each national team of students was considered as a "subworking part." For each part, one student assumed the role of spokesman.* The students involved agreed to this among themselves, *after using the private message mode of FORUM*. The chairman set a timetable for the group to submit replies to the questions. The conference was followed by two face-to-face discussions of the results, and a final document was produced.

The "Condensed Conclusions" reached by the participants are as follows:**

An analysis of the eight national positions brings to light agreement on certain basic points, while highlighting divergence of opinions with regard to the most important steps to be taken. These latter divergent opinions do not necessarily indicate outright disagreement, but rather preferences of different priorities.

The essential, positive agreement may be stated as follows: The problems of future integrated digital networks are recognized as being of high significance to all communicators. Energetic study of the economic and social aspects is supported. National differences are likely to warrant parallel and mutually independent studies, while maintaining worldwide liaison for comparison and mutual accommodation. Most delegations also feel that the narrowing down to three "either/or" choices, as per Fifth Plenary Assembly Document 119, unduly constrains the search for alternative solutions. At least for some countries, "hybrid" solutions may be interesting, i.e., mixed situations where some all-digital networks emerge at the same time as existing nondigital networks continue expanding.

A substantial number of delegates, perhaps a majority, are in favor of a breakdown of study questions for assignment to separate groups.

---

*The subworking part members were designated as: Japan 1, France 1, France 2, United States 3, etc.

**_An Experiment in Conducting a Computer Based International Conference_, Cybernetic Systems Program, San Jose State University, July 12, 1974.

Some delegations emphasize the need for future-oriented study that would be unobstructed by considerations of past investment, present structure of networks, and the services now offered. On the other hand, a comparable number of delegations are concerned about the continued viability of the current investment and the need for evolutionary planning.

Figure 3 shows the growth of public and private messages for Conference C12 over time. The conference shows a negatively accelerated growth in public and private messages sent with more public than private messages. In general, however, when there was growth in public messages, there was growth in private messages.

The striking difference between Style 1 conferences and Style 2 conferences is the increase in both the amount of message sending per unit of time and in the number of synchronous sessions. Conference C12 had a total of 236 messages over 18 days; 44 percent of these messages were synchronous. Conference C6 had 1,070 over 22 days, with 81 percent of the messages sent synchronously. (It should be noted that participants in C6 had much easier access to terminals than did those in C12.) In contrast to Style 1 or "notepad" conferences, Style 2 conferences have either a prespecified duration or a particular goal which tends to produce more concentrated interaction. Also, synchronous interaction tends to increase the amount of message sending per unit time (Proposition 6).

A total of 44 percent of the messages sent during the CCITT simulation conference were sent synchronously. From a review of the transcripts, one can observe that response to questions is usually more immediate in this mode than in the asynchronous mode. In terms of character sending, participants send about twice as many characters per minute in synchronous as in asynchronous interaction (in both private and public messages). Also, asynchronous messages tend to be 50 percent longer than synchronous messages (Proposition 7), with the greatest difference in private messages. Finally, synchroneity encourages private message sending in relation to public message sending, though the effect is quite small. Figure 4 illustrates this pattern. The majority of messages in this conference (57 percent) were sent asynchronously. Only 41 percent of public messages were sent synchronously, while 51 percent of private messages were synchronous.

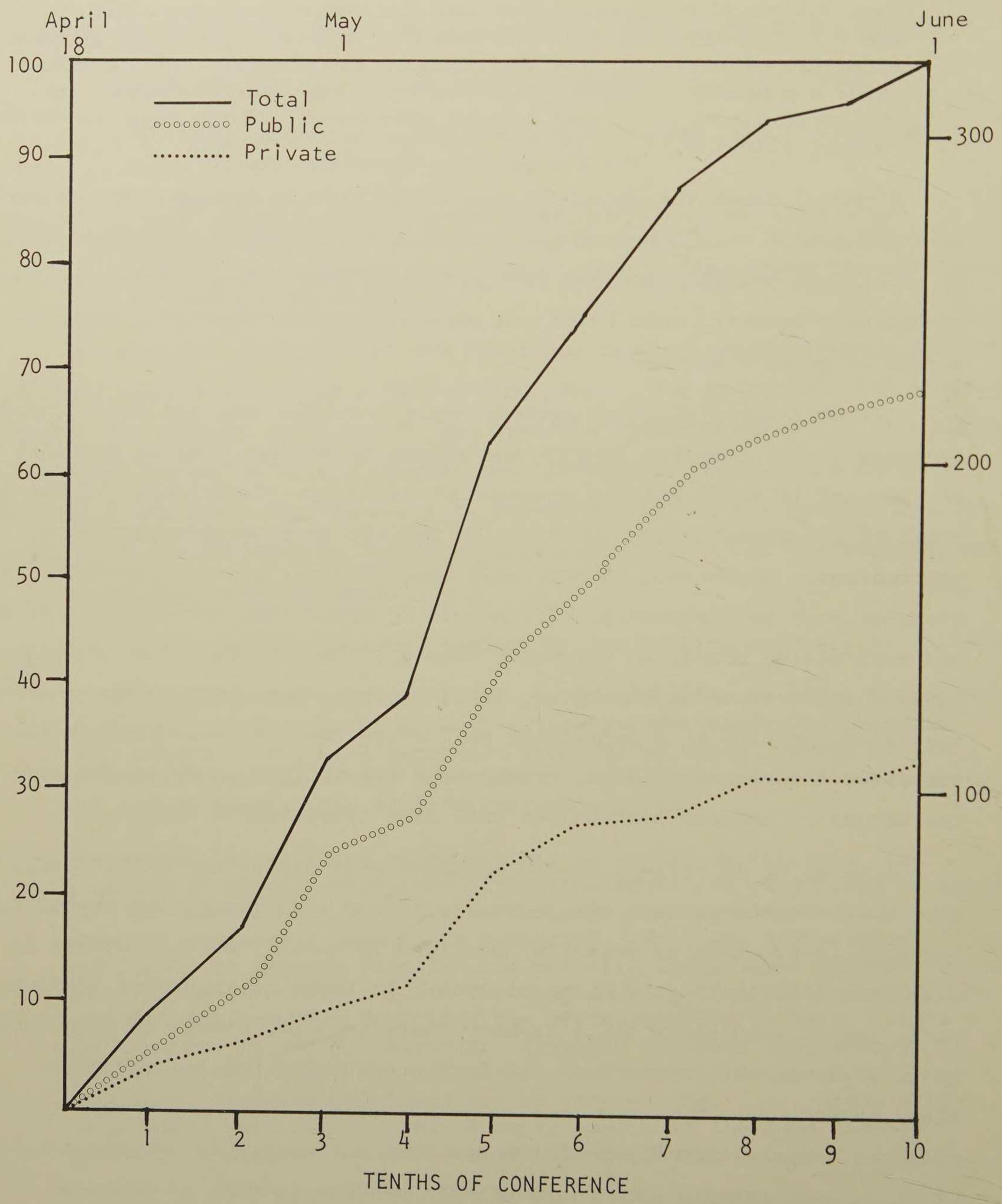


Figure 3. Growth Curves for the CCITT Conference (C12)

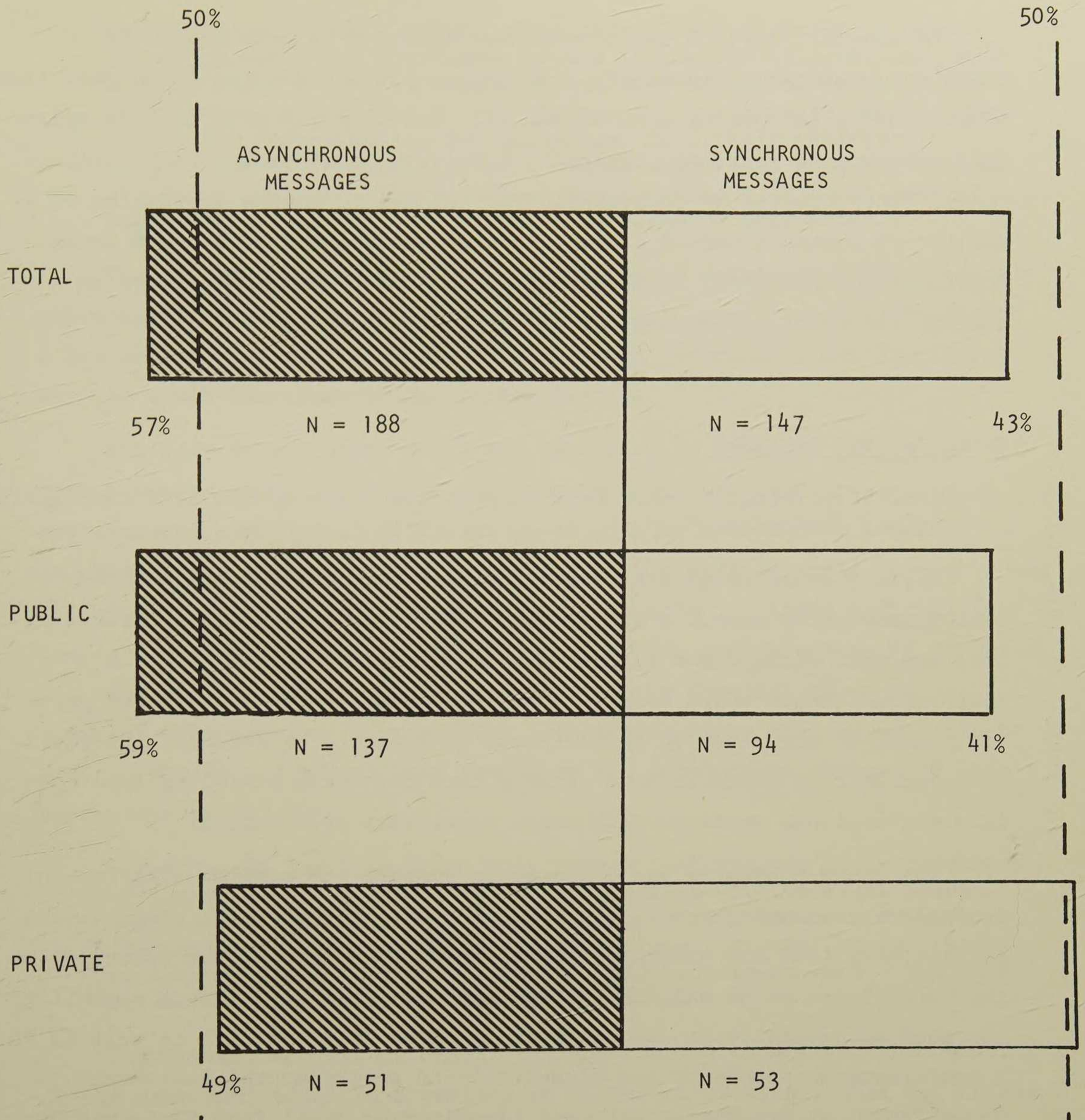


Figure 4. Synchroneity of Message Sending in Conference C12

In general, Style 2 conferences are designed to take advantage of FORUM's asynchronous capability, linking people across long distances, time zones, and variations in work schedules. But they may also include spirited synchronous sessions, typically involving small groups of participants. They provide an opportunity for *guided, purposive discussion* of a subject of common interest as well as a get-acquainted mode. And these functions are reflected in the interaction, which is characterized by similar levels of public and private participation.

STYLE 3: THE ASSEMBLY

> *"Not surprisingly, there were varying responses to the different parts of the conference."*

Style 3 conferences are more structured than Style 2 conferences, having many parts within a single conference. Because of this structure, they can both attract and support many more participants than Style 2 conferences (which would typically be unmanageable with significant participation by more than 30 participants in a single conference). Style 3 conferences thus resemble more closely than any other style the face-to-face professional meetings with which scientists are familiar.

The FORUM-6 program was designed to support the complex structure of assembly-style conferences. The organizer of the conference could divide the activity into any number of parts, each of which would be presented to the participant as he entered the conference. This structuring capability was used successfully in two staff conferences (C14 and C15) as well as in a conference sponsored by the Biomedical and Environmental Assessment Group (BEAG) at Brookhaven National Laboratories (C18) from September 20 to November 9, 1974.

The objectives of Conference C18, entitled "The Human Responses to Sulfur Pollutants," were twofold. In the words of the conference organizers:

> BEAG is charged with the development of a quantitative assessment of the biomedical and environmental effects of the energy system. Thus, the problems explored in this conference are of fundamental importance

to the BEAG mission. Second, BEAG, as well as a number of other energy research and assessment groups in the AEC laboratories, must work in close cooperation with an extended collection of other investigators if they are to satisfactorily integrate the most current scientific understanding and techniques into their assessments. Computer-based conferencing is a medium which BEAG is anxious to explore and evaluate as a potential way to conduct at least some of these communication and collaborative research activities.*

The conference was set up with a seven-part agenda that gave participants an opportunity to introduce themselves, to participate in four substantive discussions, to record bibliographic references, and finally, to discuss their reactions to the system itself.

Activity in all seven parts was tabulated in terms of public and private messages, total number of sessions, and participation rates. Many participants experienced difficulties in gaining access to a terminal and in obtaining a reliable phone connection to the ARPA network. Computer unreliability posed an additional problem. In spite of these difficulties, the conference grew rapidly (as reflected by the growth curves in Figure 5) and was generally felt to have demonstrated the feasibility of using computer conferencing in supporting interaction among this typical expert group. Morris and Morgan have summed up the substantive outcome of this conference as follows:

> A reading of the transcript will reveal that despite the strangeness of the medium to most participants, problems with terminal access, and various reliability problems, a significant amount of technical discussion and communication did take place. Several of the things we learned had direct impact on the BEAG assessment work. The conference yielded valuable technical results.
>
> The Style 3 conference offers the opportunity to analyze the behavior of the same individual in a variety of different settings; that is, in different parts of the conference. A participation map for the Sulfur Pollutants conference indicates that participants are not confined to one section of the public/private activity map (Proposition 14). Instead, they

---

*S. Morris and G. Morgan, *Human Responses to Sulfur Pollutants: Proceedings of a Computer-Based Conference*, Brookhaven National Laboratory, Upton, New York, November 1974.

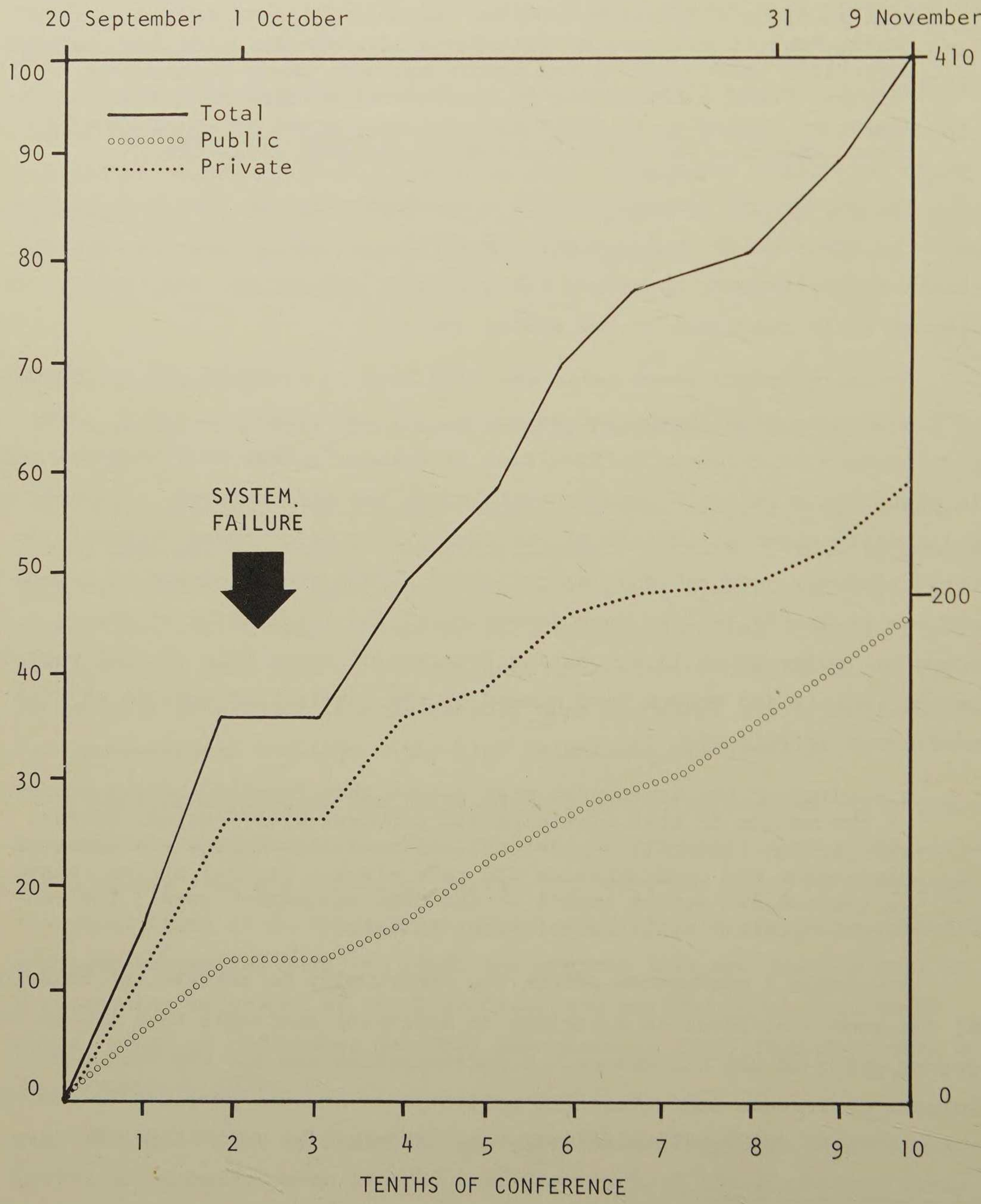


Figure 5. Growth Curves for the BNL Conference (C18)

are found to change position on this map as they move from part to part. This change in position may reflect a change in the participant's role perception, but it may also reflect the entire group's perception of the various topics. One user noted that:

> . . . . there was varying response to the different parts of the conference, the general discussion section having by far the largest number of entries. One of the unsuccessful sections was for the discussion of a study of which we do not have the full results. . . . Other exchanges were more fruitful, on two subjects in particular (the validity of linear regression models for predicting mortality and the combined effects of sulfur dioxide and ozone).

The multipart format of Style 3 conferences also permits us to correlate private message sending with the various types of activities represented by the different parts. In the Sulfur Pollutants conference, there were more private than public messages exchanged overall,* while the most public messages were entered in part 5 (a substantive discussion) and the most private messages were exchanged within the introduction (part 1), where greetings and other social messages were most appropriate.

In summary, then, Style 3 conferences are characterized by a more complex type of social interaction than any of the other styles, with different topics addressed in different subconferences. In such conferences, maintaining a sense of the overall conference is more difficult and requires more user discipline than in single activities. On the other hand, Style 3 conferences can accommodate the interests of a large group and can accomplish a much broader set of goals than any other form of computer conferencing.

---

*Apart from the restrictions of the public mode, which are similar to those in Style 2, the high number of private messages may reflect an unwillingness to be recorded publicly in this case. One participant commented: ". . . . the fact that any participant could list the whole proceedings and reproduce it made us feel rather inhibited about what we had to say, especially as the subject of the conference is quite 'hot' politically."

STYLE 4: THE ENCOUNTER

> *"The interchange was quick and generally fairly easy to follow. . . . I found the private notes particularly successful. In spite of the pace at which we were going, they almost always got answered. I tended to think of the respondent in terms of the strategy rather than personal appearance or individual idiosyncracies."*

The computer-based encounter--like its face-to-face analog--is conducted in real time; that is, synchronously. Unlike a face-to-face meeting, visual contact is absent, but there is a *potential* for greater information exchange--everyone can "talk" at once. This synchronous situation creates a unique social environment with its own set of research opportunities and also with special pitfalls. The opportunity lies in the "fast thinking" mode made possible by simultaneity; the pitfalls are related to problems of structure and the techniques of facilitation. These characteristics are reflected in participation patterns which differ significantly from those in other computer conferencing styles.

In the past year, we have sought to investigate this style more closely. Our conferences have ranged from a relatively unstructured synchronous meeting of educators to highly structured simulations of a crisis situation. These have provided some insights into the potential of computer conferencing in "real-time" situations.

A Conference on Learning. Conference C19, sponsored by the National Institute of Social Sciences, is a typical example of a Style 4 conference. It was held on August 14, 1974, among representatives of the following institutions: National Institute of Social Sciences, Dartmouth College, Massachusetts Institute of Technology, University of South Florida, Stanford University, and the Institute for the Future. It was conducted using FORUM-6, and its purpose, from the users' point of view, was to exchange information on the evaluation of off-campus experiential learning surveys conducted earlier in the year, to review guidelines, and to prepare an agenda for a subsequent meeting. From our point of view, this was an occasion to study the planning, management, and facilitation of a synchronous exchange among experts, contrasted with our earlier, primarily asynchronous conferences.

As in many of the previous experiments, the monitor data were gathered to trace participation patterns throughout the conference. As the conference reached its conclusion, there was an accelerated rate of message transmission in both the public and private modes. Also, there were almost as many private as public messages. At least two factors could have been responsible for the high number of private messages. First, most participants knew each other previously, but were not in regular close communication; therefore, as in other styles, the private message mode allowed for casual "social" communication. Also, we have observed in Style 2, for example, that synchroneity appears to promote private message sending; the high private message exchange in this totally synchronous conference is in keeping with such an observation.

We have derived a graph showing the percentage of total messages sent by each participant, both for public and private entries (Figure 6). A distinct difference in the slope of the curves was observed between this conference and those we had analyzed earlier, which were predominantly asynchronous. At several different times during this conference, there were four participants typing public messages simultaneously, and once there were six simultaneous entries generated and transmitted. It appears then, that participation rate is significantly affected by the synchronous or asynchronous nature of the interaction (Proposition 8).

We have also analyzed the public transcript of the NISS conference for content. The categories identified include substantive (54 percent), personal (30 percent), procedural (11 percent), and learning statements (4 percent).* The substantive entries were considerably longer (in characters per message) than were any of the other content types. All participants transmitted personal entries; these were flavored with humorous or anecdotal exchanges.

---

*Procedural entries are reflected by the following example: "Can we review the Stanford material before we put ours on?" Tutorial statements were largely limited to private exchanges; however, a few were entered publicly, e.g., "I am confused about the listing of three names after each entry. Can someone explain that?" For an analysis of the relative growth of learning and other content categories, see Chapter III.

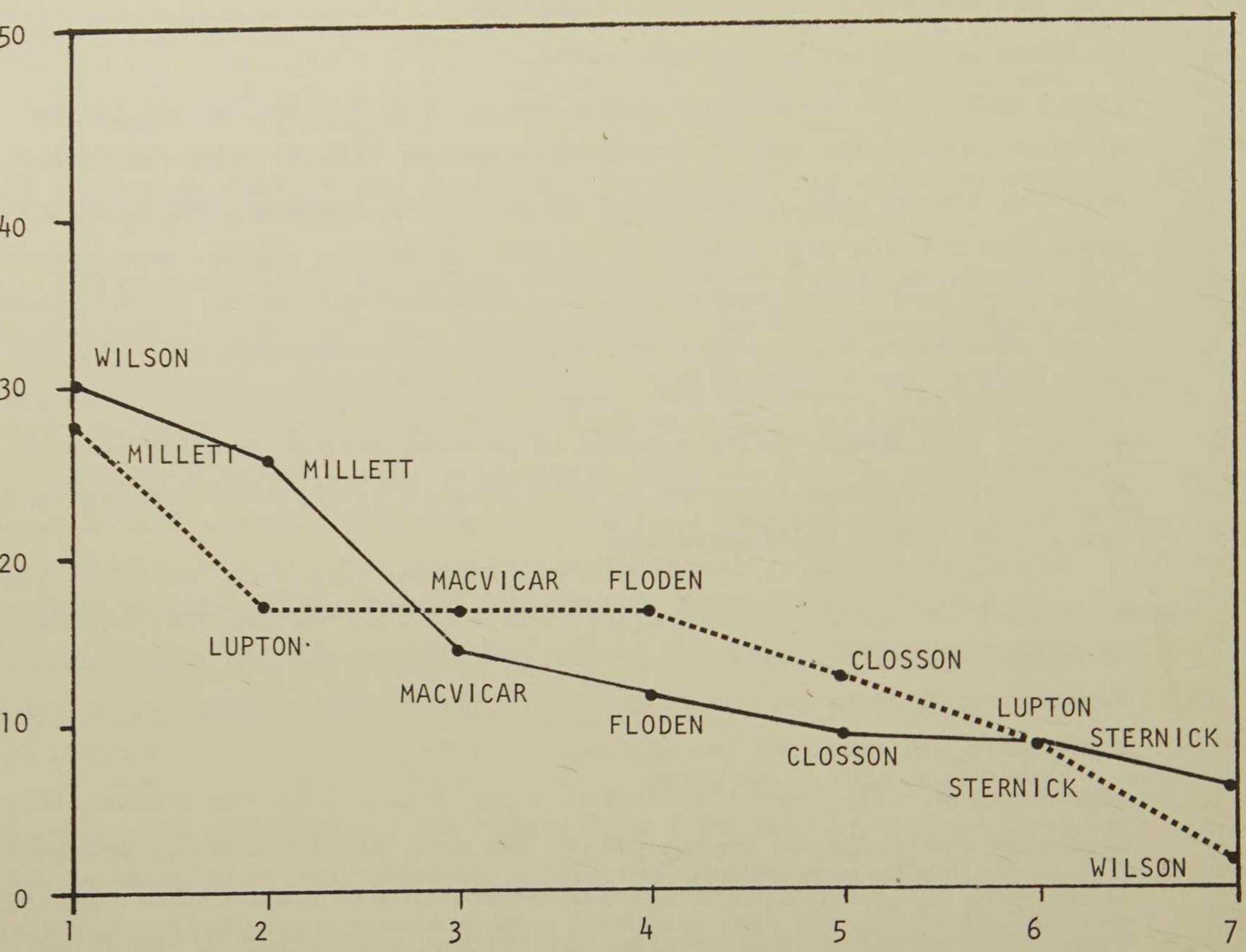


Figure 6. Distribution of Participation in the NISS Conference (C19)

Simulation via Computer Conferencing. Because computer conferencing affords a view of social interaction that is, in some ways, more quantifiable and more flexible than any other experimental setting, we felt that it might lead to a new type of simulation study. Thus, during October 1974, we discussed these possibilities with Dr. Garry Shirts of Simile II,* who accepted our invitation to serve as a consultant to this project. We reviewed with him the range of social simulations that were amenable to synchronous conferencing on a computer. For the purposes of our initial experiments, the search was narrowed to collaborative planning and to crisis resolution situations.

Conference C25, entitled Freeway Planning, is an example of a collaborative planning exercise in which six participants were asked to debate the alternative options for the design of a freeway. The freeway was to lead from the top to the bottom of a map supplied to all participants (Figure 7). Roles were assigned to the group members to simulate a planning commission meeting, and the "value" of each cell on the map was set at a different level for each participant. The conference lasted over two hours and most of the participation was in public mode. As with the NISS conference, public participation rates were markedly different from the typical distribution observed in asynchronous usage. (See Proposition 8.)

Unfortunately, the effectiveness of computer conferencing for playing "Freeway" was hampered by the lack of a graphic display capability. We concluded that, for this task, it was essential to be able to share a common visual space (possibly through a television system or computerized graphics) to speed up the discussion of possible designs for the planned freeway. Consequently, we did not pursue visually oriented simulations but turned instead to those relying on more verbal tasks.

---

*Simile II, 1150 Silverado, La Jolla, California 92037.

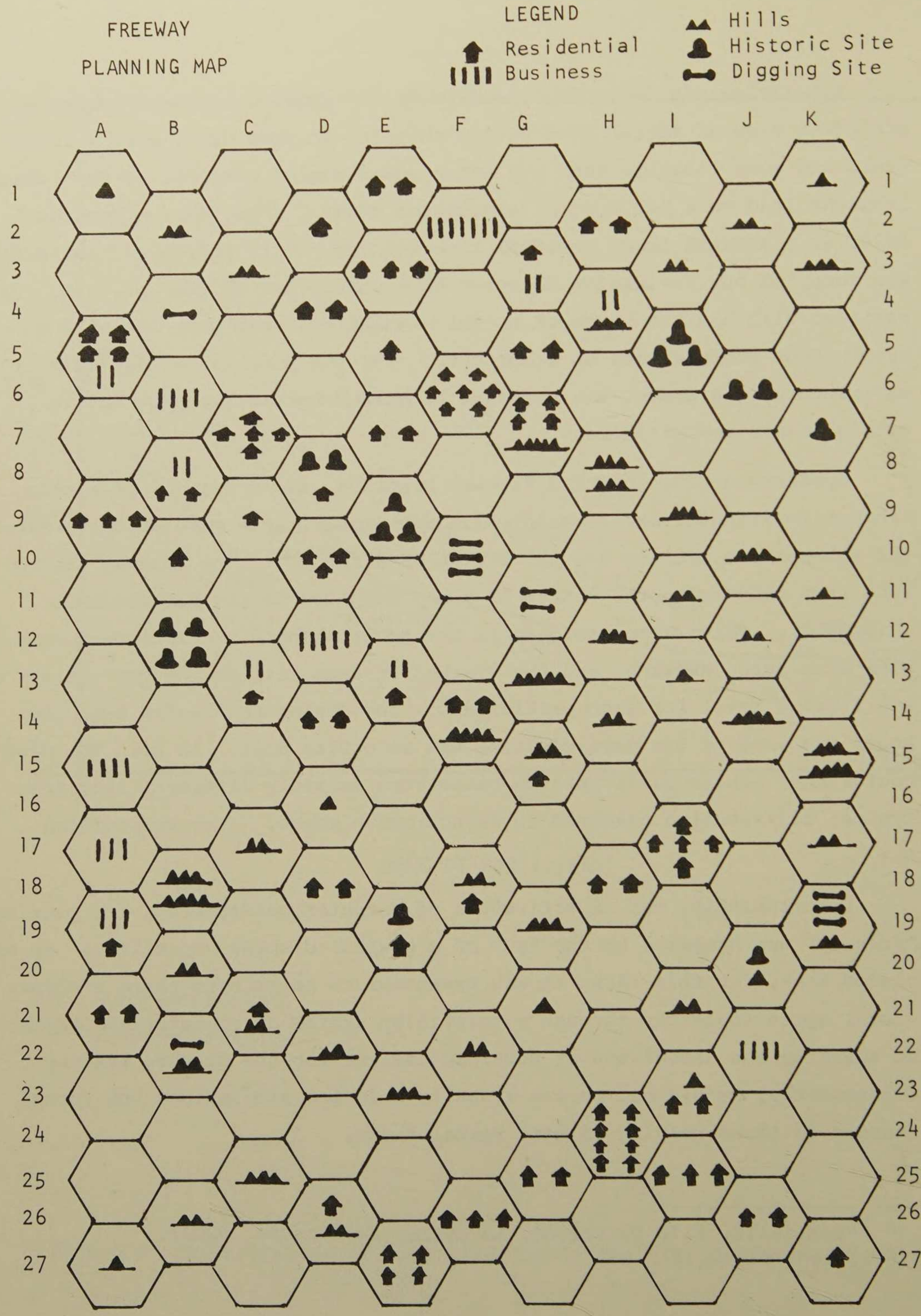


Figure 7. Sample Map for Simulation of Freeway Planning

The second type of simulation conference dealt with CRISIS resolution. In a *Science* article devoted to crisis management,* Kupperman, Wilcox, and Smith have pointed out that computer conferencing might provide a suitable tool for the improved resolution of conflicts:

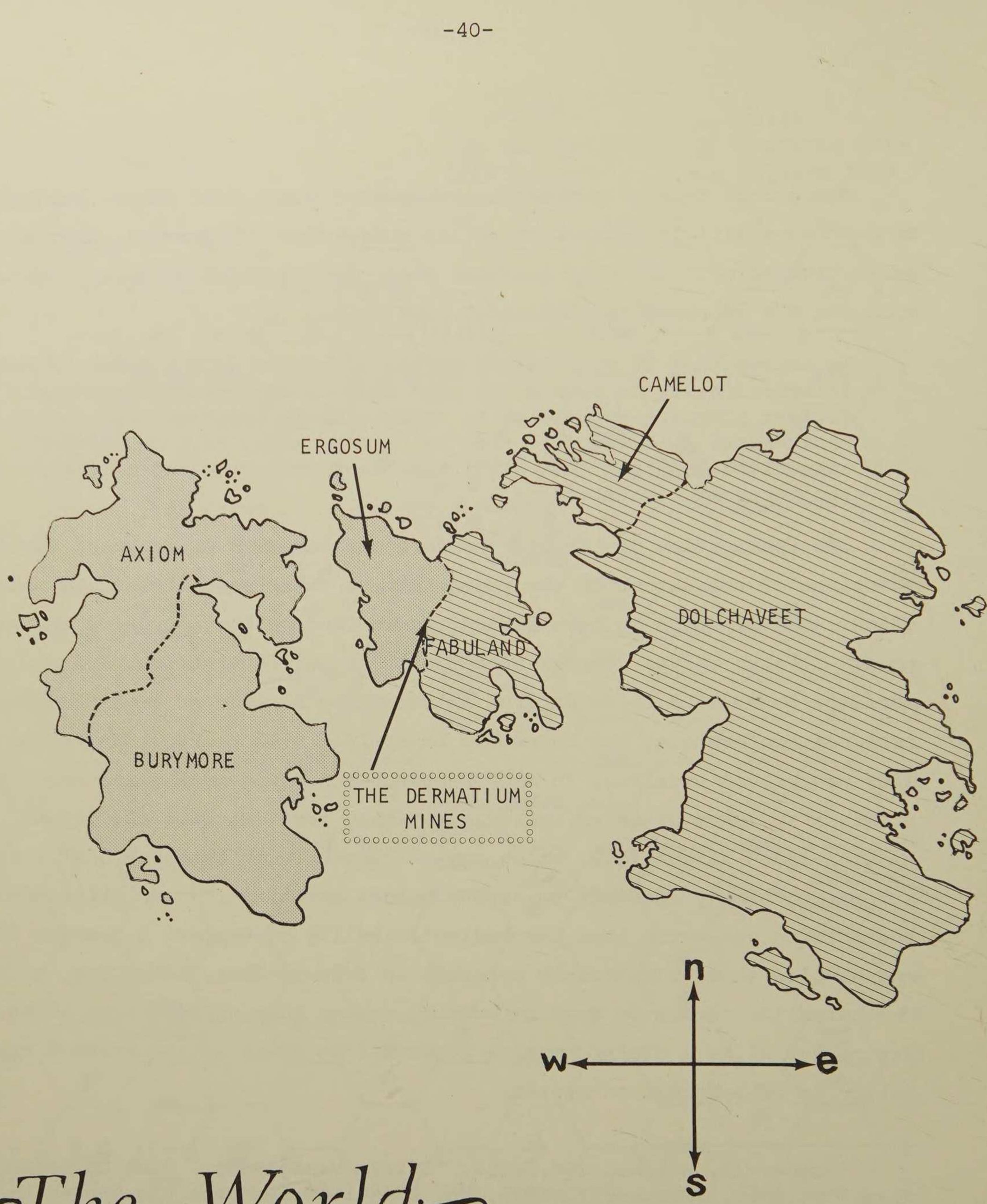
> We assume that it will take a decade or so for such systems to develop internationally in such a way that many nations of the world gain sufficient planning experience to engage in computer-assisted crisis management. Nations will then be able to enjoy rich methods of communications that will offer them deep understanding of each other's socioeconomic institutions.

The application of computer conferencing in this environment involves questions of the nature of the communication interface between man and machine, some of which we have already recognized in the course of our own work. It also raises complex problems of social interaction, and *our experience teaches us to be careful in selecting a range of tasks to which computer conferencing can currently be applied with profit.* While the medium has proved excellent in many research and management situations, and promises to serve as an effective substitute for some business travel, emotion-laden discussions, which arise frequently in international crises, are not so simply amenable to technological solutions.** In particular, there is no guarantee that the medium's ability to support a greater information flow than is currently possible in face-to-face, telephone, or TELEX communication cannot be used to *confuse* rather than enlighten an adversary. Its potential as a *disinformation system* is as great as its current capability as an information system.

---

*Kupperman, Wilcox, and Smith, "Crisis Management: Some Opportunities," *Science*, February 7, 1975, pp. 404-410. See also the letter to the editor by Jacques Vallee et al., *Science*, April 18, 1975, p. 203.

**The work of the Communications Studies Group is instructive at this point, since their experiments imply that differences of outcome do exist in conflict situations discussed over audio and video systems. These findings suggest that differences may also occur if computer conferencing is used in conflict or other emotion-laden communication situations. See Communications Studies Group, "Cooperation and Competition in an Experimental Bargaining Game Conducted Over Two Media," E/71160/SH; "Conflicts of Interest and Conflicts of Opinion in an Experimental Bargaining Game Conducted Over Three Media," E/71245/SH; "The Effects of Medium of Communication on Persuasion, Bargaining, and Perceptions of the Others," E/73100/SH.



—The World—

Figure 8. Map of Nations for CRISIS Simulation

To begin a study of crisis situations, we adapted a social simulation game named CRISIS (developed by Dr. Shirts) for synchronous interaction among eight participants. In this game, six of the participants represent the nations shown in Figure 8, while the other two play the roles of "Director" and "World Press." The nations vary in size and military strength, and each has goals of securing a resource of vital importance, as well as striving for the preservation of world order and preventing their own destruction. The game typically begins as the four largest countries (Axiom, Burymore, Camelot, and Dolchaveet) notify the director of their decisions and actions toward the crisis situation. These decisions, made at the beginning of each of three structured periods, range from a policy of neutrality to committing units of armed forces to take over the mines. The director notifies all countries when a session period begins and ends, and as a result of their decisions, what consequences have developed relative to the probability of war, their potential loss of office by revolution, and other related possible outcomes.

Two conferences were run on FORUM-6 under these conditions, and the resulting files were analyzed with the help of a special statistical program. All countries exchanged messages among themselves, some using this facility considerably more than others. The participants interacted through the private message mode to form coalitions, and transmitted public messages in attempts to clarify procedures or present national policy statements which did not necessarily reflect their statements made in the private mode.

In the first simulation (CRISIS-1), the Director was informed by Axiom, Dolchaveet, and Fabuland, toward the middle of the last period, that an alliance had been formed among them. This coalition, based upon the Index of Relative Overall Strength, was enough to preclude the other three nations from any further action. With the coalition formed, the Director announced that the game had ended.

In the second crisis simulation conference (CRISIS-2), the experiment was modified by adding an additional player as Secretary of the World Organization and by structuring more rigidly the three periods of the game. As

this conference ended, two distinct coalitions had formed. The two largest nations in terms of military and technological strengths, Burymore and Dolchaveet, had agreed to an alliance and a commitment to equally invade and control the area of contention; and Ergosum and Fabuland who bordered the mining region, joined together in an effort to maintain the resources for themselves. Axiom and Camelot, though respectively nonaligned, tended toward more passive and intermediary roles throughout the simulation. With the above relationship established, the director ended the conference.

Both of these conferences were analyzed for several parameters. First was information flow. As we have already indicated, a characteristic of group interaction during a computer conference which is not possible with other media is the ability for each participant to "speak" without restrictions. Unlike face-to-face, audio, or video interaction, in which only one person may speak at a time, computer conferencing allows each person to make statements whenever he or she desires. Theoretically, the total amount of information transferred during the conference is limited only by the typing skill of the participants and the computer terminal printing speed, as well as the ability of the participants to read and process the proceedings.

In CRISIS-1, using the total number of characters transmitted by the group divided by the length of the conference (180 minutes) and assuming a word length of five characters, we found a message exchange rate of 67 words per minute during the conference. Since the average typing speed was only 27 words per minute for the group, it is obvious that there was a high degree of simultaneous message transmission.*

Coalition behavior was another important parameter. Figure 9 shows the two-nation coalitions that were formed in CRISIS-1 and the percentage

---

*In an analysis of dyadic problem-solving, Chapanis has reported information exchanges rates ranging between 10 and 18 wpm for teletype communication; 17 wpm for handwriting; 171 wpm for voice; and 190 wpm for a "communication-rich" environment. See Alphonse Chapanis, "The Communication of Factual Information through Various Channels," *Information Storage and Retrieval*, Vol. 9, 1973, p. 224.

CRISIS 1

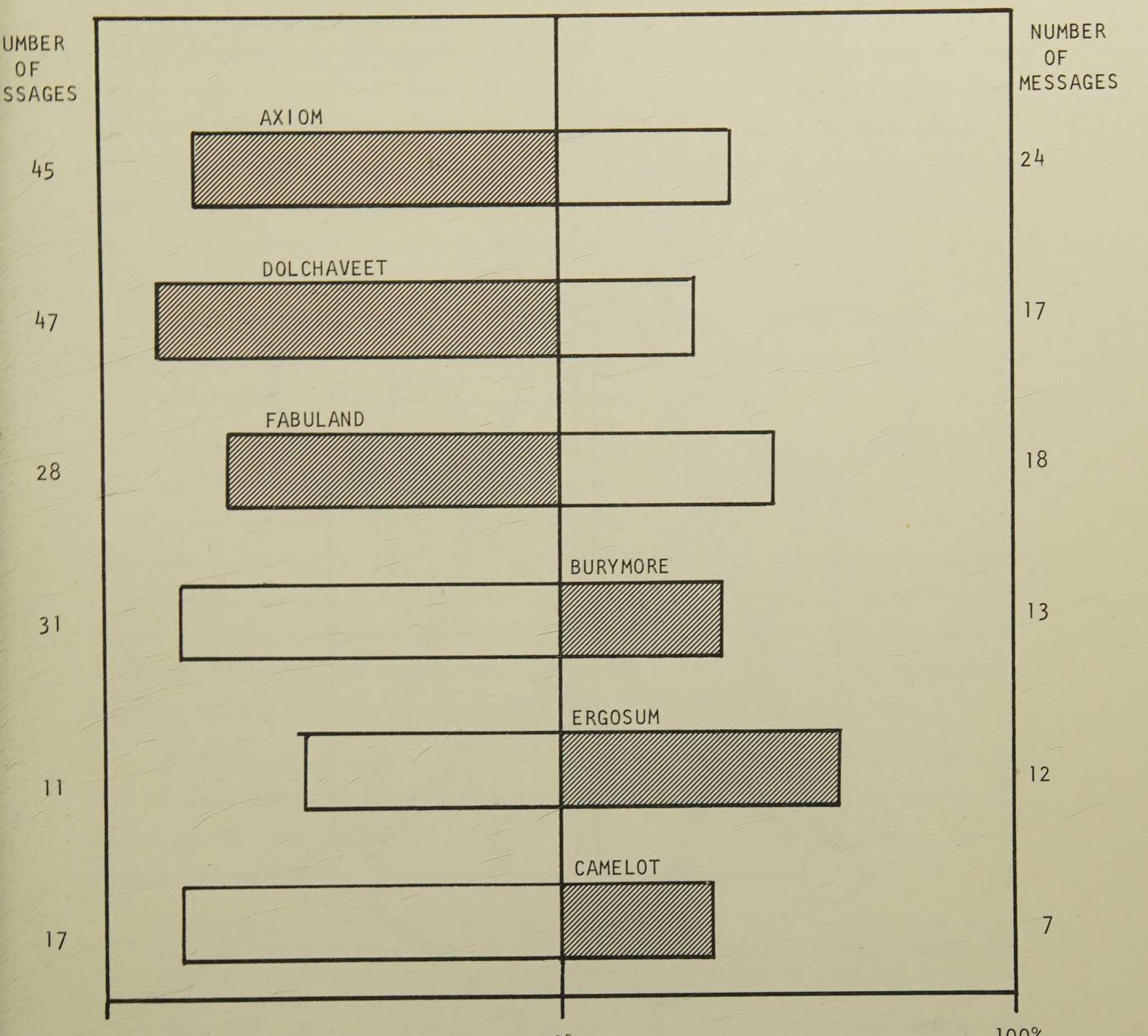


Figure 9. Percent of Private Messages Sent and Received by Each Nation in CRISIS-1 (C27)

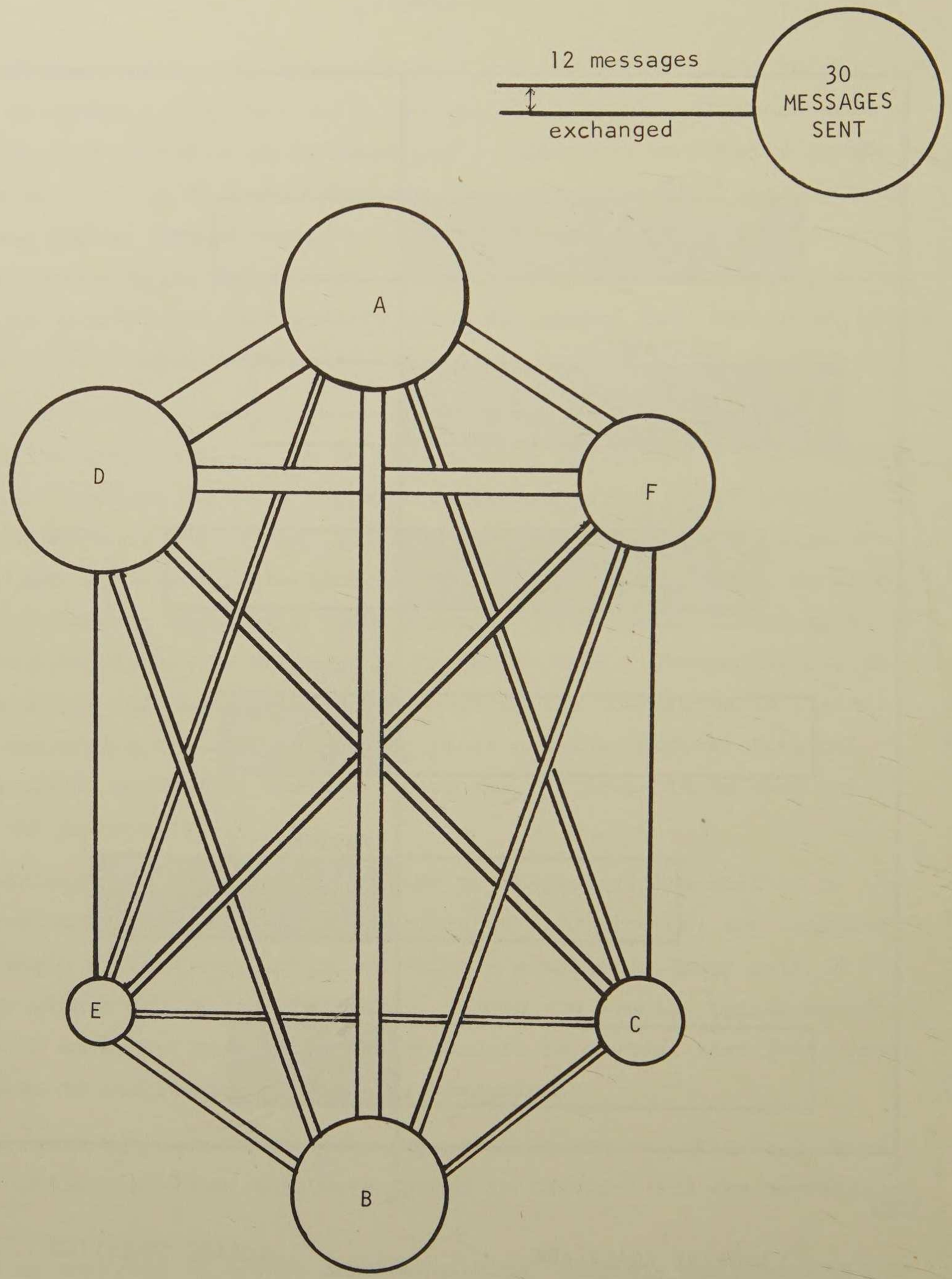


Figure 10. Private Message Exchange in CRISIS-1 (C27)

of private messages that were exchanged within the respective coalitions. The nations of the "winning" coalition interacted significantly more among themselves than did the "losing" nations. Figure 10 further displays the private message exchange activity of the six countries. In this graph, the size of each circle is proportional to the number of messages sent by the country *in private mode*, and the thickness of each link between two circles is proportional to the traffic between them. The winning coalition is clearly identifiable in this graph. Figures 11 and 12 show the interaction via private messages among the six nations in CRISIS-2. Here, the two distinct alliances have exchanged significantly more messages than the two "nonaligned" nations.

In both CRISIS conferences, there was a significantly larger number of private than public transmissions (Figure 13) as attempts were made by each nation to solicit support from others and develop alliances and compromises. The participation map for CRISIS-2 (see Proposition 17) shows a marked difference in message sending behavior between the three "staff" roles (director, secretary, and World Press) and the six nations: staff activity tended to be more public while the rectangles representing the nations clustered together in the "private" region.

It is of interest to review the similarities and differences between the CRISIS game as it was observed in computer conferencing and as it is known by the game designers to behave in face-to-face interaction. Dr. Shirts has reported:

> As director [of the FORUM-based simulation] I felt a great deal more control of the game than in the face-to-face mode. I felt confident that if I put something on the machine, it would be read by everyone, or if it weren't read, it would be available for them to read when they had time. I felt in closer contact. In face-to-face games, one is never sure that the verbal requests are heard, and the players have the advantage of "not hearing" in order to gain time or do what they want.

While we have not attempted controlled comparisons, Dr. Shirts notes that face-to-face groups, like computer conferencing groups, start out slowly, with each participant exploring possible alliances with all others while the group is seriously attempting to find a peaceful solution. The

CRISIS 2

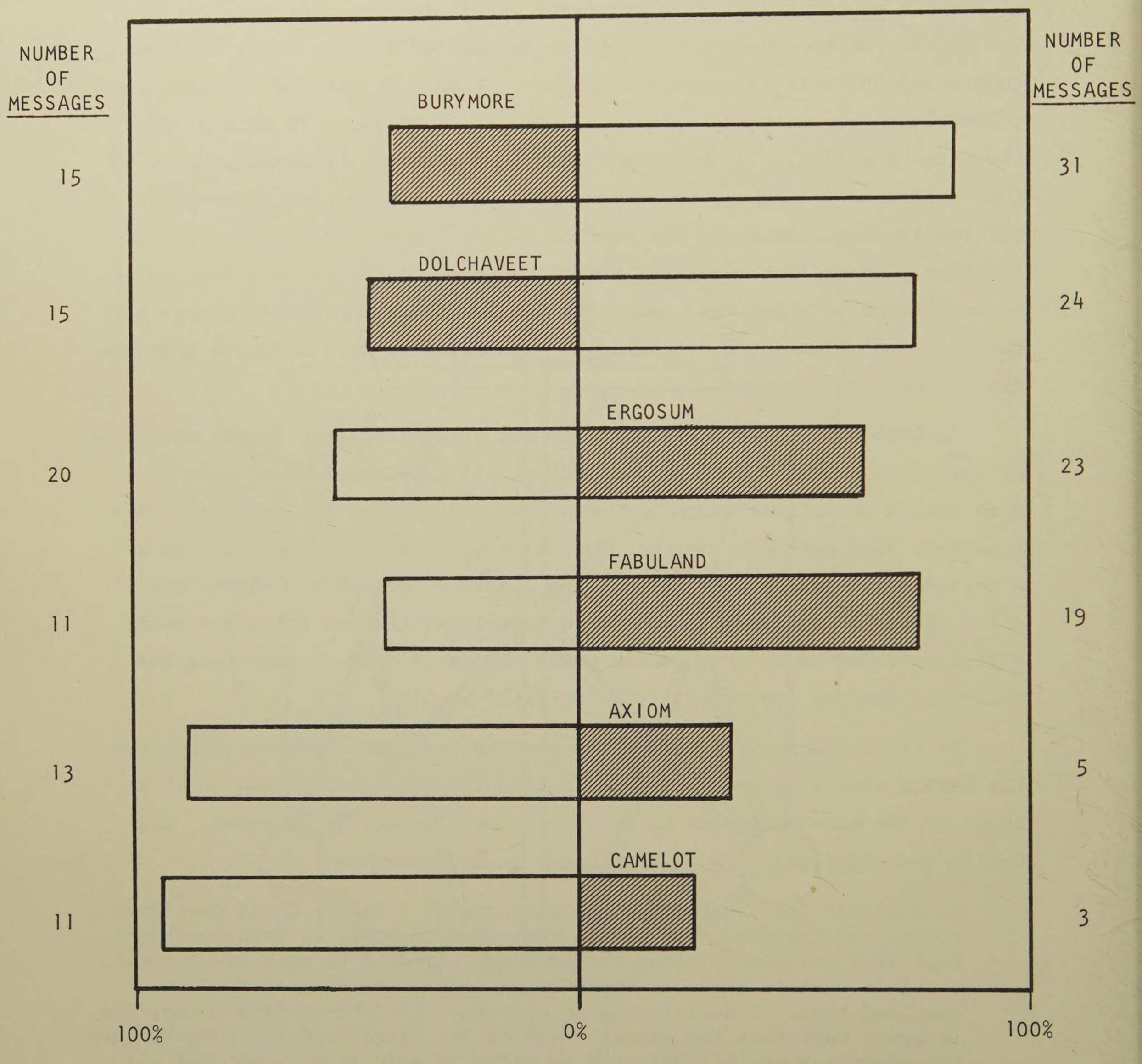


Figure 11. Percent of Messages Sent and Received by Each Nation in CRISIS-2 (C28)

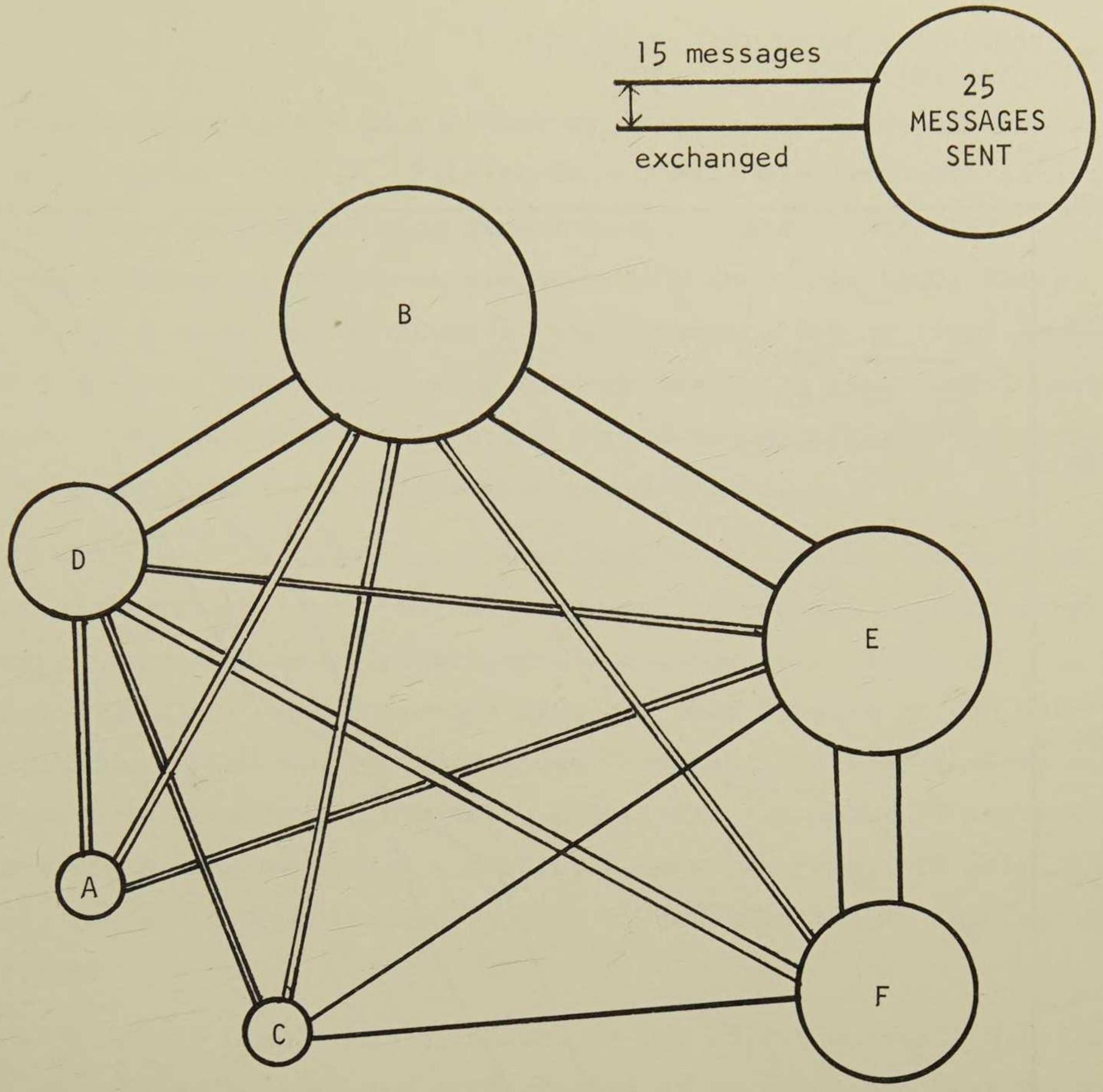


Figure 12. Private Message Exchange in CRISIS-2 (C28)

CONFERENCE DURATION: 3 Hours
TOTAL MESSAGES: 385

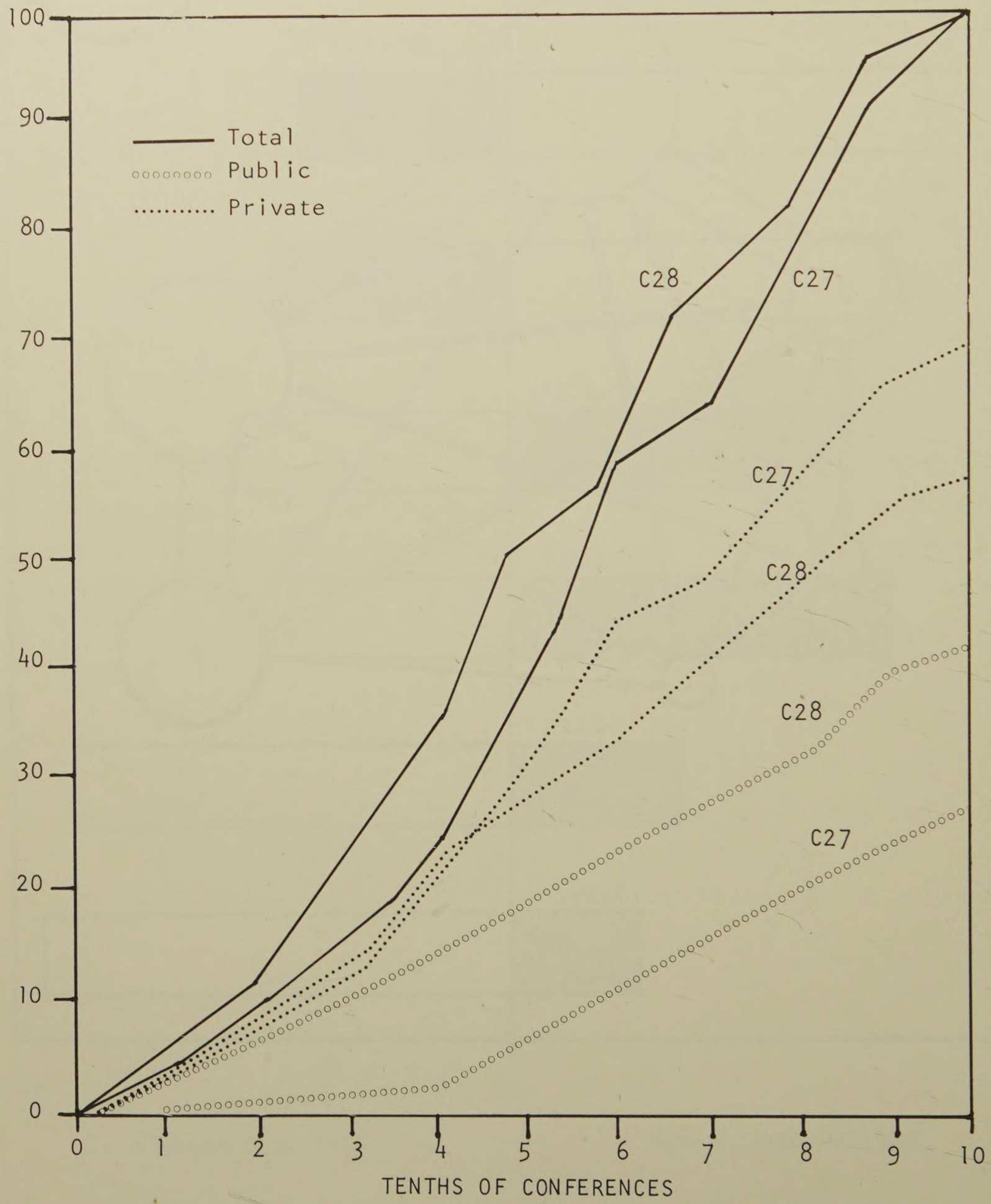


Figure 13. Growth Curves for the Two CRISIS Simulations (C27 and C28)

turning point takes place when one country makes a secret suggestion for coalition to another country. Face-to-face groups discover such activity faster than computer conferencing groups because each country team can observe the behavior of the other players. (On the other hand, their initial level of trust may be lower.) The deterioration of trust in the computer conference takes place when someone makes the first public accusation that a secret coalition is being formed by others, or when a "secret" message is intercepted--not unlike real world events.

In both media, the trust level then begins to decline; coalitions form rapidly; and "hard" action is taken. The winning coalitions formed by FORUM users (Axiom/Dolchaveet/Fabuland and Burymore/Dolchaveet in CRISIS-1 and CRISIS-2, respectively) have not been typical of the face-to-face coalitions, which usually form along "historical" lines (Axiom, Burymore, Ergosum vs. Camelot, Dolchaveet, Fabuland). In about 90 percent of all face-to-face outcomes, such a coalition ends the game. In only a few cases does the World Organization succeed in establishing an international police force.

In a "control" simulation organized by Dr. Shirts on April 2, 1975, the game was played by 10th and 11th graders at Torrey-Pines High School in Del Mar, California. After two rounds, one country (Fabuland) persuaded the four major powers to award it 40 percent of the resources in return for access to 15 percent each. The sixth country (Ergosum) was entirely crushed and left out of the agreement. This was an unusual ending, obtained after approximately 75 minutes of game.

All private messages among nations were written on paper notes, which were retained and analyzed in the same manner as FORUM exchanges, with the results shown in Table 3 and tabulated side by side with those of the two computer conferences. Although it is clearly not possible to generalize, this type of preliminary experiment establishes the fact that accurate measurements and reliable experimentation using simulation are now well within the state of the teleconferencing art.

In summary, Style 4 activities represent the fastest, most intense form of interaction possible in computer conferencing. Overall information

Table 3. Private Messages Sent in Three CRISIS Simulations

Medium		ARPANET						FACE-TO-FACE		
Conference		C27			C28			COMPARISON		
		Mes-sages	Char. Length	Avg.	Mes-sages	Char. Length	Avg.	Mes-sages	Char. Length	Avg.
Nations	A	43	6,330	150	20	1,090	54	25	1,165	47
	B	44	6,010	136	38	6,830	180	24	1,290	53
	C	20	1,270	64	18	1,600	178	12	780	65
	D	36	7,530	209	30	3,280	109	11	680	62
	E	13	5,610	430	33	6,730	204	18	1,345	75
	F	22	4,015	182	29	7,065	244	18	1,520	84
Total		178	30,765	173	168	26,595	158	108	6,780	63

flow is very high because the interaction is synchronous, and any number of participants may type at the same time. This is the style most conducive to crisis management, to discussion of emotional issues, and to other types of intense interaction.

STYLE 5: THE QUESTIONNAIRE

> *"It provides rapid dispersal of information and rapid response time. It also provides a time line of events."*

Conferencing in Style 5 is best characterized as an "electronic questionnaire"--a highly structured question-and-response interaction which barely resembles communication in the other styles. It is made possible in the FORUM program by a series of response-elicitation services. An "ask" command allows any user--but typically the organizer--to ask a question for which FORUM will gather responses in one of four forms (as specified by the inquirer): essay; votes (yes, no, or abstain); number responses; and probability estimates in the form of a range of positive numbers indicating the uncertainty of the respondent. Such a question, or series of questions, will be presented to the participant whenever he enters the conference.

The author of the question may review the responses in one of two forms. He may see the answers identified by participant name or he may simply see a summary of the answers without the identity of the respondents. He may also display the responses in either of these forms for all participants.

The use of FORUM in this style thus resembles a questionnaire survey, with Delphi and open voting at opposite ends of the spectrum of possibilities. While many of our conferences have used this system capability as a part of less structured formats,* only one has been devoted entirely to a question/response format which would characterize Style 5 conferencing. This was a conference to test the feasibility of short-term forecasting via FORUM.

---

*In particular, voting was extensively used in our crisis simulations.

Conference C21 was cosponsored by the Institute and the Office of Resource Analysis at the U.S. Geological Survey. It was conducted during the Circum-Pacific Energy Resource Conference attended by mineral economists and energy experts from all countries and was held in Honolulu between August 22 and August 29, 1974. Nine experts, who were unequally familiar with the different subjects of the inquiry, were asked to estimate the average December 1974 price for gold, silver, copper, aluminum, and gasoline; these experts included:

- a mineral economist from the USGS
- a geologist from the USGS, active follower of gold prices
- a commodity expert
- a geologist, USGS, well-read consumer
- a USGS branch chief, mineral resource expert
- a geologist with a Canadian mineral resource company, formerly a metals commodity specialist
- a USGS geologist, specialist on South America
- a mineral resources expert from Mexico
- an economist on the Institute for the Future staff

All participants were provided with information on current price history, including average prices for June 1973, December 1973, March 1974, and June 1974. The probability elicitation function of FORUM-6 was used to prompt them for future values in the manner shown in Figure 14. The resulting forecasts, together with actual high, low, and average figures, when available, are shown in Figure 15.

The results of the conference told more about the limitations of the Delphi technique than about future commodity prices. A typical example here is the case of gasoline, for which even the low forecast is about 30 percent above the actual value. The same trend is observable for all commodities we studied. In retrospect, several procedural improvements would have helped to better encode the state of information available to the experts: (1) experts who knew more about the subject in question could have been given

[1] Askevold Fri 23-Aug-74 12:26PM

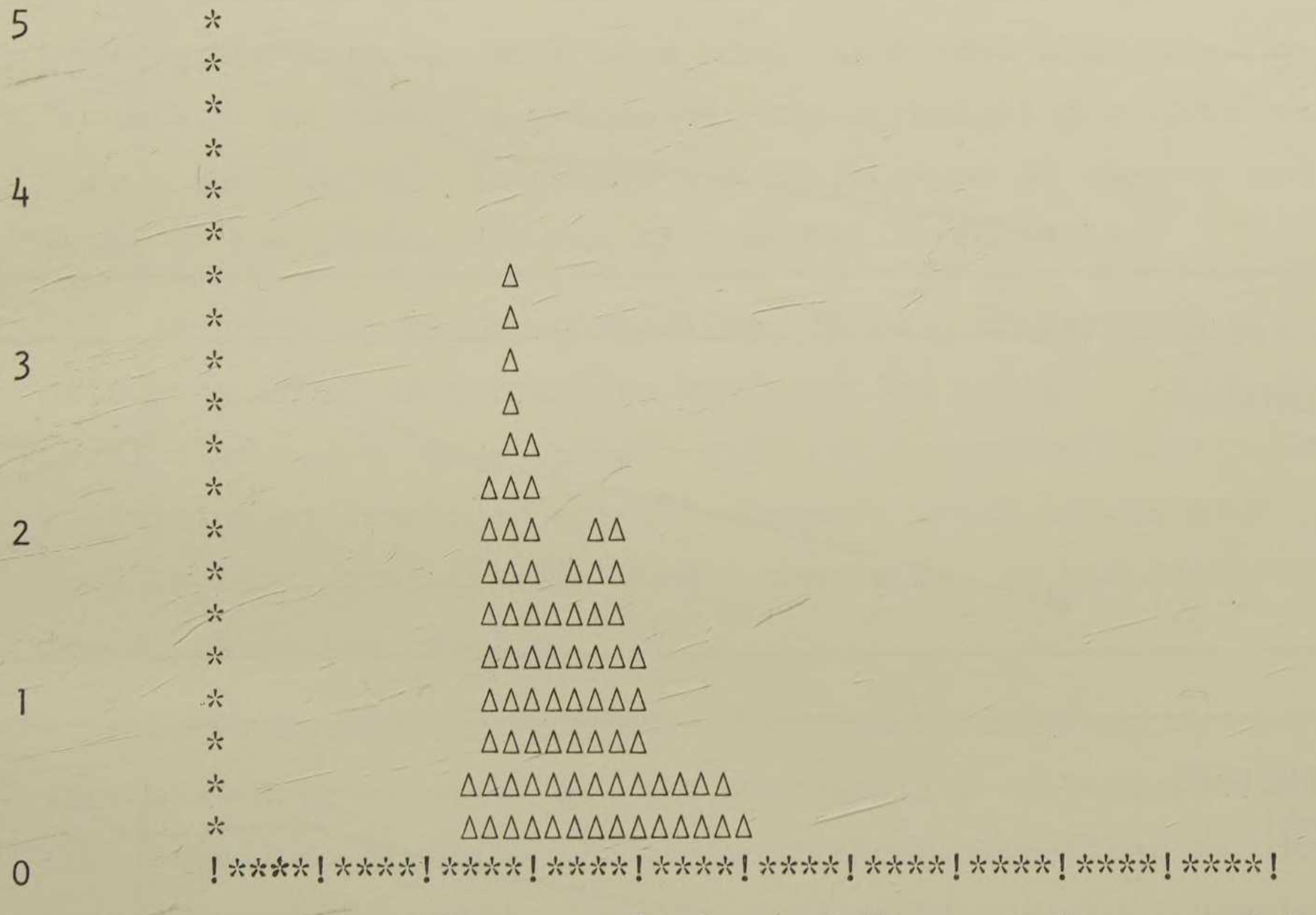
Past history (U.S. refinery) $/lb.

6/73	$0.59
12/73	0.66
3/74	0.63
6/74	0.86

[2] Askevold Fri 23-Aug-74 12:29PM

I would like you to forecast the average December 1974 price of copper in dollars per pound.

Vertical axis: probability density
Horizontal axis: range of variable



Summary of probability estimates:

No. of responses: 3

10% projection	.6565217
50% projection	.815
90% projection	1.05
Expected value	.8375
Standard deviation	.1569567

Figure 14. Sample Transcript from the Circum-Pacific Conference (C21)

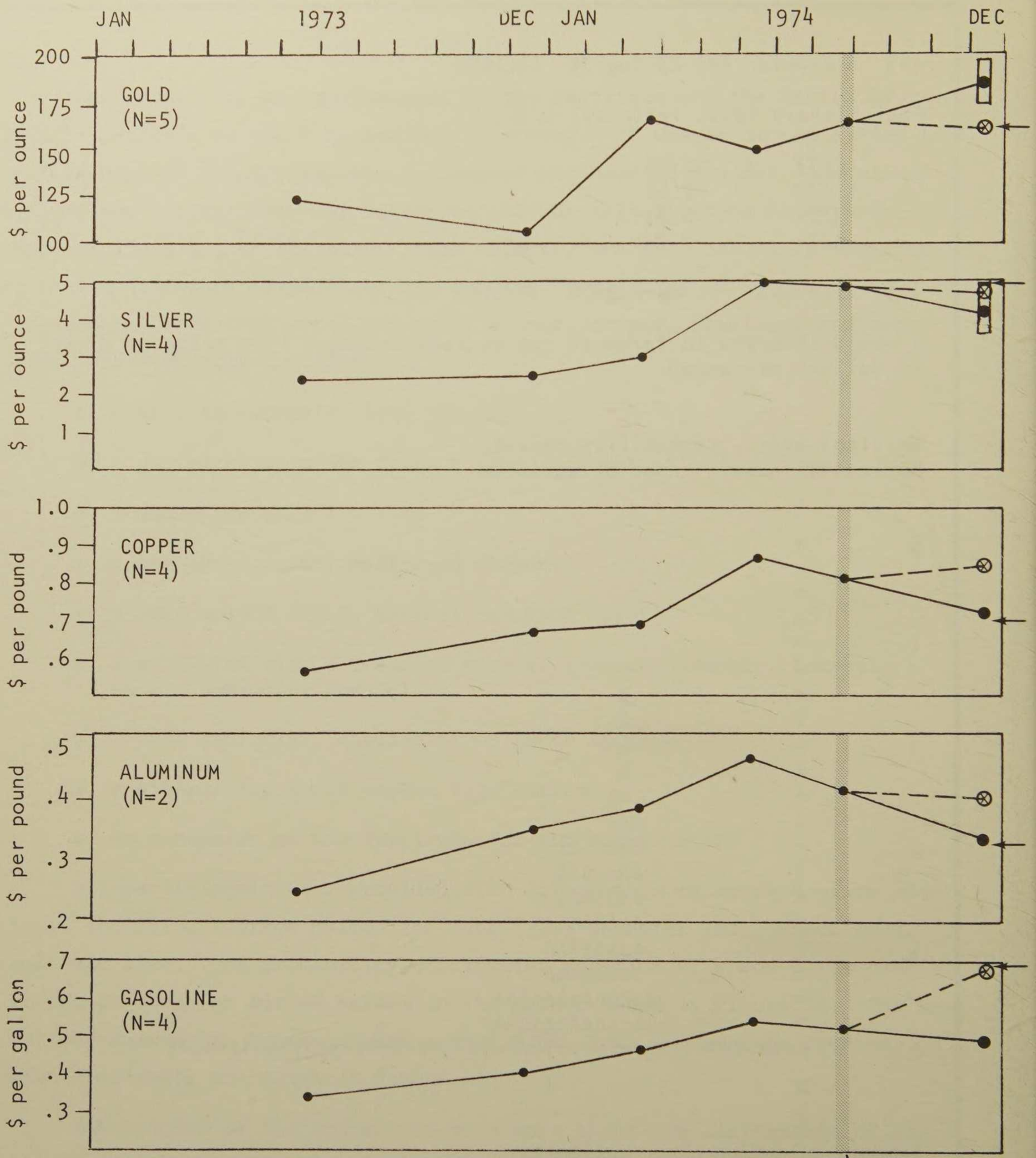


Figure 15. Summary of Projections in the Circum-Pacific Conference (C21)

more weight, (2) the experts' opinions could have been corrected for their assessing ability; such a correction typically would have spread their estimates by a factor of at least two, (3) information exchange between the experts would have helped--assuming that there was at least one member of each respondent panel who could have explained which variables might affect the future price.

When we later asked the participating experts to explain the process by which they arrived at their individual estimates, the results were seen more generally as illustrating some of the basic problems inherent in group forecasting. There was a widespread tendency in mid-1974 to overestimate *all* future price rises because of the strong inflationary pressure of the previous months, and it is doubtful that, short of a discussion between the experts, this bias could have been eliminated by more Delphi "rounds." As can be appreciated, the structuring of forecasting questionnaires and the identification and calibration of experts are processes which go beyond the effects of computer conferencing.

In terms of group interaction, Style 5 conferences are fundamentally different from other computer conferencing styles. Synchroneity is largely irrelevant since the structure does not encourage variations in rate of participation or length of entries--factors which are related in other styles and, in fact, characterize them. Anonymity, on the other hand, may be all-important in the results.

Other dimensions inherent in computer conferencing are important for forecasting procedures, and the availability of this medium opens the door to a detailed, quantitative study of their significance. Following the criticism of the procedures used, one might ask, for example, whether a group operating synchronously would work better with a predetermined, debate-terminating algorithm than with a chairman alone? Does the positive aspect of anonymity (for results of a decision-making problem) depend on all participants' having knowledge of the skill or expertise of others? Is elicitation of distributions more time-consuming, but more accurate than elicitation of point estimates?

Such questions properly belong in a long-range study of the medium in an environment where Style 5 activities are a matter of everyday routine, rather than a laboratory exercise. The availability of FORUM in such operating environments (notably at the U.S. Geological Survey) promises to lead to new data in these areas.

III. THE DYNAMICS OF COMPUTER CONFERENCING

III. THE DYNAMICS OF COMPUTER CONFERENCING

From the description of the five styles of computer conferencing in the preceding chapter, it is apparent that there is no simple "social effect" of computer conferencing. This new medium offers a variety of communications experiences to which people respond in many ways. In order to understand these experiences, we must first identify the important communications variables and then examine the dynamics of these variables in the learning and use of the medium.

BASIC COMMUNICATIONS VARIABLES IN COMPUTER CONFERENCING

In our earlier work, we developed a primitive taxonomy of the basic elements in any group communication situation.* Our subsequent analysis of FORUM conferences--using both questionnaires and performance statistics--has identified a refined set of communications variables which seem particularly important to computer conferencing. This revised taxonomy (Figure 16) provides a framework for understanding user behavior and reactions, including factors related to individuals and the group, medium characteristics, and tasks to be performed.

Individual and Group Characteristics. When individuals join a computer conference, they "arrive" with a set of attitudes toward the group, the medium, and the task to be performed, as well as certain skills and a perception of their respective roles in the group. Paramount among these individual characteristics is the personal motivation of conference participants.

---

*See *Group Communication through Computers, Volume 2*, p. 22. For more detail on the structure of the taxonomy, see Johansen, Miller, and Vallee, "Group Communication through Electronic Media."

MEDIUM CHARACTERISTICS

- Access to computer terminals
- Computer reliability
- Performance of computer conferencing program
- Compatability with other computer services (e.g., text editing, data bases)
- Ease of learning and use (e.g., human/machine interface, access to facilitator)
- Cost
- Access to alternative media (including possibility for travel)

TASK(S)

- Specificity
- Time constraints
- Task type (e.g., according to "Description and Classification of Meetings" categories)
- Rules for procedure (e.g., amount of pre-planning)
- Amount of effort required for task(s)

BASIC FACTORS IN COMPUTER CONFERENCING

PERSONS

- Attitudes toward task(s)
- Attitudes toward computers and computer conferencing
- Attitudes toward group
- Attitudes toward current media
- Openness to change
- Personal "stake" in participation
- Physical characteristics (e.g., appearance, physical handicaps)
- Personal communication skills (e.g., writing, self-expression)

GROUP

- Size
- Prior history
- Social structure (e.g., role hierarchy)
- Organizational climate (e.g., incentives, hostility)
- Relation of group to external organizational or societal factors
- Financial limitations

Figure 16. Taxonomy of Basic Factors in Computer Conferencing

Computer conferencing is a communications medium which must be activated by each user; there is no ringing telephone or other strong social demand. When a participant is so motivated, he dials an access point to the computer network and joins the conference. A person's need to communicate will influence the decision to join a conference, and a lack of group motivation will lead to sporadic attendance. As one user commented: "We had to depend on participants' logging in regularly, but most didn't. For a person who is very busy, unless he has a great personal commitment to the conference, it's easy to ignore it."

When we inquired specifically about the conferees' professional and personal "stake" in the conference proceedings (this question was asked in the questionnaire following Conference C18), the importance of personal motivation was demonstrated convincingly. Participants who expressed a stronger motivation at the start actually did contribute more regularly and in greater volume (see Proposition 26). This observation might indicate that persons who do not have a high need to interact with other group members are more likely to use existing media when they need (or feel required) to participate.

Experience with computers is another characteristic of the individual which seems important to his or her success in a computer conference but actually leads to some unexpected observations. New users are sometimes put off or discouraged, especially when first using a computer terminal. Experienced computer users pass through this initial stage more quickly. On the other hand, computer expertise is clearly not a prerequisite for a positive attitude toward computer conferencing. The medium seems enjoyable to most users and perhaps even more so to those with no previous computer experience. Certainly a partial explanation of this observation is that FORUM was designed for persons who do not know the jargon of computers (and generally do not want to learn it). This "normal English" orientation, however, may frustrate dedicated computer people who often

seem to crave an esoteric language of their own.*

Typing ability certainly is important to users of computer conferencing, but it is not at all a critical factor. Even poor typists have been able to participate actively in computer conferences. They can do so at their own speed, without any pressure in a conference which is dominantly asynchronous. Also, participants who have a secretary available have occasionally communicated via him or her. Still, our conferences have shown consistently that persons with higher typing skills (by their own estimation and by the measurement of the FORUM system itself) tend to participate more in terms of frequency and quantity of their contributions. They appear to be more confident initially, and their typing proficiency is one less barrier in their learning process. However, terminal keyboards are very different from normal typewriter keyboards: keys are placed differently, unfamiliar symbols are present, and the "feel" of the keys is not the same. These differences seriously reduce the typing rate of even a professional typist and may lessen the "handicap" to the inexperienced typist.

Alphonse Chapanis has found in his controlled experiments with various media that typing ability *per se* is not an important factor in the time it takes to solve dyadic problems.** Though we have not replicated the

---

*This attitude of users with previous computer experience is reflected in their many suggestions for "improving" the language. Typical of such suggestions was one expert's recommendation that the system include:

a "CTRL-B" command to back up one-half screen,
a "CTRL-T" to go to the top of the current entry,
a "CTRL-P" to go back to the previous entry,
a "CTRL-N" to go to the next item,
a "CTRL-H" to retype a header,
a "CTRL-n-B" to back up n half screens,

and so on! Such "improvements" would have made the system useless to all except systems programmers. We have observed that many "experts" make mistakes that "novices" do not make, because they expect to prompt the computer and are surprised by the fact that FORUM, in effect, has no "command language" in the discussion mode.

**A. Chapanis, "Interactive Human Communication," *Scientific American*, March 1975, p. 36.

Chapanis experiments in a group computer conferencing environment, we do have initial evidence to suggest that--at least in synchronous conferencing--the percentage of time actually spent typing is much less than is possible (Proposition 3). This finding reveals a flexibility in personal thinking/reading/typing patterns which may compensate for varied typing abilities within a computer conference. In one computer conference, however, we did find that experienced typists tended to join the conference for longer periods of time than poor typists (Proposition 20). Such a finding may indicate that experienced typists are more comfortable with the medium and thus become more involved in the tasks at hand. However, detailed data on performance of experienced and inexperienced typists in computer conferences are not yet available.

The role(s) a person plays in a group will also have an effect on his or her computer conferencing experience (see Propositions 16, 17, and 18). The preconference history of the group will, of course, influence the behavior of individuals during the conference. In many of our conferences, chairpeople and facilitators* were preassigned, and these roles tended to be the most active. In Conference C6, for example, the facilitator (Johansen) participated predominantly in the private mode, while the chairman (Kollen) had a high number of public entries. However, anonymity or even pseudonyms are possible in a computer conference, and can affect the potential for strong leadership roles. Also, there is an inherent ability for all participants to interact freely, with perhaps less inhibition than in face-to-face meetings. Nevertheless, initial evidence indicates that problems of control, at least by some measures, are not significantly different in a computer conference from face-to-face situations (Proposition 23).

Medium Characteristics. Of all of the characteristics of computer conferencing which might shape the conference experience, network reliability and access to terminals seem most important. The concern about network reliability is underscored by the semantic differential questionnaire which

---

*The role of facilitator is emerging as an important feature of a computer conference and is described in detail later in this chapter.

was used before Conference C12. In this questionnaire, it was found that one of the most important factors for new participants *prior* to their experience with computer conferencing was the "stability" of the medium (Proposition 29). It appears that users of an electronic medium of communication (especially a *new* medium) expect dependability, and responses to postconference questionnaires show that they are frustrated when they do not get it.

In our initial conferences, we found that lack of terminal access and network unreliability were the major obstacles to the operational use of computer conferencing. The first of these two factors accounts for the major drop between the number of invited participants and the number of active users. For example, in Conference C18, almost all users who logged in made at least one entry, but only two out of three made more than five entries. Of those who did not participate actively, most had difficulties in getting easy access to a computer terminal. The second obstacle, computer network unreliability, was a constant source of frustration on the ARPA network, and in more than a few conferences jeopardized the momentum of the interaction. This problem serves, at least partially, to explain the further drop between the number who made one entry and who made five or more entries.

The frustrations of network unreliability can be minimized, however. In the case of C19, for example, the interruption caused by the computer failure did not dampen the enthusiasm of the participants to continue once the system was restored to operation. There are at least two explanations for this continuity: (1) During the failure, communication was established via telephone, and a primitive message-sending routine on the ARPA network, not affected by the failure, was also used. The staff at IFTF informed the participants to hold while the system was being brought back up. (2) Since none of the participants had prior experience with computer systems and, therefore, had no expectations as to how computer conferencing is affected by anomalies, there tended to be a sense of camaraderie and excitement generated by a common plight.

Task(s) To Be Performed. Figure 17 shows a classification of tasks for all FORUM conferences. This classification is based on the Description

	STYLE 1											STYLE 2									STYLE 3			STYLE 4				5
CONFERENCE NUMBER	2	5	7	9	10	11	13	20	22	24	26	1	3	4	6	8	12	16	17	23	14	15	18	19	25	27	28	21
Delegation of work	■			■	■				■				■															
Giving information to keep people in the picture	■	■	■	■	■				■	■	■		■			■			■	■				■				
Information seeking						■	■					■		■	■	■							■	■				■
Discussion of ideas	■	■	■			■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Presentation of report													■															
Disciplinary review																												
Negotiation																	■								■	■	■	
Policy decision-making	■												■				■								■	■	■	
Conflict																									■	■	■	
Problem solving			■	■									■	■				■	■		■	■		■	■	■	■	
Forming an impression of others	■													■	■													
Inspection of objects																												

Figure 17. Tasks Performed in 28 FORUM Conferences

and Classification of Meetings (DACOM) system developed by the Communications Studies Group,* and our own observations of the interaction. It suggests that the most common task in our conferences to date has been the discussion of ideas, though there is a variation among task types. And of course, different participants may have different task priorities. In the case of the two CRISIS simulations (C27 and C28), for example, we have already noted the general differences in public and private message-sending patterns between staff and nation roles (see page 45). These patterns may be analyzed in more detail through a Bales analysis,** revealing that public and private message sending varies across such categories as "agrees" and "gives opinions" according to the task to be performed (Proposition 18). Computer conferencing offers a unique potential for studying interaction patterns in relation to tasks. Our research to date has only begun to explore the range of possibilities here.

General User Reactions. Given all of these variables, it has been difficult to isolate user reactions uniquely related to the characteristics of the medium. Attitudes of conferees have varied across the conferencing styles described in Chapter II, without a strong pattern of reactions which could be ascribed to the medium itself. One fundamental characteristic of computer conferencing has emerged as universally important, however: synchronous vs. asynchronous usage.

In Conference C12, in which we have had the most detailed access to information about conferees and proceedings, the ratio of synchronous to asynchronous communication emerged as an important factor in the reactions of the conferees. In the CCITT conference (C12), for example, the only significant difference in volume statistics is the greater number of characters per message that were sent asynchronously than synchronously.

---

*Rober Pye, Brian Champness, Hugh Collins, and Stephen Connell, *The Description and Classification of Meetings*, London: Communications Studies Group, P/73160/PY, June 1973.

**Robert F. Bales, *Interaction Process Analysis: A Method for the Study of Small Groups*, Cambridge, MA: Addison-Wesley Press, Inc., 1951.

Sending rate statistics in the two modes also led to important insights: significantly more messages per minute, more private messages per minute, and more public messages per minute were sent during synchronous interaction. If one looks at characters sent per minute and private characters sent per minute in the same manner, it is found that *character sending rates are also significantly faster during synchronous interaction*. Public characters per minute did not show a significant difference. So it seems that "information flow" is significantly faster--from two to four times faster--during synchronous interaction. (See Proposition 6.)

Participants from Conference C12 who were involved in these higher information flows (through more synchronous interaction) also tended to feel that the group was more effective. Those who thought they conveyed their positions well had a higher character-sending rate, less time logged in asynchronously, more characters per public message sent synchronously, and greater average use of computer time. Other information rates and volumes and their correlations with the criterion were moderately positive. This finding would indicate that the more information one transmits and the shorter amount of time one takes, the more effective one feels about participation in a computer conference. Not only does this finding confirm that those who use the system more efficiently are more satisfied with their performance, but it also shows that synchronous conferencing generates an excitement which increases positive attitudes toward computer conferencing and group effectiveness. Such an apparent need for synchronous meetings may not simply be a carry-over from what we are used to in face-to-face communication; it certainly appears to be important to both experienced and new users. Whether this need will continue with persons using computer conferencing regularly over a period of years remains to be seen.

Looking at participant evaluations of computer conferencing, it is possible to identify some personal behavior patterns which seem to predict the nature of their responses. Those with positive evaluations of computer conferencing tended to: (1) send more public messages; (2) send fewer

private messages (usually sent only when others were present); (3) send short messages, both publicly and privately; and (4) frequently "meet" people in spontaneous synchronous sessions.* These factors were identified in a regression analysis using evaluations of FORUM as the dependent variable and usage statistics as independent variables for Conferences C12 and C13. Such characteristic behavior patterns have also been observed less formally in our other conferences. The persons who feel most positively toward computer conferencing convey much information without a lot of separate log-ins and frequently without a great deal of private communication. The degree of private communication, of course, will vary greatly, depending on the substance, the participants, and the style of a particular conference.

In attempting to classify more specific characteristics of persons who were positive in their evaluations of computer conferencing, we have not yet identified clear patterns. There do not seem to be any easily identifiable set of background characteristics, attitudes, or usage patterns which characterize satisfied computer conference participants. As the taxonomy for basic factors in computer conferencing shows, there are multiple dimensions involved in every conferencing experience. These background factors, however, do not predetermine the way in which any given person will learn to communicate via computer conferencing. Therefore, we have devoted considerable attention to the process of learning and using computer conferencing.

THE DYNAMICS OF LEARNING

A computer conference is a dynamic experience, subject to personal and social influences. Perhaps most notably, a computer conference can be greatly influenced by a dynamic individual. Just as there are especially effective face-to-face communicators, there are those whose personal strengths emerge fully in a computer conference. (This observation raises the question of whether the same people are effective communicators in both

---

*Complete data are available from the Institute on request.

media.) As users become more comfortable with computer conferencing, they begin to test its social limits, to explore themselves as they can be revealed in a computer conference--often with people whom they have never met face to face. Such personal exploration is influenced by the characteristics of the system, but created in the minds of individual conferees. People may gradually improve their ability to communicate through the computer, just as they can learn to be better public speakers. Users of computer conferencing will learn only over time since there are no proven "teachers." As a result, their initial performance and reactions may vary greatly from their reactions after extended use. And while they will initially be likely to generalize from their experience with face-to-face communication or with other electronic media, a broader exploration of personal communication skills unique to computer conferencing will gradually begin to occur.

Our experience to date enables us to examine in detail the *initial* learning process through which a person is introduced to computer conferencing. Over the last three years, over 150 people have participated in FORUM conferences, most of whom had not had previous experience with computer conferencing or even with computers. Because of this unfamiliarity, the role of a "computer conference facilitator" has evolved as a necessary function. The concept of the facilitator parallels that of an "integrating agent," introduced by J. L. Bennett.* Bennett, referencing a computer-based decision support system, feels that "the user correctly perceives that the Decision Support System [teleconferencing] is very different from any of his current sources of information [communication]. He will find that working with the system requires that he learn a new way of thinking."

This "new way of thinking" is complemented by new sensations and perceptions. In the new environment, two major differences exist compared to face-to-face communication. First, fingers and eyes replace vocal and audio channels for transmission and reception. Users may adapt to this

---

*John L. Bennett, *User Acceptance of Decision Support Systems: The Role of an Integrating Agent*, IBM Research Laboratory, RJ1502, January 22, 1975.

difference easily or they may find it initially threatening, depending on their past experience and skill in typing. The second change is that the medium is no longer assumed; the medium is not "transparent." As mentioned earlier, a computer terminal presents unusual keys and switches with strange symbols and names. There is a coupler for the telephone and an unseen computer many miles away. These new symbols, switches, and equipment must be explained simply, but not condescendingly, to the new user before communication can begin.

Most interactive systems are introduced with the help of a bulky "user's manual" and several tutorial sessions. Given the environment in which we were operating, neither of these approaches was practical. We had to accept the challenge of designing the medium for very busy, impatient users who could not afford the time to read a manual and were too far away geographically for a face-to-face tutorial. We had to rely on human facilitation, extreme care in interface design, and a concise user's guide.

How much and what information the facilitator gives to the new user depends on how confident the participant is in his ability to learn and adapt. "The new user," according to Bennett, "faced already with an overload as he enters the confidence phase, needs access to information which contains all (and only) what he needs to know, . . . so that information overload is avoided." After an introductory telephone conversation with the new user in which the facilitator explains how to access the system network as well as what password and codes are necessary, our approach has been to start the learning process using the medium itself.

Since the most common type of message sent and the easiest to initiate is the public message, the facilitator tells the user to communicate in this mode for the first few entries. The following exemplifies the initial interaction between the facilitator and the user, in which an Institute staff member (Thad Wilson) was the facilitator.

The title of the activity is:
A DEMONSTRATION CONFERENCE

There are no entries so far.

Now joining: User

[1] Wilson
Good morning Al. Did you have much problem getting on?

Typed simultaneously

[2] User
Thad, I think I'm on. What next?

[4] Wilson
You apparently have figured out the system pretty well. As you notice, by simply starting to type you send a public message that is received by all participants. Don't forget to end your messages with a double carriage return.

[3] User
No, but I'm having trouble with each character I print on this end. Each double prints and has apparently random skips. Is this possibly a problem at this end?

Responds to [1]

[5] Wilson
Could you check your terminal and coupler to see if they are both set for full duplex? Full duplex is what you want.

In the above example, the user (a social scientist at an East Coast university) is completely unfamiliar with the terminal and questions what is appearing on his transcript [3]. A technical problem is discussed, but the user does not know what to do and is not even certain that his messages are received.

[6] User
Did you receive my last message and questions?

[7] Wilson
I'm receiving your messages correctly (no double characters). Let me know about the duplex settings.

[8] User
Have checked coupling; it's okay, but don't know how to ascertain the full duplex setting. Any suggestions?

[9] Wilson
There should be a switch on the coupler that says full or half duplex; same for the terminal. In any case, your messages are coming to me fine.

[10] User
Coupler has "FD" and "HD". We have it on "HD". Is that right? Also are you inquiring about the duplex as the potential problem re my still getting double characters at this end?

[11] Wilson
Set the switch for "FD"; that probably is the problem.

The facilitator now feels that the user is confident in his ability to send public messages and is ready for instructions on how to send a private message. (The transcript shown is from Wilson's terminal.)

(To User)
This is an example of a private message, Al. It is received only by the participant to whom it is addressed. Why don't you try sending me one.

Private message from User
On this one I am now having carriage control problems. I am getting overprinting . . . .

[14] Wilson
Do you appear to be getting too few or too many carriage returns? By the way, your private message was received.

[15] User
Now on "FD"; good now; that resolves that one. Will now try to review message no. 3.

In [14], the facilitator is again eliciting more information from the user regarding apparent duplex problems.* The second sentence confirms that the private message was received.

Besides sending public and private messages, the participant must, at some point, learn the special services of the system. The most frequently used and important command is "REVIEW". But in order to use it correctly,

---

*"Half" and "full duplex" refer to the characteristics of the signal between the terminal and the computer.

the user must understand how to obtain a service from FORUM. Our user population was such that we could not explain the concept of a command language. Instead, we asked them to "send a private message to the system itself," although it was also possible to use a control character to access the services.

The user makes a mistake here sending the request as a public message. →

[16] User
Review by User in 3.

[17] Wilson
To review, first depress the control key and the letter "F". Then type the word "REVIEW" followed by the entry number you want to review. Try that, Al, and see what happens.

Another mistake. →

[18] User
Thad, review 3.

[19] User
Thad, I have a review of 3 back, but not the use of the control key and the letter "F". Is this just another way of review from that specified in the manual?

[20] Wilson
Re 19, yes. Depressing the control key and the letter "F" is just a little quicker. However, whichever you prefer is O.K.

The user is confused about the execution of the command in order to use the "REVIEW" service. The facilitator in [17] made the mistake of telling the user something that conflicted with what was written in the user's manual, as evidenced in [19].

[21] User
Ignore 18. The delay on printing of my carriage caused me to hesitate. I've got to work out message corrections prior to the conference, but will study the manual some more for that. Note: I was not done with the last message, but it was interrupted. I presume that hereafter I can just keep on typing while other stuff is coming in. Right?

The participant now seems to understand the proper way to "REVIEW" and shows a desire to learn more about the system before the actual conference begins. In the last sentence in [21], the user senses that, unlike

face-to-face interaction, computer conferencing allows him to "talk" whenever he wants.

[22] User
I'd like to try an anonymous message next, just to see how it goes.

[24] Anonymous
This thing is still a little hairy. My print is in lower case, but all from FORUM is in upper. Does it make any difference if I do or do not shift to upper?

[25] Anonymous
I was sending inadvertently in upper case; however, either upper or lower is fine.

[26] User
How come I get my anonymous comment back even when I did not request a review of it?

[27] Wilson
It is literally anonymous such that the computer doesn't know who authored it and consequently it is sent to everyone, including the anonymous author.

[29] User
Got you on the anonymous thing. Do I have to hit "CR" each time I start to write a message? Also, can I ignore the carriage return in the middle of my message, so that a word does not get arbitrarily split?

[31] Wilson
Just start typing to begin a message. FORUM automatically generates a CR at the end of a line, and though it looks disjointed to you, it is received in correct format by the other participants.

This dialogue shows the eagerness of the participant (in [22]) to learn more; he questions what "anonymous" means (in [26]) and requests specific information on things he has observed happening on his terminal (in [24] and [29]).

[30] User
Before I sign off, how about a few hints as to how to get on the system later in the week to try out some more features, e.g., corrections. Will I merely access it like I did this a.m. for logon?

[32] Wilson
Do exactly the same as you did this morning, remembering "FD" for duplex setting.

[33] User
I'm about ready to sign off, as soon as I receive reply to my query no. 30. Will hold sign-off till I hear from you to do it.

[35] Wilson
O.K., Al. Thanks for taking time during your lunch hour for this demonstration. I'll talk to you later this week.

The end of the interaction is prompted by the user in [30] with a question of reassurance that he will be able to return at a later time. In [35], the facilitator is intentionally signing off so that the user will get a system-generated message that the facilitator is "now leaving." From now on, the user is "on his own."

[34] Anonymous
Super. Doesn't seem to require too much of the user, but this test is most helpful. When I know you are not there to help, however, I hope I don't panic. If I should, I'll just type "help" and hope that it will get me going again.

[36] User
Thanks for your time, too. Much appreciated. With much thanks. Al

[37] User
On Monday, I'll plan to start in the system by calling for a review of status. I presume there'll be some type of updated agenda to get us underway.

[38] User
I guess you're already out. I presume that now I'm just talking to myself, but as long as this is okay, I'll continue for a few more minutes and see what happens.

[39] User
I'd now like to make a mistake and try to correct it.

[43] User
I want to add this statement and then check status again.

[44] User
One more correction. This is fun.

Messages [34], [35], and [36] are sent before the user has realized that the facilitator has left. The concept of talking "to myself" (in [38]) seems initially strange but apparently "socially" accepted in this medium. The user continues in good humor in an effort to learn more, attempts to understand commands that will be useful to him, and lastly, sums up his introductory experience: "This is fun."

For a facilitator to be effective (more precisely, to increase the learning rate and self-confidence of the new user), he must prepare himself for circumstances that will be unique to the particular user's personality and propensity to learn. This task is especially difficult when the users are "experts"--that is, highly respected, recognized authorities in their own field--whose time is valuable and who may be inhibited, frustrated, or intimidated by the terminal. (Many of our users had never used a terminal before. Some were frankly antagonistic to computers, and especially to the concept of computer-based communication, which they expected to find "de-humanizing"). Although most initial interaction follows the above pattern, there are exceptions. The following is the last part of an exchange in which the user and the facilitator had difficulty in understanding each other. The interaction had been confusing to the user and frustrating to the facilitator.

[42] Another User
Are you there? Would I know if you left?

[43] Wilson
FORUM will notify each participant when someone else leaves or enters a conference.

[44] Wilson
By accessing FORUM (CONTROL F) and then typing the word "STATUS" you can find out what each other participant has seen in the conference.

[45] Another User
Shall we quit now?

[46] Wilson
What has given you the most problem so far?

[47] Another User
You

[48] Another User
I and you ask and answer, respectively, different questions. I suspect I am typical of the other participants, and you will have to anticipate that they will not think in the same way you do.

The unexpected answer to entry [46] and the subsequent caveat in [48] were valuable information for the facilitator. Earlier in the demonstration he had been guilty of assuming too much about the user's knowledge of the system and had offered too much information based on this false assumption. In summarizing the integrating agent's objectives, Bennett states: "The agent must be keenly perceptive of user needs and responsive to user difficulties in system use. *He will be continually impressed with how little is reliably known about helping people manage their own learning process*" [our italics]. Like Bennett's integrating agent, the computer conferencing facilitator is "chiefly guided by intuition and experience."

The role of the facilitator in a computer conference begins to change as the conference participants become familiar with the characteristics of the medium. At that point, the facilitator becomes less a teacher and more a guide and assistant in the conference proceedings. He may be called upon to act as a human translator of the machine's behavior, particularly in the case of system or network failures. And as conferences get fully underway, he will make suggestions about how the medium can best be used to accomplish the conference tasks. He might suggest, for instance, that the chairperson send a private message to several key participants about a particular issue under discussion. Also, he will periodically check with various participants to see if they are having any problems using the medium to express their own points of view. Examination of the private message traffic to and from the facilitator in Conference C19 reveals both the informality, the humor, and also the very critical skills which characterize the facilitator's function:

Private message [20] to Terry
Welcome back, Margaret. Never let a machine overcome Yankee ingenuity.

Private message [23] from Terry
Joanna's name appears but no messages seem to follow. Is she transmitting?

Private message [24] to Sharp
Why don't you break in on Joanna and advise her to send her message in bits and pieces.

Private message [33] to Terry
You might, at a propitious time, announce some recess for lunch and schedule an afternoon regrouping. A. West should be coming on around 1:30 EST. I leave the recess decision in your hands.

Private message [34] to Terry
I think it might be sage, in view of the inconsistency of the "host," that maybe you discuss the agenda schedule for September as that is probably most important now.

As is clear from this example, the function of computer conference facilitator is an important and varied one which might be performed by more than one person.

The dynamics of learning in a computer conference can be quantified through an analysis of the content of messages sent when the computer conference actually begins. Conference C12 was analyzed in this fashion, and provides a good example, since none of the conference participants had previously been in a computer conference. The first half of the conference was used mainly for getting acquainted with the computer conferencing system and the procedural aspects of the conference itself. After about one-third to one-half of the entries had been made, errors in usage were at a minimum. From that point on, the comments pertained overwhelmingly to the issues to be confronted by the conferees. Interspersed in this "learning phase" were the chairman's opening remarks, requests for clarification, and preliminary position statements. After the position statements had been made, some initial integration occurred. Based upon suggestions made in the discussion, the chairman recommended that delegates divide into groups to study the separate areas which had been raised during the conference. The conference was brought to a close as the CCITT secretariat submitted the remaining position statements, and the delegates made their corrections.

The conference proceedings have been classified into the following general types of entries: *learning*, *procedural*, *position statements*, and *integration proposals*. Figure 18 is a graph of the cumulative number of

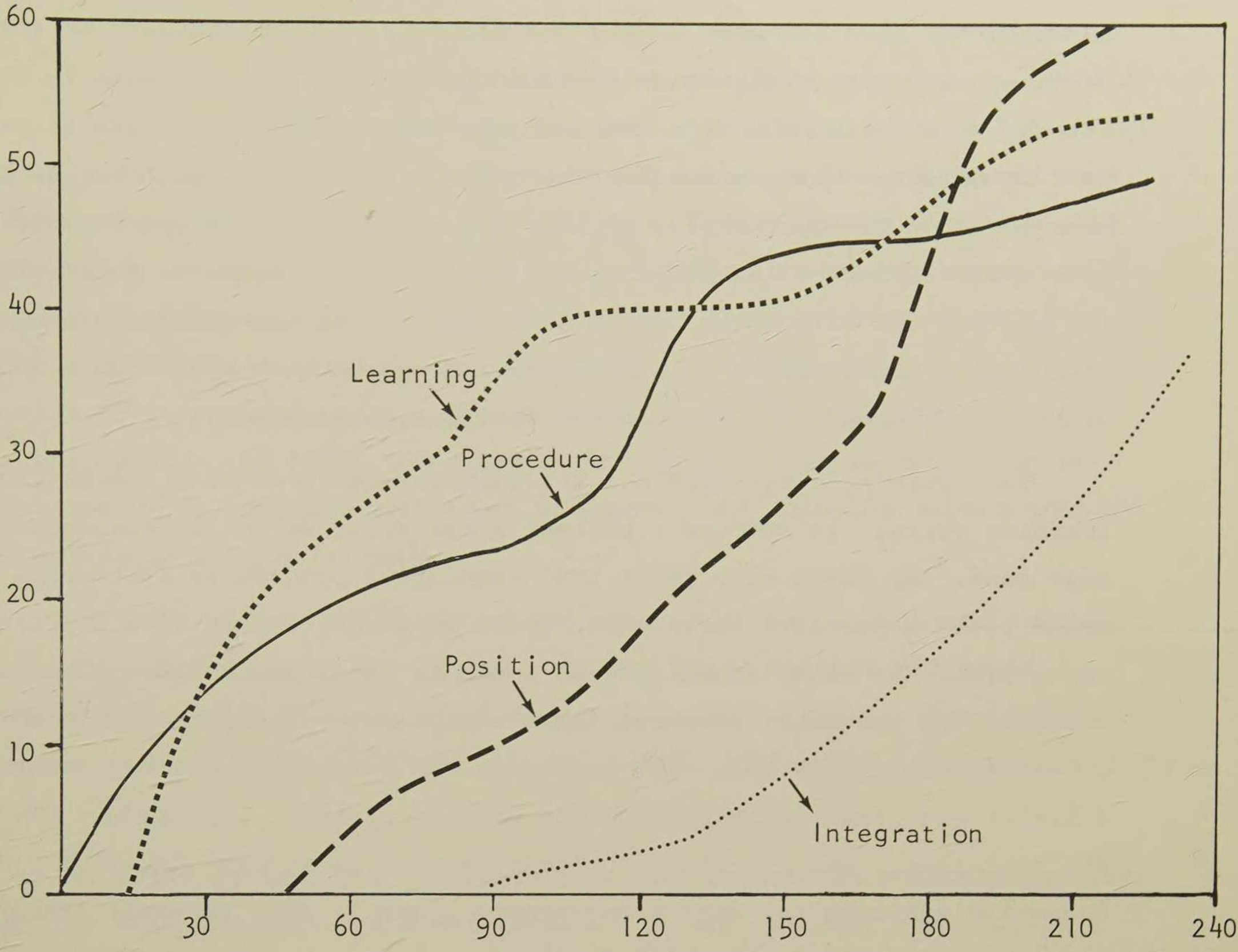


Figure 18. Content Categories in the CCITT Conference (C12)

messages for each category versus the number of public messages in the conference. A position statement is an entry which makes reference to or states one's position on the topic of the conference. A procedural statement is an entry which addresses the procedure which is, will be, or has been used for the conference. A learning statement is an entry which is made while trying to learn how to use the system or terminal or in helping another use either the system or terminal. An integrative statement is an entry which refers to other positions which have been made. (Other types of statements could be termed social communication.)

The learning curve here has the same general form as a theoretical learning curve. *It reaches a plateau after about 90 to 100 messages have been sent*. We might also think that cumulative procedural statements would yield a positive curve which would approximate that of a learning curve since the major questions and comments about procedure will usually occur during the early parts of the interaction. This pattern did actually appear in Conference C12. The curve for the procedural discussion grew at a higher rate than learning, and did reach a plateau. But midway through the conference, new procedural priorities were raised and debated. (Japan 1 suggested starting the entire conference again.) This upheaval itself followed a negatively accelerated function.

Only after much of the procedure has been outlined and learning the system has occurred do position statements begin to appear. The growth of this type of message seems to be linear or positively accelerated. Only after the first types of statements occur does integration begin. This pattern would be expected because integration is necessarily a function of the number of previous position statements. Had we been able to continue the conference over a longer time scale, we might have witnessed a plateau in the statement of positions, and the appearance of a fifth type of entry, related to the formulation of a consensus report, possibly with a statement of minority positions. Bargaining would also have played a greater role at that stage of the interaction. (See Proposition 22.)

One can imagine a time when the human factors will be understood well enough for the system itself to take over some of the functions of a

facilitator. The ability to detect the level of skill of a user was, in fact, introduced in FORUM-6. The mechanism relied on a technique inspired by artificial intelligence schemes and used a weighting of nine "skill ratings," continually updated as a function of messages sent, commands used, elapsed time, and requests for information. These indexes described the proficiency of the participant in nine aspects or phases of system usage. *It allowed FORUM to adapt its own behavior to the demonstrated skill of the human with which it was interacting.* This adaptation took the form of shorter or longer welcoming messages, additional prompts, indications of the availability of help, and command descriptions and repeating of instructions. It was also reflected in suggestions actually volunteered by the system in a tutorial mode.

The *skill rating index* was an aggregate measure of each participant's usage and adaptation to the system. It was based on nine different indexes reflecting the number of messages sent, the editing characters used, and the participant's familiarity with various subcommands available within FORUM.

The skill ratings for CRISIS-2 show that two of the participants were familiar with the system and had occasion to use the full command set (including questions and votes); however, while they did achieve a higher skill level, the growth pattern of adaptation was similar for all nine users. The final values for the two "expert" users are 9.1 and 8.9 (Director and Secretary, respectively), while the other participants range from 7.5 to 8.5. Previous experience does have an effect on skill, but as far as we have been able to observe it, this effect only accounts for a small variation in the participant's overall skill (Proposition 21).

The dynamics of learning about computer conferencing are complicated to study, but they necessarily dictate the evolution of the conference and the reactions of conferees. Though the technical skills necessary to participate in a FORUM computer conference are minimal, it is also true that some adaptation and experimentation will be necessary in order for a new user to feel "at home." To date, we have only studied persons who have used computer conferencing for limited periods of time. Further analysis

of long-term usage (over one year, for example) will reveal whether the dynamics of learning continue as people begin to communicate routinely by computer conference.

IV. CONCLUSION: FIVE SCENARIOS

IV. CONCLUSION: FIVE SCENARIOS

"The work has been based so far upon the meetings that now take place; as important in some instances will be those that do not take place (but, in some sense, should). It is worth considering how well someone fifteen years ago might have predicted present use of photo-copies from statistics on the use of carbon paper."

Martin Elton
Communications Studies Group, London

Computer conferencing, as we have observed it over the past three years, creates a new intellectual environment. It is more than an adjunct to a voice-based system and more than an extension of a TELEX system. It transcends the common notion of "electronic mail." It is a powerful instrument which allows groups of geographically separated people to reshape their time and space constraints. And while the unreliability of current computer networks and problems of access to terminals still represent major obstacles to further development of the medium, many anticipated problems have not proven significant. Given a system such as FORUM--which incorporates the careful design of user interface and places no serious limitation on verbal expressions--neither the cost nor the typing requirement represents a serious impediment to successful conferencing in operational environments.*

We are concluding this phase of our work with the assurance that computer conferencing is ready to be applied to a wide range of tasks. Of

---

*The PLANET program, a successor to FORUM that runs on a commercial time-sharing network, has been used for nine months with an average hourly cost to users of $16, of which $10/hour is a flat communication charge. This translates into a cost of about one quarter (25¢) per user minute and can be contrasted with the cost of a telephone conference call: Such a conversation between San Francisco, Boston, and Tampa costs $6.00 for the first three minutes and $1.25 for each additional minute. (It should be noted that these costs do not include equipment rentals; i.e., telephones and terminals.)

course, many questions do remain. We are still uncertain about some of the managerial and economic aspects of linking groups of people. The long-term impact of the medium on organizations also remains to be explored with more controlled experimentation. And finally, the possibility that computer communications might replace a large fraction of face-to-face interaction raises serious philosophical questions. At present, "human contact" usually means being together "in person." For some people, the mere thought of a communication medium which renders human bodies (or even voices) irrelevant is frightening. Isaac Asimov, in his novel *The Naked Son*, and E. M. Forster in his 1929 story, "The Machine Stops," have offered nightmarish projections of a future in which electronic communication replaces human contact as we know it. We have examined computer conferencing as a supplement to face-to-face communication, not as a replacement. But the long-term negative possibilities deserve attention, if only so they can be avoided.

In summarizing our findings about the capabilities of computer conferencing, it is possible to project a vision of the medium as it might be used several years from now. We have organized this vision around the five conferencing styles identified in this report. We have placed the vision 5 to 10 years into the future--close enough to avoid severe distortion by unpredictable technological developments, yet far enough for some of the possible social effects to emerge. We conclude this report, then, with five views of computer conferencing as the reader may experience it in the future.

STYLE 1: WHEN A SCIENTIFIC DISCIPLINE GOES "NETWORK"

There has always been a fundamental need for people working in the same field to have strong communication links with access to a common store of information. In the Middle Ages, this need brought numerous scholars, using Latin as a single international language, to the leading courts of Europe. Today, it is manifested in the use of computer conferencing, a tool which is stretching the limits of academic disciplines.

Effectiveness in the communication of new ideas is basic to the development of many fields, but nowhere is it more essential than in astronomy. The sheer bulk of the information, however, often gets in the way of sharing real knowledge. As early as 1970, the Astronomical Society of the Pacific had observed an increase in the number of astronomical papers published each year "to the point that no one person can read and remember their contents in even the narrowest branches of astronomy, much less become familiar with details of the literature of previous decades." The Society recommended the establishment of an astronomical data center. In 1979, such a center was finally established as part of an Astronomical Resource Network (ARN). This network currently links all major universities as well as observatories and a number of research institutions. It is estimated that approximately 100 astronomers use it daily to communicate with colleagues at remote sites, to access the data center, and to monitor flash announcements of important phenomena, such as comets and novae.

The effect of the ARN has been to increase the amount of communication among researchers in the field of astronomy. The network has encouraged the sharing of preliminary research results as well as cooperative projects which make optimum use of available funds and special talents. Astronomers no longer lose contact with the scientific community when they are away at earth-based or orbiting stations for observing periods. Furthermore, the availability of data, together with new communication opportunities, has tended to equalize research capabilities among institutions, allowing smaller, less established groups to contribute more significantly to the field. It was originally anticipated that the network would have the opposite effect, that established groups would dominate network conferences. But two factors have worked against their dominance: first, they

were not initially as dependent on the ARN as the less established groups and therefore did not participate fully in the beginning. Furthermore, the pressures of group hierarchies are simply not as great on a computer conferencing network. One product of the reduced hierarchical pressures is a greater airing and, in many cases, acceptance of unorthodox ideas. This feature of ARN was demonstrated dramatically during the 1981 Velikovsky debate and in the new interpretation of the nature of pulsars.

The ARN is run by an administration board of 11 experts. This board is the outgrowth of a small group of computer specialists who were instrumental in establishing the network. (This history also explains some of the conflicts between the board and the astronomers who use the networks.) The board has now been expanded to include not only information systems specialists and facilitation experts but four leading astronomers and an editor of the *Astrophysical Journal*. In addition, the network is supported by an extensive staff, including facilitators. Since there are always at least 30 major conferences active on the network, each conference has its own chairperson who knows the subject matter intimately and can direct the flow of information, identifying innovative ideas and encouraging their exploration. The staff facilitator supports these chairpeople and is generally assigned to several conferences, since the need for his participation declines as the conference unfolds and the participants become comfortable with its structure.

Conferences are generally established by petition to the administrative board of ARN. The board evaluates the petitions in terms of their general interest to the entire discipline, the novelty of their subject matter, and their potential impact on the discipline as a whole. As one might expect, this review process is the source of some discontent, since it effectively allows a small group of people to shape the research of the entire discipline. However, once a conference is established, a petition by 20 members can establish a new activity within the conference, providing some measure of control to participating astronomers.

One of the most prominent effects of the ARN has been a decline in the "publish or perish" syndrome, which was previously almost universal.

The network activities provide an ideal medium for sharing research results. These can be entered not only as preliminary results to elicit broad discussion, but also as final results submitted to the entire network. And participation in these computer conferences is now professionally rewarded in much the same way that publishing in the "right" journals was in the past. Thus, the publishing process has become a more integral part of the daily communication among researchers. The board position of the *Journal* editor reflects the importance of this "publishing" function of the network. A staff of editors periodically reviews and edits the transcripts of conferences which are then resubmitted in data files and made available in printed form. In fact, two journals have been discontinued because the network performs this function so effectively.

There was some concern initially that the sharing of preliminary results would raise questions of ownership of information. However, the computer conferencing system provides a very adequate record of who submitted an entry and the date and time of submission. This entry stamp serves, in effect, to establish scientific precedence, and it enables the tracing of new concepts. Furthermore, concerns of ownership have declined with the decline in pressure to publish one's results formally. Changes in the funding patterns of astronomical research are also altering the ownership issue: funds are beginning to be funneled through the ARN to researchers.

Finally, the existence of ARN has produced some significant changes in the education of astronomers, particularly at the graduate level. More than ever, the educational program is a selection process; this selectivity is evident from the fact that one of the privileges gained with admission to candidacy for the Ph.D. is access to the network. In fact, some advanced coursework is offered only through the network in the form of idea discussion and problem-solving on actual projects in cooperation with active researchers. The availability of the network has also greatly expanded advisory services for students of astronomy.

All these redefinitions of the discipline of astronomy have strengthened the communication links among astronomers and thereby increased the collective nature of their work. The field is growing more rapidly,

spurred by cross-fertilization of ideas. A new power complex has certainly emerged, but it appears to be a more organic part of the discipline itself.

STYLE 2: CONFERENCING UNLIMITED, INC.

Advertisement *New York Times, August 10, 1983*

CONFERENCING WITHOUT TRAVEL

Need to be in touch with people who are far away? Computer conferencing can link you to those people across time and distance barriers. Next time you make a conference telephone call or schedule a meeting in a distant place, think about the alternative:

- All arrangements made by our professional staff
- No equipment or technical skills necessary
- Communication through keyboards: you need not be present at the same time as your colleagues, and you'll always have a record of what was said
- Easily accessible anywhere in the United States, Europe, and other areas of the world
- Costs far less than comparable face-to-face meetings

"Computer conferencing isn't for everyone, but it might be for you . . . ."

CALL: CONFERENCING UNLIMITED, INC.

800-987-6543

Conferencing Unlimited, Inc., is part of the growing human services industry. It provides computer communication links among any number of people located all around the world. Typically, it supports topic conferences or limited-duration meetings among people who do not use computer

conferencing more continuously. (Regular users have their own terminal equipment and accounting procedures.) Thus, Conferencing Unlimited provides the important services of access to computer terminals and takes care of all the formalities of computer networks or any other computer trivia which plagued new users even a few years ago. Also, consulting staff for Conferencing Unlimited--representing a broad variety of backgrounds--are available as facilitators to ease people into the world of computer conferencing.

Conferencing Unlimited has no central offices; the staff is located in various parts of the world and is interconnected by international computer networks. Representatives in different areas handle the tasks of introducing people to the medium, delivering loanable computer terminals (owned by the firm), and even aiding in the organization of the conference agenda.

Conferences are continuously being conducted on a wide range of subjects. Many of them are, of course, confidential. These sessions include boards of directors of various organizations and innumerable committee meetings and task forces. Some conferences, however, are made broadly available in published form. For instance, the paperback series, *Discussions with Today's Great Thinkers*, is derived directly from the transcripts of computer conferences on current topics among leading authorities. Also, a variety of interviews is conducted via computer conferences and reprinted in magazines. Conferences among handicapped persons and psychotherapy groups have also been explored. And the company has made a major impact on computer dating services which previously operated primarily by mail. (In fact, it came under the serious scrutiny of the antipornography committee of the House of Representatives in 1980.) Even the college player draft of the National Basketball Association was organized in 1982 by Conferencing Unlimited--though it had previously been conducted over conference telephone calls.

Computer conferences have certainly not replaced face-to-face conferences and meetings; they have, however, expanded the range of possible "conferences." For every national face-to-face conference which was held in 1983, an estimated five computer conferences were arranged--primarily through the services of Conferencing Unlimited. And many of these computer

conferences are meetings which might not have occurred without such a medium. This observation was dramatized in 1981, when the company organized a two-week workshop on the subject of "Freedom, Violence, and the Law" among the inmates of 10 U.S. prisons.

Terminals now cost less than electric typewriters did in 1975, and with the drop in the price of computer conferencing to about $5 per hour anywhere in the world, irrespective of distance and time of day, Conferencing Unlimited has attracted some fringe groups that might not have made any impact on public opinion when long-distance communications were difficult and expensive and when they required complex equipment. A case in point is the Psychic Computer Church, whose members in all countries hold weekly "services" through the network. Surprising healings and other phenomena have been claimed to take place during these sessions, which constitute a new form of religious experience.

In short, Conferencing Unlimited and organizations like it have greatly extended the availability of computer conferencing and have proven that this new medium is a serious alternative for human communication.

STYLE 3: THE "MEETING WITHOUT TRAVEL"

OF THE WORLD FUTURE SOCIETY (JUNE 3 TO JULY 6, 1983)

Dear Elizabeth:

In the memorandum I sent to your office last week in my capacity as chairman of this year's Assembly, I stressed the issues and the substance rather than my experience with the process of our meeting. Since that time, however, several people have commented that ours was the first large scientific society to use computer conferencing for a worldwide meeting, and that I would be remiss in my responsibility to our membership if I did not offer an evaluation of this unique experience. Perhaps this letter can be the starting point for such a report if you feel, in your role as president of the Society, that my remarks deserve publication.

My first feeling upon emerging from this very intense experience was one of vindication: many of us had complained for years about going to large conferences, about stuffy panels, about lack of participation, and about general frustration. This year's Assembly was certainly a far cry from these old hassles.

True, we had our problems, but at least they were different problems. The highest percentage of participants were still from the United States, but this time it represented only about 50 percent of the 2,146 registrants. There were more minorities, more women, and more persons from developing countries than at any previous Assembly. There was a loud cry that this assembly was more authoritarian than previous meetings; others said it was the most democratic large gathering they had ever attended. Clearly, the meeting was both the most authoritarian and the most democratic. For electronic gatherings of this sort, the old emphatics seem out of place.

It was authoritarian in those sessions in which leaders exerted a strong control over the proceedings. Some leaders, for instance, limited general input to three lines per message with general participants only allowed a limited number of questions (sometimes they had to ask questions, not make comments). These sessions produced orderly transcripts, though

in one case, frustrated participants began entering obscene anonymous messages in an attempt to disrupt the meeting. Although this option was rarely used, some participants were forcibly removed from the computer conference. This action by session leaders was, as most of you know by now, highly criticized. (According to Assembly rules, no participants could be removed secretly; the whole session was informed when a removal occurred.)

The Assembly was more democratic than ever before in that more complete information was available to more people. Many session leaders allowed full contributions from all attendees (not just from "panelists," who did submit a brief pre-session statement). Content summaries and major conference themes were gathered continuously through computer searches of the text. Where appropriate, samplings of opinion were gathered from all conferees.

Private messages were freely allowed from and to all participants. Of course, no one was required to answer every private message. However, it does seem that access to well-known persons was higher in this medium and that they could respond easily to a greater number of questions. Synchronous mini-sessions occurred frequently and were often spirited. The apparent impersonality of communicating through computer terminals was balanced by the broad range of interaction which occurred. Casual encounters across continents and between countries took place almost constantly. The global village seemed to come alive, if only for those three weeks.

There is a serious question about whether computer conferences should <u>replace</u> more traditional face-to-face assemblies. It is clear that a unique form of communication is possible <u>without</u> travel and that this medium should be taken seriously for more regular meetings. The transcripts of sessions were distributed broadly beyond the active participants. (Requests were accepted by mail and were printed on high-speed printers. Whole transcripts could be ordered, as could "keyword" searches, comments by particular persons, or other such selected printings.) A summary of the proceedings was published in paperback form during the week following the conference. Thus, the interaction was high and the circulation broad. We felt as if we were unleashing a monster when the Assembly started, and in some sense we were.

On the topic of next year's meeting, I would raise one point about cost and terminal access. We required a $25 registration fee for ordinary attendance, with an added $8 per hour for active participation. I think these rates limited foreign participation. Next year, we should either try to lower the rates or to award special grants to non-U.S. persons interested in attending.

I look forward to your reactions to these ideas and expect that next year's Assembly will be even more interesting than the one we just attended.

With best regards,

Emilio

STYLE 4: AN INTERNATIONAL CRISIS MANAGEMENT NETWORK

U.P.I. June 2, 1983. The U.S. Senate today voted to officially join the International Crisis Management Network by appointing three U.S. representatives to the network's management board. The act will also provide funding for a staff of U.S. delegates to the network's resource board. The United States has been supporting the ICMN unofficially for the past two years through Department of the Interior funding of its energy-related work. Today's act, when signed by the President, will transfer the funding responsibility to the Department of State.

The ICMN is a worldwide network of statespeople as well as economists, scientists, military strategists, psychologists, and other resource persons who are connected to a 24-hour-a-day computer conferencing service. The ICMN was established two years ago when three major international planning networks merged. These earlier networks had been designed to promote international cooperation in energy distribution, food distribution, and trade, respectively. But while even these networks were well attended by representatives of most Western nations, the Soviet Union, Japan, and Australia, the ICMN has not until recently been officially recognized by any state, and its decisions and recommendations have thus not been binding.

Nevertheless, the ICMN has been uniquely successful in dealing with a number of worldwide crises. Typically, crisis negotiations involve intensive, synchronous network sessions. During these sessions, the members of the management board are almost continuously at their computer terminals. The negotiations have often been characterized as tidal waves of information: negotiators depend heavily on extensive information exchange with their own resource people as well as with those of other nations. Some researchers estimate that computer conferencing allows the exchange of this information about five times faster than face-to-face meetings in highly structured environments such as the United Nations--a point demonstrated by its swift handling of the "portable H-bomb" international scare of last year.

The success of the network rests in the skill of ICMN members in manipulating its wealth of information to support their proposals for solutions to crises, to evaluate the proposals of others, and to make adjustments to proposals in the course of the negotiations. They are assisted in this awesome task by an extensive set of models which have gradually been developed by the ICMN as part of its noncrisis planning activities. Typical of these new tools are the joint Japanese-European energy model and the Club of Rome data base on food supply.

Of course, much of the success is due directly to the conferencing skill--and endurance--of the network members. Particular credit must go to the three representatives who organize and facilitate the crisis conferences. From the first notification of a crisis, these ICMN members must recognize the parameters of the situation to structure a set of conference activities which will best support the negotiations that follow. This organization includes the provision of access to appropriate models and data

bases, the creation of separate activities for discussion of various aspects of the crisis, the linking of resource people, and the monitoring of participation to anticipate communication breakdowns.

Another feature of the ICMN which has received special notice is its values interpreters. Members of the resource board, these people come from the disciplines of history, sociology, psychology, and religion. They are in regular international contact, and their task is to interpret the likely responses of other nations to the proposals being submitted, based on their values implications. In particular, they try to identify as quickly and accurately as possible the overlapping value commitments of parties in the crises to provide a common starting point for future negotiations.

With the U.S. vote to join the ICMN, it will now officially represent 18 countries.

STYLE 5: ALASKA MINERAL WEALTH FORECASTS, INC.

Comprehensive forecasting of the future has been an historically recurring but empty promise. The promise has now been revised in such a way that it can be fulfilled--admittedly within very real limits. Alaska Mineral Wealth Forecasts (AMWF, Inc.) has demonstrated that mineral production can be reliably projected and that satisfactory reserve estimates can be obtained through a formal process of expert interaction. In this case, the experts are a highly trained group of mineral geologists whose "track record" is continuously under review. The interaction techniques augment these talented geologists with communication and computer resources and are reminiscent of the "Delphi" concept of the sixties.

The procedures used in reserve and production forecasting are highly quantitative and make use of historical data on production, as well as expert projections about future possibilities for new mineral wealth. The geologist/forecasters are located all over North America, and each of them brings to the group a particular experience and expertise related to forecasting production within Alaska (the first state which sponsored an extensive methodological study, resulting in a multimillion dollar contract to AMWF, Inc. in 1980). These experts participate in weekly computer conferences to review information records about mineral properties in the files. The "conferences" are highly structured iterations of quantitative forecasts in which the probabilistic estimates supplied by each expert are mathematically aggregated to produce a graphic feedback for the group. The results are periodically published or supplied directly to governmental and private subscribers engaged in mineral exploration.

The success of Alaska Mineral Wealth Forecasts has demonstrated that computer conferencing and quantitative forecasting techniques can be of value in some important fields of study. Though largely rejected in general social forecasting, such techniques can now be used in fields in which the parameters of study are clearly defined and the sources of expertise easily documented. Given such a situation, the combined resources

of computer conferencing and large-scale data bases can be used to produce much more comprehensive forecasts than were previously possible. While less dramatic than other applications of computer conferencing, forecasting services such as AMWF are important. Without them, for example, the pipeline capacity crisis of 1982 would not have been projected and corrective measures would have been taken too late, possibly precipitating major energy problems in North America.

* * * * *

These scenarios suggest some of the potential for the future development of computer conferencing. As we complete our third year of experience with this new medium, its range of possible applications and the technology of its use are better understood than its political and regulatory impact, which could only be outlined in broad terms in our study of social effects.

During the development and use of FORUM, over 150 persons in the United States, Canada, and England have participated in our computer conferences. It is on their work and their reactions that our observations are based. The trends we have found are already being extended in new systems (such as FORUM's successor, named PLANET-1) inspired by the same concept. They open the door to a new phase of evaluation as computer conferencing becomes available for general application.

APPENDIX

PROPOSITIONS ABOUT COMPUTER CONFERENCING

PROPOSITIONS ABOUT COMPUTER CONFERENCING

This appendix presents our current conclusions about computer conferencing, along with statistical support data. It encompasses theoretical considerations, observations of participant behavior in 28 FORUM conferences, and user reactions gathered through questionnaires and interviews.

We have organized these findings into 30 "propositions." The data represented by these propositions are derived from actual usage of the FORUM system for real communication needs which, in many cases, constrained the kind of observations which could be collected. Some propositions, for example, reflect questionnaire responses from a single conference; others reflect an analysis of all conferences of one style; still others encompass the observation of patterns in all 28 cases. (For each proposition, the nature and size of the data base is specified.) We have called these findings "propositions" to convey our feeling that the evidence presented here needs to be explored further under more controlled conditions. On the other hand, this set of statements is more conclusive than a simple list of hypotheses such as we presented in Volume 2 of *Group Communication Through Computers* (pages 105-107).

Each of the propositions in the following pages specifies: (1) the general context in which the statement is proposed, (2) the text of the statement, (3) an explanation of the nature and specificity of the data, and (4) relevant statistical material in table or graph form. As an introduction to the propositions, Table 4 presents an overview of the statistical data for all 28 conferences.

Table 4. Overview of 28 Conferences

NO.	NAME	ACTIVE PARTIC-IPANTS	DURA-TION (DAYS)	TOTAL MESSAGES**	CONFERENCE OBJECTIVE	USER HOURS
C1	USGS	9	30	1341	link to data bases	20*
C2	Staff Meeting	7	122	439	research management	81
C3	Experiment Design	7	125	517	research design	64
C4	XYZ	7	51	533	joint planning	35*
C5	WPO	3	27	53	media usage comparison	26
C6	Tradeoff	29	22	1070	technology assessment	304
C7	Users 1	31	120	399	distributed software testing	133
C8	Users 2	21	111	551	joint research activity	89
C9	AWARE	3	18	414	seminar planning	9
C10	APG/ISI	9	42	300*	computer science research	100*
C11	CSG	6	90	100*	joint research	25*
C12	CCITT	23	44	336	negotiation	81
C13	CCITT Reactions	12	44	140	reactions to medium	30
C14	Staff FORUM 5	4	15	95	research planning	35

*Estimated

**Message statistics throughout this appendix may vary slightly due to differences in the treatment of anonymous messages.

Table 4 (Concluded)

NO.	NAME	ACTIVE PARTIC-IPANTS	DURA-TION (DAYS)	TOTAL MESSAGES	CONFERENCE OBJECTIVE	USER HOURS
C15	Staff FORUM 6	4	10	76	research planning	28
C16	CSG	11	70	403	joint research	135
C17	Education	4	28	60	questionnaire design	23
C18	BNL Pollution	20	49	410	conference on pollution	173
C19	NISS	7	1	400	conference on education	43
C20	SCAG	4	22	84	notepad	33
C21	Pacific	9	7	70*	forecasting	20*
C22	Staff	4	30	114	internal planning	7
C23	Staff	4	16	23	design of future experiments	4
C24	Panel	4	10	22	note exchange	3
C25	Freeway	6	1	205	social simulation	13
C26	Education II	4	30	63	research planning	25
C27	CRISIS-1	8	1	384	crisis negotiation	24
C28	CRISIS-2	9	1	385	crisis negotiation	25
TOTAL				8991		1588

*Estimated

PROPOSITION 1

THEORETICAL LIMITS ON WORD TRANSMISSION RATE

In synchronous conferencing:

there is a maximum word transmission rate μ *such that*

$$\mu = \frac{RNT}{R + (N-1)T}$$

where R = *printing rate of the terminal (in words per minute)*
N = *group size*
T = *average group typing speed (expressed in words per minute)*

Figure 19 shows this theoretical limit on word transmission for average group typing speeds of 10, 20, 30, and 40 words per minute. The word transmission rate μ, defined as the number of words transmitted per minute, is equal to the number of participants times the average group typing speed times the fraction f of time the group spends typing:

$$\mu = NTf$$

The fraction f of time spent typing can be obtained from noting that, on the average, a participant's time is divided between typing f of the time, reading what the other N-1 participants have typed, and waiting w. Thus,

$$f + \frac{(N-1)Tf}{R} + w = 1 \qquad \text{and} \qquad f = \frac{R(1-w)}{R + (N-1)T}$$

giving

$$\mu = \frac{NTR(1-w)}{R + (N-1)T}$$

The maximum word transmission rate is obtained when the wait time w is zero.

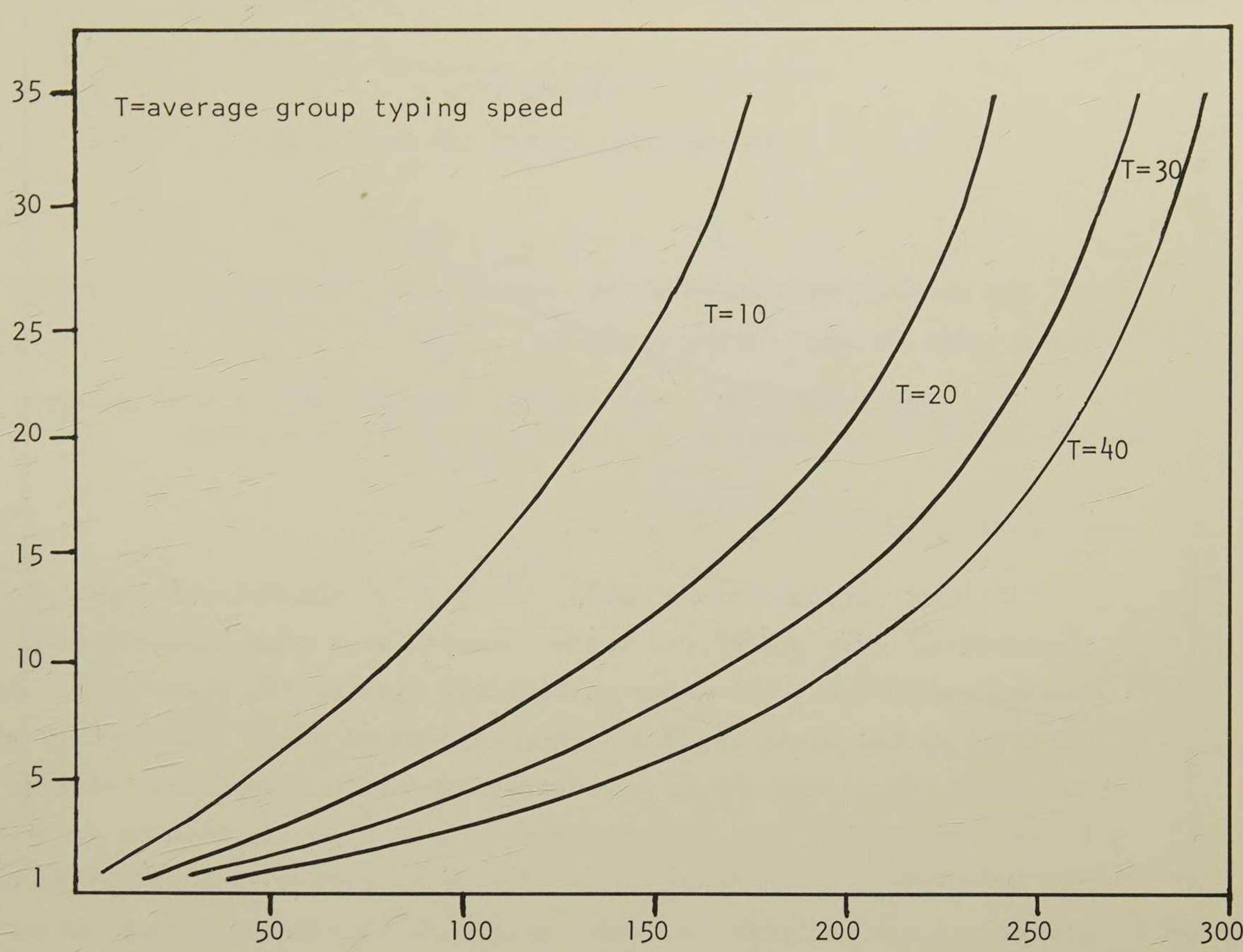


Figure 19. Theoretical Limits on Word Transmission in FORUM Conferences (Assumes a terminal printing rate of 30 characters per second or 360 words per minute)

PROPOSITION 2

THEORETICAL LIMITS ON GROUP SIZE

In synchronous conferencing, for a given terminal printing rate R and for a given average typing speed T:

> *the percent of time spent typing, denoted as P, places an upper bound on the group size N (and vice versa) such that*

$$N \leq 1 + \frac{R}{T}\left(\frac{100-P}{P}\right)$$

In most communications media, there is no theoretical limit on group size because only one person sends messages at a time. In computer conferencing, however, all group members may type at the same time. Therefore, as participants spend a larger percent of their time typing, the actual word transmission rate approaches the maximum word transmission rate μ (see Proposition 1). This maximum imposes a restriction on group size. For example, if participants with an average typing speed of 25 words per minute are using a terminal which prints at 30 characters per second (360 words per minute) and if they spend 30 percent of their time typing, the group cannot exceed 34 persons. Likewise, given a group size of 34, with R = 360 wpm and T = 25 wpm, the participants cannot spend more than 30 percent of their time typing.

Figure 20 shows this theoretical limit on group size/typing time for average typing speeds of 10, 20, 30, and 40 words per minute.

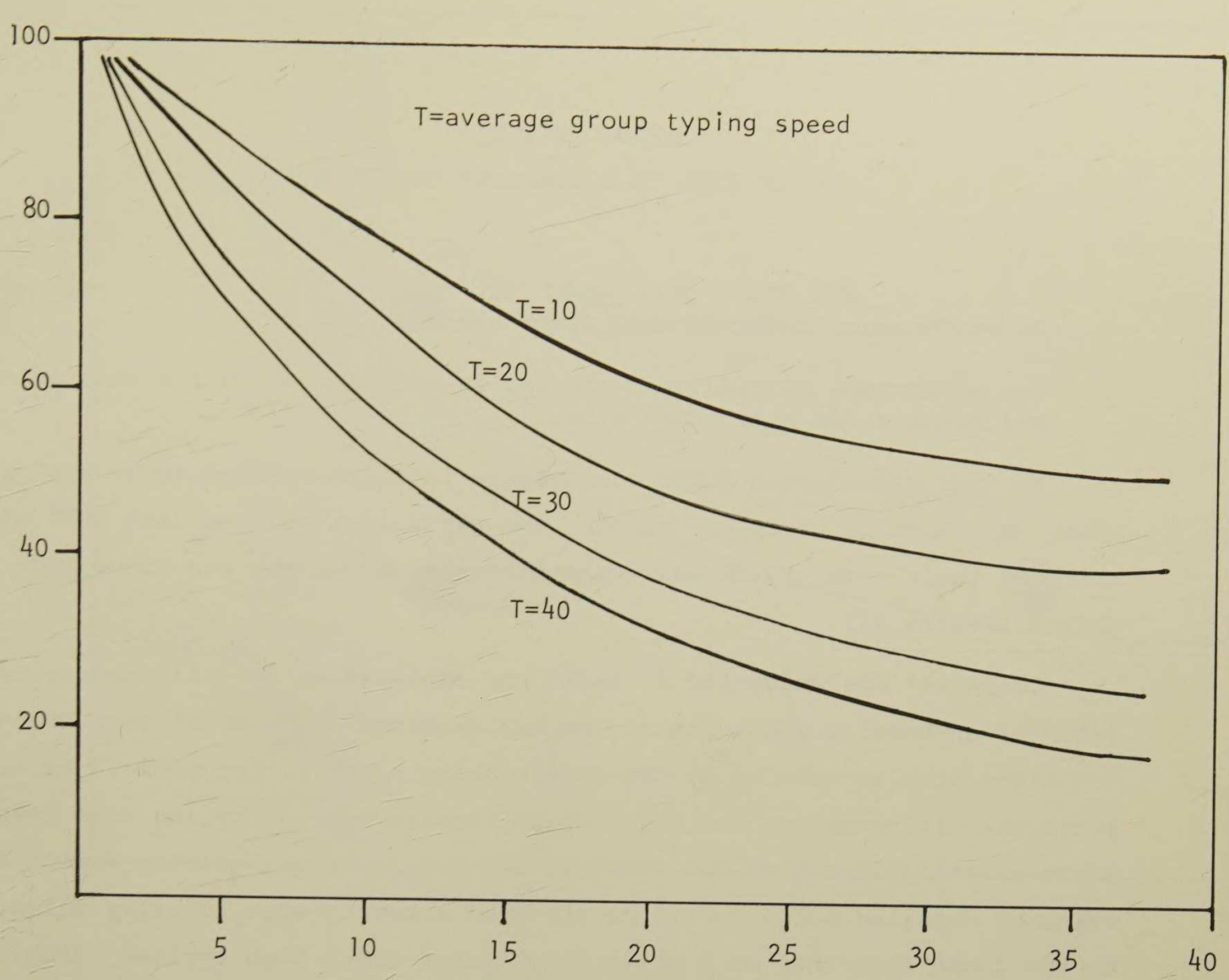


Figure 20. Theoretical Limits on Group Size in FORUM Conferences (Assumes a terminal printing rate of 30 characters per second or 360 words per minute)

PROPOSITION 3

USE OF TIME IN A COMPUTER CONFERENCE

In synchronous conferencing, given a group size *N*:

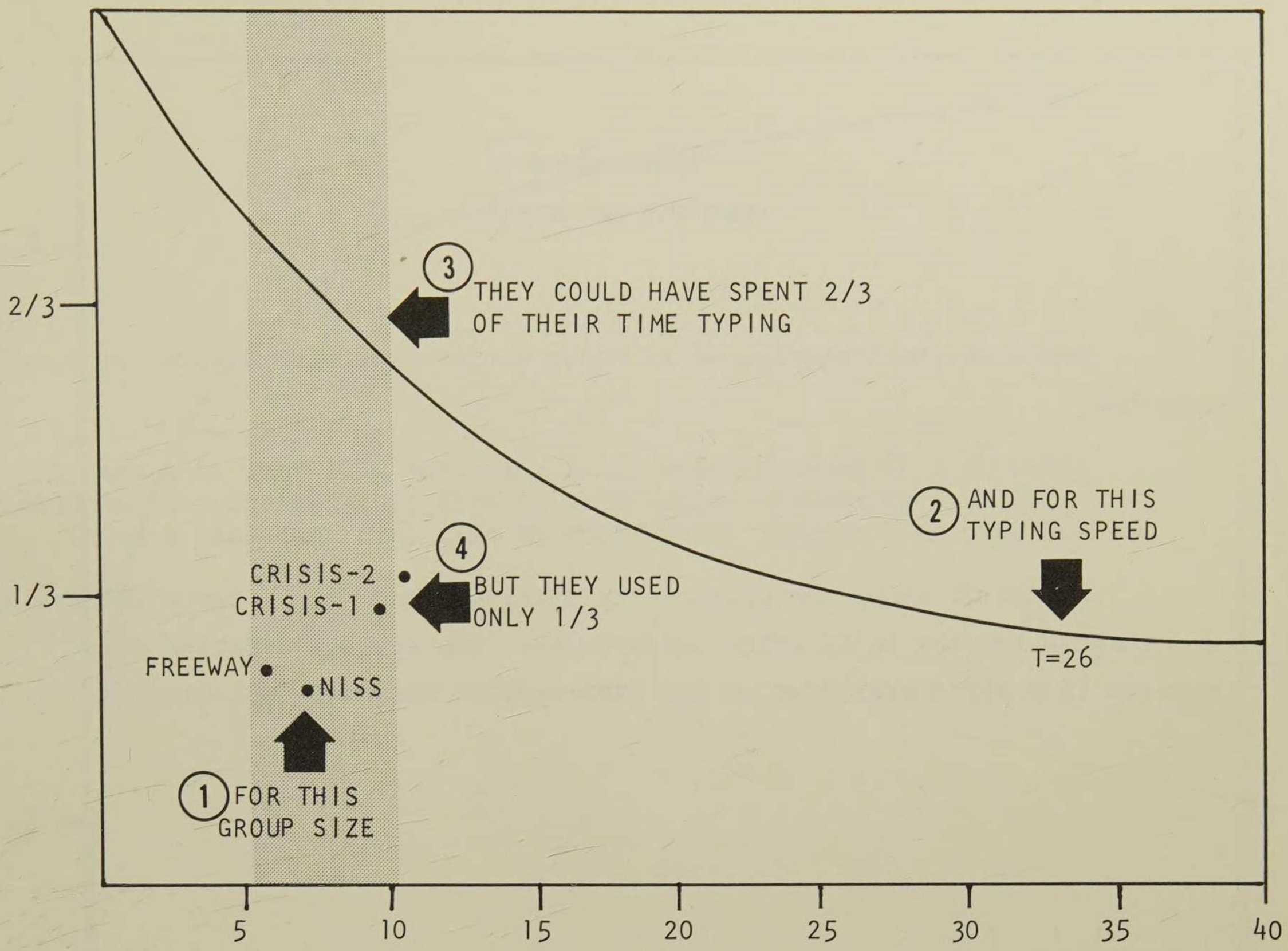
the percentage of time spent typing is much less than the theoretical maximum for that group size.

In four synchronous FORUM conferences in which average group typing speed was about 26 words per minute, the participants spent less than one-third of their time typing while the theoretical maximum was about two-thirds (Figure 21).

Chapanis* has suggested at least one explanation for this characteristic of keyboard communication. He has examined the special case of interactive problem-solving by two people using a variety of media. He has found that in communication modes which require typing, typing time represents slightly less than one-third of the total problem-solving time. By means of detailed measurements of what the subjects were actually doing, he has found that they do a great many things other than typing: they make notes, think about what to say, handle objects, and search for information related to the subject matter.

---

*A. Chapanis, "Interactive Human Communication," *Scientific American*, March 1975, p. 36.



	NISS	FREEWAY	CRISIS-1	CRISIS-2
Public Characters	59520	25200	21820	34105
Private Characters	30080	4075	38405	33755
Total Characters	89600	29275	60225	67860
Group Size	7	6	8	9
Length of Conference (hour)	6.8	2.2	3.0	3.0
Average Typing Rate/ Participant	25.5w/min.	28.4w/min.	27.4w/min.	25.3w/min.
Average Number of Words/Minute Transmitted	42.2w/min.	44.4w/min.	66.9w/min.	73.4w/min.
Percent of Time Typing	24.6%	26.0%	30.5%	32.0%

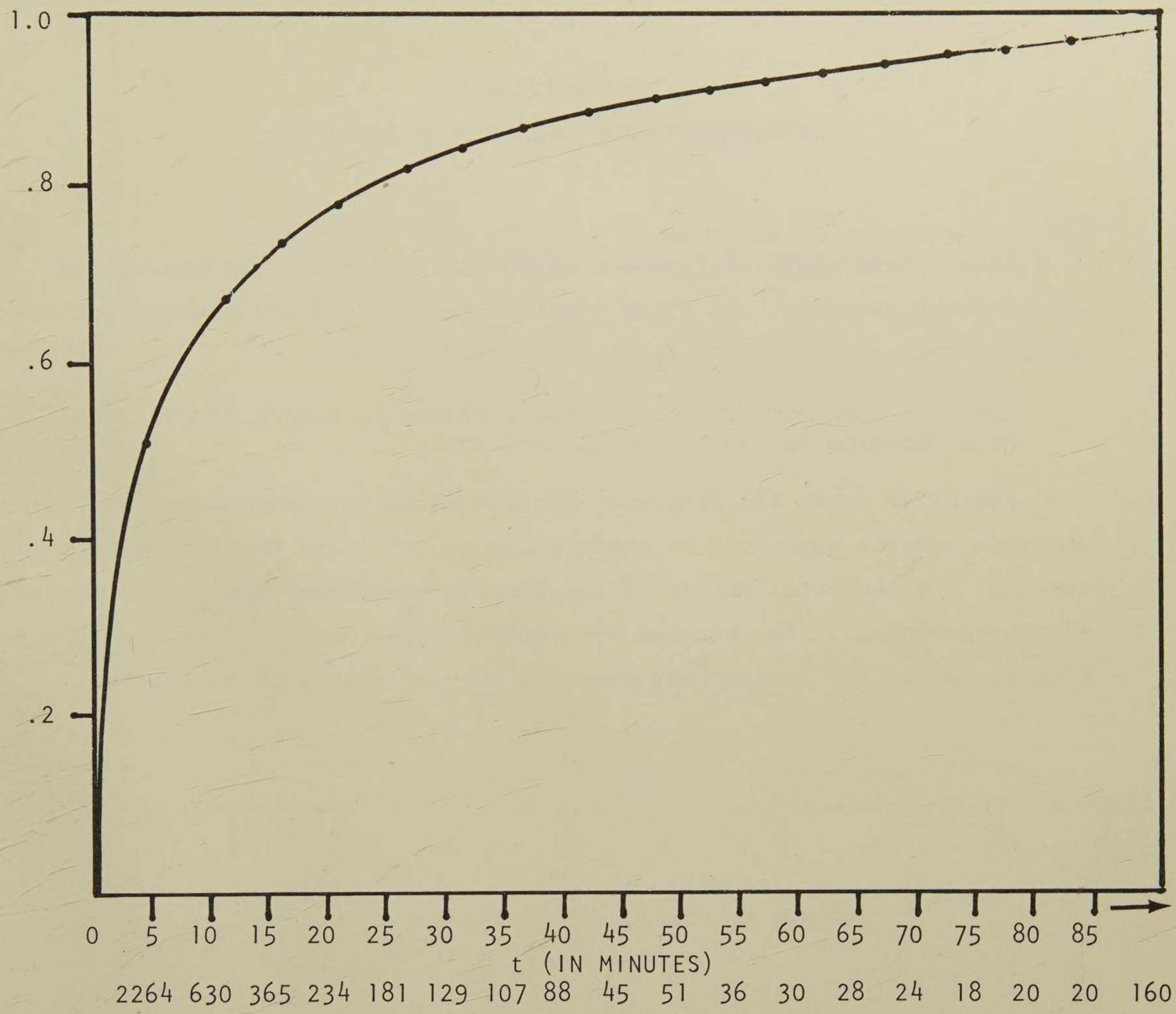
Figure 21. Use of Time in Four Synchronous Conferences

PROPOSITION 4
DURATION OF SESSIONS

Based on the histories of 12 FORUM conferences with a total of 4,486 sessions:

> *there is a 53 percent chance that a session will last less than 5 minutes, a 64 percent chance that it will last less than 10 minutes, and only an 8 percent chance that it will last more than 1 hour.*

Figure 22 shows the probability distribution over 5-minute intervals for session lengths in 12 FORUM conferences. The average duration of a session in FORUM conferences on the ARPA network has been 19.1 minutes.



*P = Probability that session will last less than t

Figure 22. Probability Distribution for Session Duration in FORUM Conferencing

PROPOSITION 5

SYNCHRONEITY AND DURATION OF SESSIONS

Given three FORUM conferences which included both synchronous and asynchronous sessions, and given separate frequency distributions for synchronous and asynchronous session durations:

> *the mean duration for synchronous sessions is nearly double the mean duration for asynchronous sessions.*

Figure 23 shows the frequency distributions for synchronous and asynchronous session durations in conferences C2, C12, and C16 in 5-minute intervals. Of the total number of sessions in these conferences, 80 percent were asynchronous. The average duration of synchronous sessions was 25.1 minutes, while the average asynchronous session lasted 12.6 minutes.

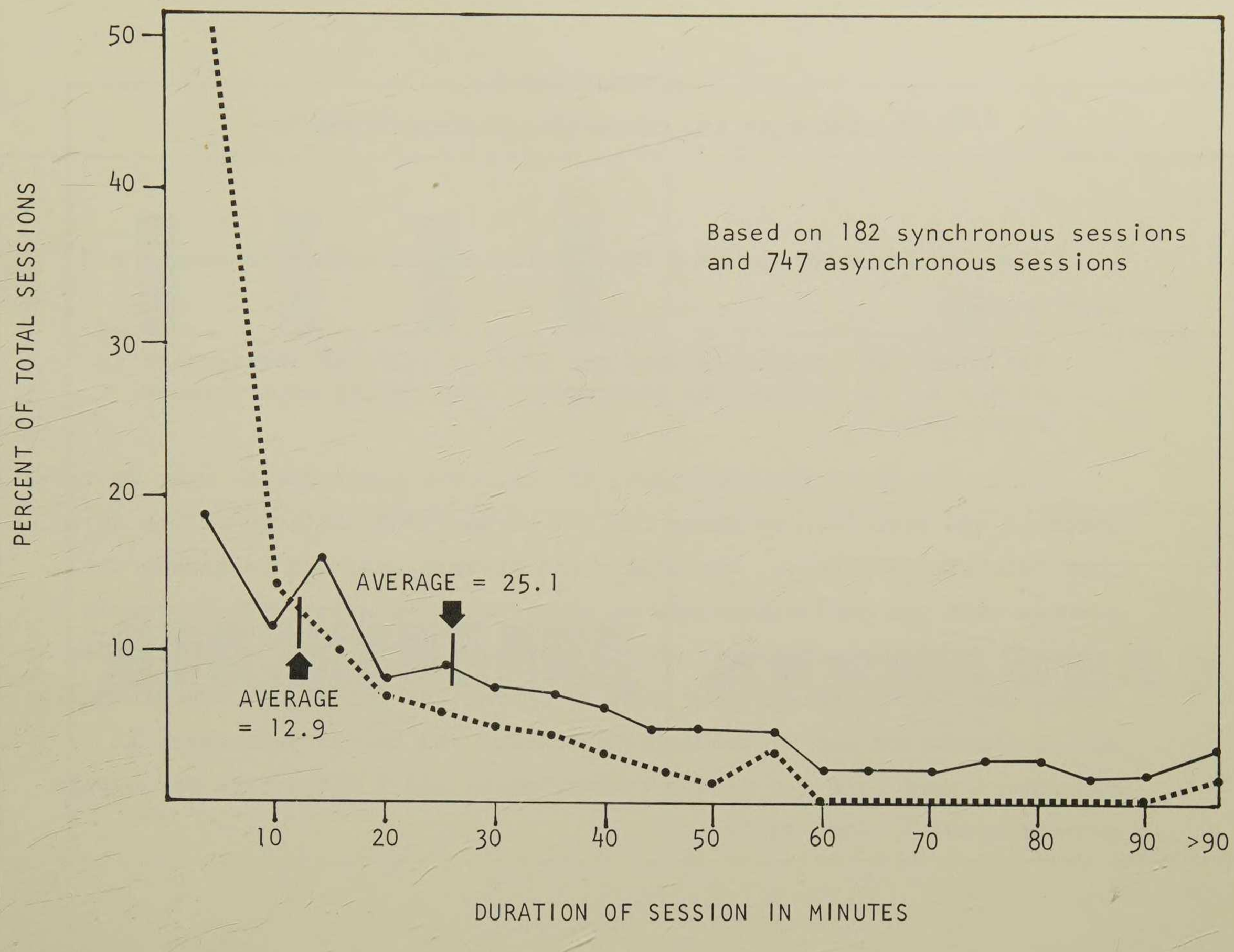


Figure 23. Session Durations for Synchronous and Asynchronous Sessions in Conferences C2, C12, and C16

PROPOSITION 6

SYNCHRONEITY AND CHARACTER TRANSMISSION RATE

Given conferences in which the interaction is both synchronous and asynchronous:

> *the number of characters sent per unit of time per participant is higher during synchronous interaction than during asynchronous interaction.*

Figure 24 shows the difference in character transmission rate in synchronous and asynchronous modes for the three FORUM conferences for which such data are available. For public and private messages combined, the average rate per participant was 45 characters per minute synchronously compared to 26 characters per minute asynchronously. In the public mode alone, the average participant sent 33 characters per minute synchronously and 23 characters per minute asynchronously. In the private mode, 12 characters were sent per minute synchronously and 3 characters per minute asynchronously. (See Table 5.)

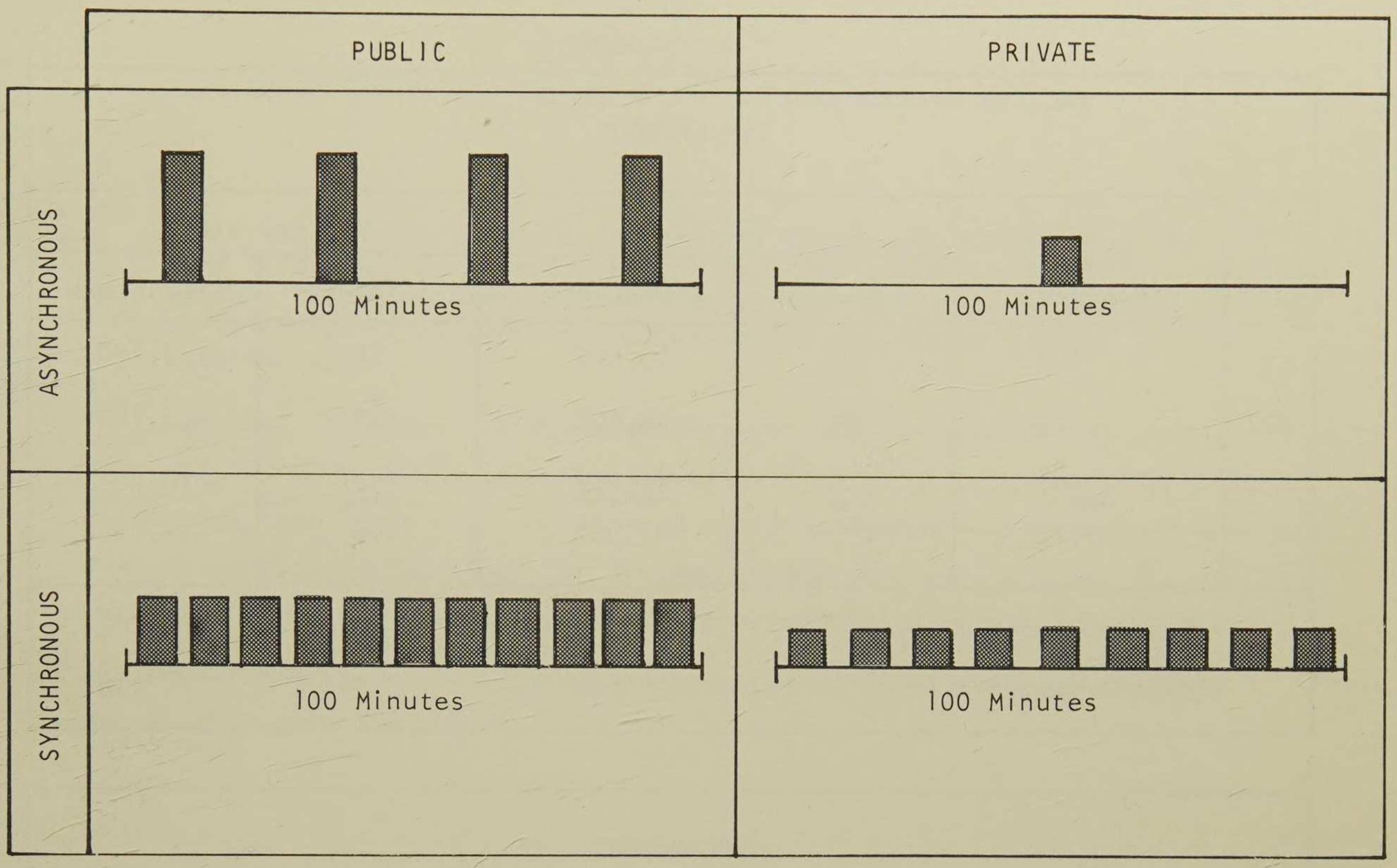


Figure 24. Character Transmission Rates in Synchronous/ Asynchronous and Public/Private Modes

Table 5. Comparison of Public and Private Message Sending in Synchronous and Asynchronous Modes for Three Conferences

SYNCHRONOUS

Conference	Time (Minutes)	Public		Private	
		Messages	Characters	Messages	Characters
C2	564	87	15,685	71	7,120
C12	1,175	94	38,205	53	6,780
C16	1,601	114	33,460	152	18,795
	3,340	295	87,350	276	32,695
Average Length of Message (in Characters)			296		118

ASYNCHRONOUS

Conference	Time (Minutes)	Public		Private	
		Messages	Characters	Messages	Characters
C2	4,088	245	115,750	29	5,660
C12	3,685	137	60,550	51	9,775
C16	3,009	176	88,545	50	13,625
	10,782	558	264,845	130	29,060
Average Length of Message (in Characters)			475		224

PROPOSITION 7

SYNCHRONEITY AND LENGTH OF PUBLIC AND PRIVATE ENTRIES

The average entry length in a computer conference varies with the mode (i.e., public or private) and with the synchroneity of interaction. Public messages tend to be longer than private messages, while synchroneity produces significantly shorter public and private messages.

Ignoring the effect of synchroneity, the average length of a public entry in 17 FORUM conferences was 380 characters; of a private entry, 178 characters (see Table 6). In Volume 2 of *Group Communication Through Computers*, we had reported that the average length of a public entry for our early conferences was 306 characters; of a private entry, 192 characters.

Table 5 shows the effect of synchroneity in three FORUM conferences for which data are available.

Table 6. Basic Statistics for Public and Private Message Sending in Conferences for which Statistics Are Available

Conference	PUBLIC		PRIVATE	
	Messages	Characters	Messages	Characters
C2	332	131,435	100	12,780
C3	431	106,145	89	11,090
C4	420	99,315	113	23,470
C5	46	30,375	5	1,005
C6	513	214,530	557	100,250
C7	237	91,415	153	19,300
C8	139	49,625	436	111,030
C9	397	66,345	6	885
C10	226	216,190	68	11,615
C12	232	98,755	104	16,555
C13	94	25,020	54	10,715
C15	59	96,175	2	190
C16	290	122,005	202	32,420
C18	176	115,710	235	54,250
C19	204	58,930	196	30,080
C25	155	22,770	50	4,075
C27	115	20,800	255	38,405
C28	137	33,230	238	33,755
	4,202	1,598,800	2,863	511,870
Average Length of Message (Characters)	380			178

PROPOSITION 8

SYNCHRONEITY AND PARTICIPATION RATES

Given those conferences which are predominantly synchronous and those which are predominantly asynchronous:

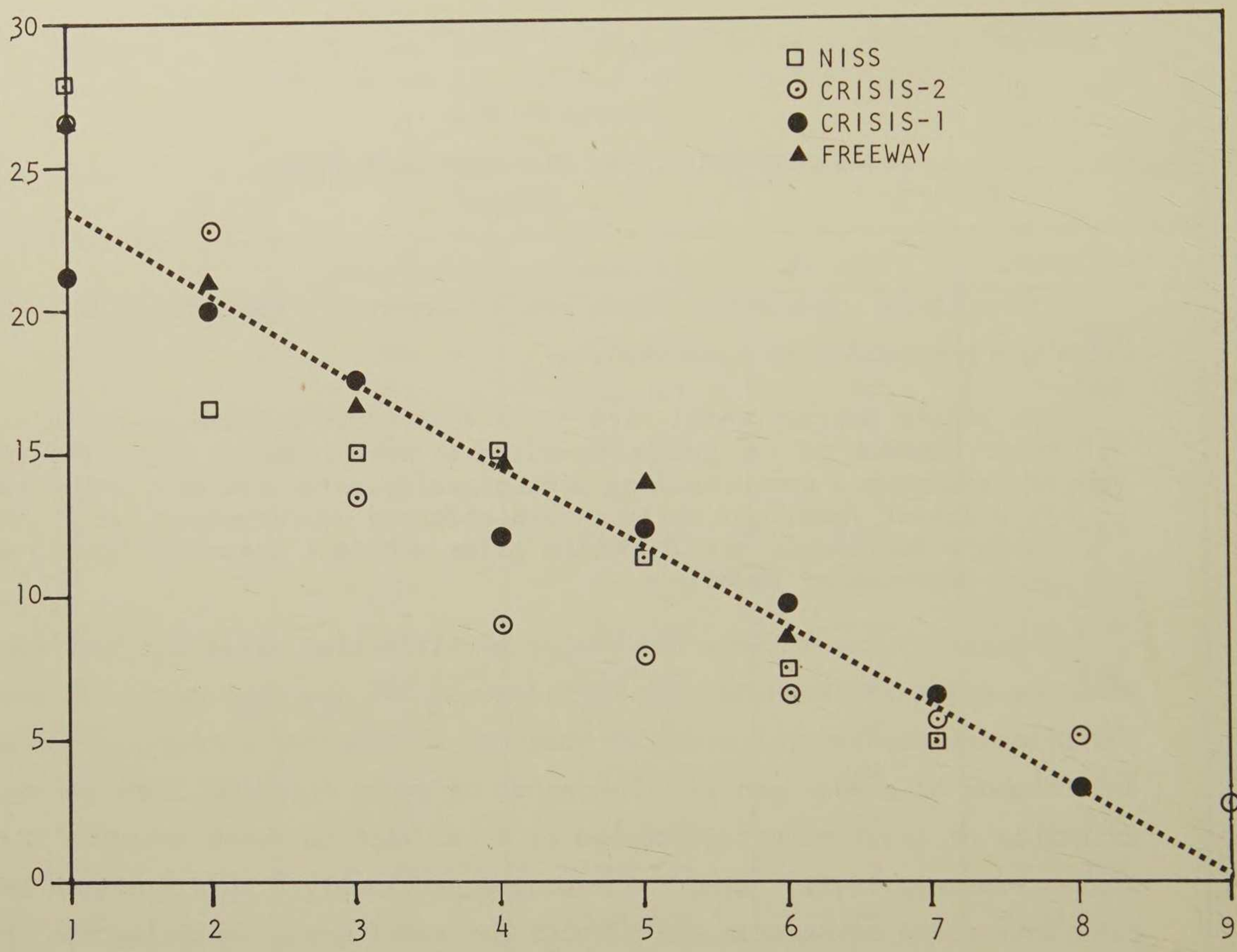
> *the public participation rate of an individual differs in relation to other members of the group according to synchroneity. Specifically, in synchronous conferencing, participation rates are best described by a linear function; while in asynchronous conferencing (as in face-to-face meetings), participation rates are best described by a negative exponential function.*

Figures 25 and 26 show the public participation rates for four synchronous and three asynchronous conferences. It has been suggested that the negative exponential function observed in computer conferencing might be an instance of a more general phenomenon of group activity, such as the principle of least effort described by G. K. Zipf in *Human Behavior* (Cambridge: Addison-Wesley, 1949). Also, as reported previously,* this function resembles that found by Stephan and Mishler for small group participation rates.

One interpretation of the linear function in synchronous conferencing is that synchroneity in a computer-based conference promotes equality of participation compared to other modes of communication, since it is generally true that other modes (such as face-to-face) are characterized by unequal participation rates among group members. In a computer conference, everyone can "talk" at the same time, promoting equality of individual participation.

---

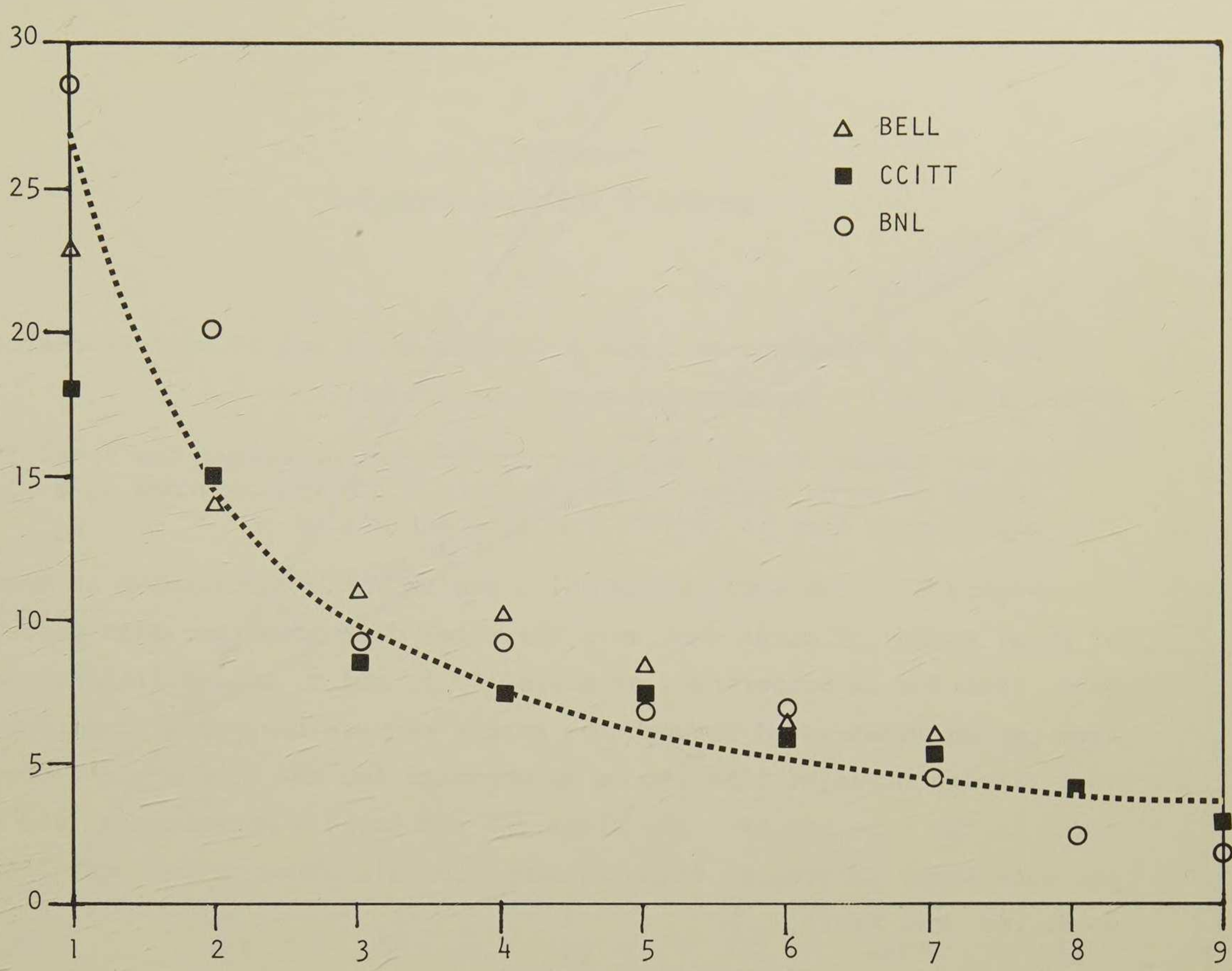
*See *Group Communication Through Computers, Volume 2*, pp. 47-48, and Figure 12.



SYNCHRONOUS
($y = -2.89x + 25.83$)
Percent variance accounted for by this equation = 90

x = Rank of of Participant	y = Predicted Percent of Public Participation	Actual Percent of Public Participation C19	C25	C27	C28
1	22.94	27.4	26.4	20.8	26.2
2	20.05	16.2	20.6	20.0	22.6
3	17.16	15.7	16.1	16.5	13.8
4	14.27	15.7	14.8	12.1	9.4
5	11.38	11.8	13.5	12.1	8.0
6	8.49	7.4	8.3	9.5	6.5
7	5.60	8.9		6.0	5.8
8	2.71			2.6	5.1
9					2.1

Figure 25. Public Participation Rates for Four Synchronous Conferences (Showing Actual Rates and the Best Fitting Straight Line)



ASYNCHRONOUS
($y = 27x^{-.897}$)
Percent of variance accounted for by this equation = 90

x = Rank of Participant	y = Predicted Percent of Public Participation	Actual Percent of Public Participation C6	C12	C18
1	27.0	23	18	28.4
2	14.0	14	15	19.8
3	10.0	11	9	9.6
4	7.83	10	7	9.0
5	6.48	8	7	6.8
6	5.4	6.25	6	6.8
7	4.59	5.75	5	4.5
8	4.05		4	2.8
9	3.78		3	2.2

Figure 26. Public Participation Rates for Three Asynchronous Conferences (Showing Actual Rates and the Best Fitting Curve)

PROPOSITION 9
GROWTH OF WORD TRANSMISSION

Given 4 conferences of Style 4 (synchronous) and 14 conferences of Styles 1, 2, and 3 (synchronous and asynchronous):

> *as the number of user hours per conference increases, the total number of words transmitted in a Style 4 conference grows at a higher rate than in conferences of other styles.*

Figure 27 shows word transmission for 18 FORUM conferences in terms of total number of words sent over the total user hours for each conference. For the 13 conferences of Styles 1, 2, and 3, a best fitting straight line can be constructed through the points representing each conference. A best fitting straight line can be constructed for the four Style 4 conferences in the same manner. The slope for the Style 4 conferences (410 words per user hour) is greater than the slope for all other conferences (150 words per user hour).

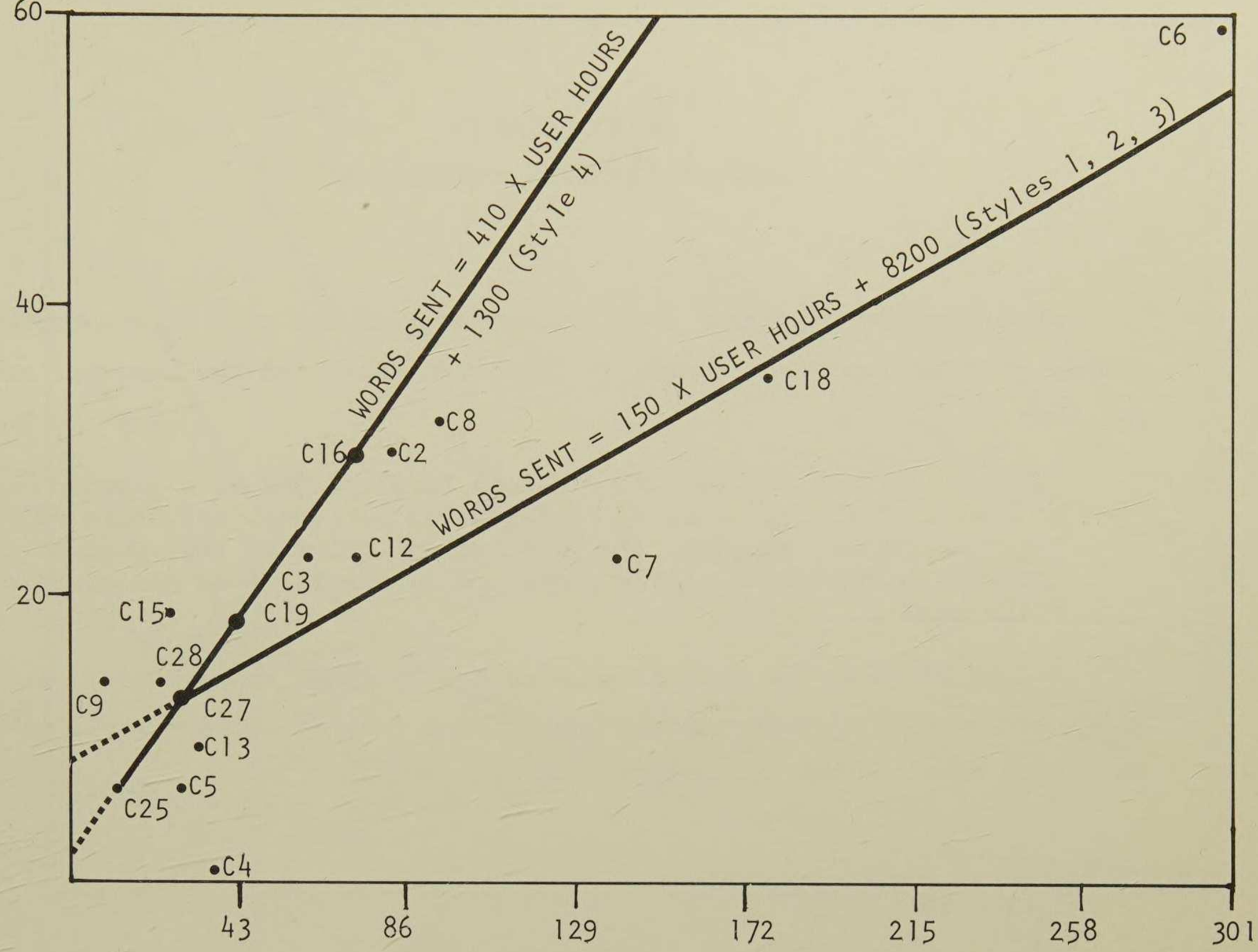


Figure 27. Word Transmission in 17 FORUM Conferences

PROPOSITION 10

COSTS OF COMPUTER CONFERENCING

Given conferencing cost levels computed from the size of the group, the number of hours each user spends in the conference, and the computer costs per hour:

> *the cost of computer conferencing can be displayed as a function of number of users, hours of conferencing per user, and style of the conference. However, the patterns are not such that cost of computer conferencing can be predicted on the basis of conferencing style alone.*

Figure 28 shows the cost of each of the 28 FORUM conferences. This graph suggests that projections of conference costs must take style as well as other, more obvious parameters into account.

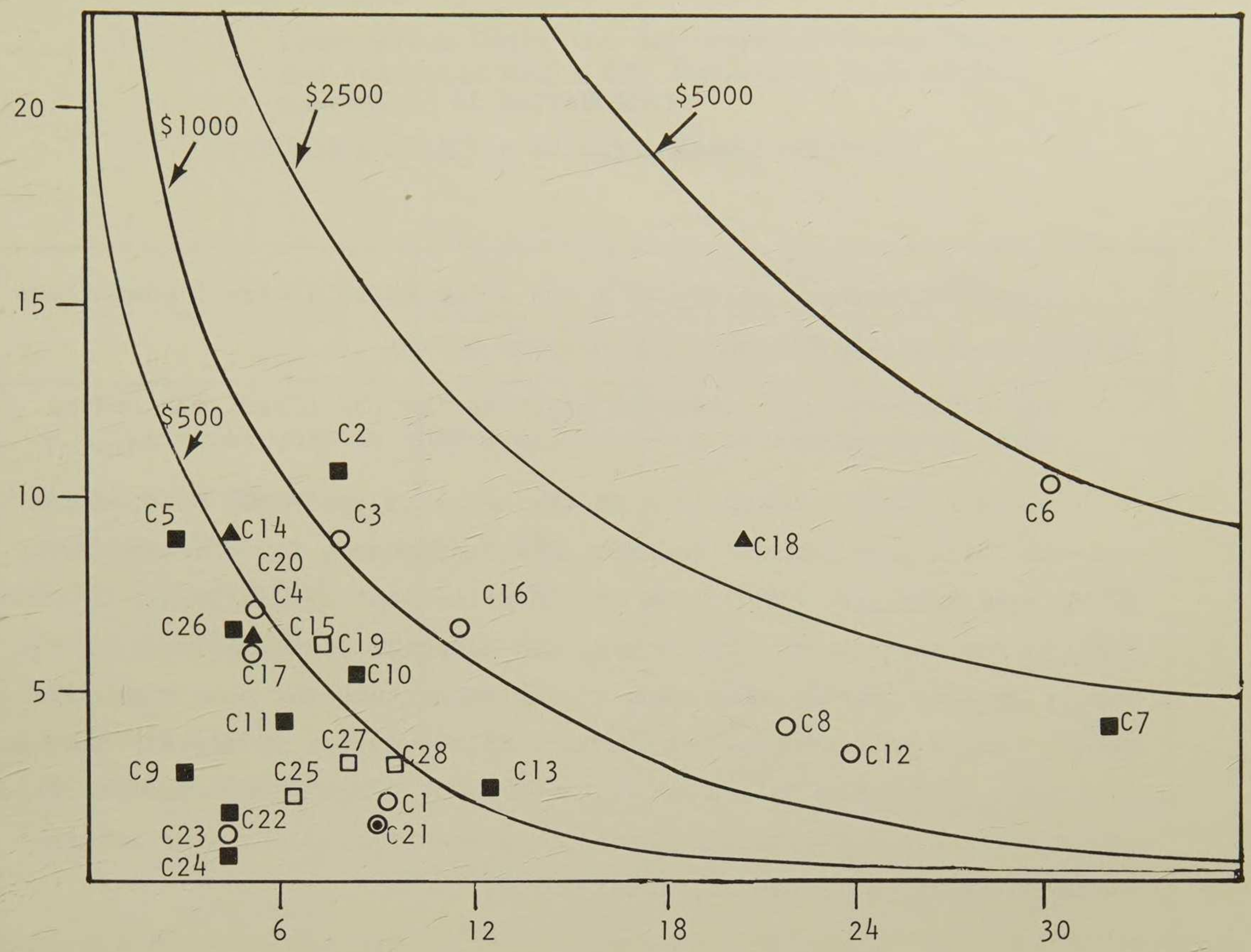


Figure 28. Cost of 28 FORUM Conferences

PROPOSITION 11

COMPUTER CONFERENCING AS A TRAVEL SUBSTITUTE

Given conferences of Styles 2 and 3 for which a direct comparison has been made among travel and other related costs:

> *the substitution of computer conferencing for travel can reduce costs by one-third to one-half, depending on many factors.*

Table 7 shows a comparison of the costs of two FORUM conferences (C6 and C18) with hypothetical face-to-face conferences for the same tasks, group, and duration. The issue of "substitution" of one medium of communication for another is complicated, and computer conferencing will not necessarily *replace* travel, even when it can substitute for some communication needs. For a more concise explication of the notion of travel/communication tradeoffs, see James Kollen and John Garwood, *Travel/Communication Tradeoffs: The Potential for Substitution Among Business Travellers* (The Business Planning Group, Bell Canada, April 1975).

Table 7. Comparative Costs for Two Computer Conferences and Estimated Costs for Comparable Face-to-Face Meetings

	C6		C18	
	Face-to-Face	FORUM	Face-to-Face	FORUM
Travel*	$ 7,000**		$3,795***	
Hotel and Lodging	2,600		1,360	
Meeting Place	1,000		1,000	
Labor (Organizing)	300	$ 300	300	$ 300
Labor (Training)		400		400
Telephone		50		50
Computer Time+		5,000		3,860
Transcript Preparation	500+++	80++	500	80
TOTAL	$11,400	$5,830	$6,955	$4,690
PERCENT REDUCTION	48.9%		32.6%	

*The location of the hypothetical face-to-face conferences was chosen based on a central location for the specific participants in each conference.

**Round-trip air fare to Chicago, 29 persons.

***Round-trip to New York City, 8 persons (for those not living in New York area).

+On the basis of $20/hour, including computer storage and communication costs.

++Xeroxing and mailing.

+++Taping and transcribing, reproduction and mailing.

PROPOSITION 12

EFFECT OF COMPUTER CONFERENCING ON USE OF WORKDAY

Given the size of a conferencing group and a computed index of the percentage of an 8-hour day spent in FORUM by each participant:*

> *the percentage of the workday spent in computer conferencing varies according to the style of the conference.*

Figure 29 shows the 28 FORUM conferences according to their group size and the average number of person-hours per 8-hour period. As can be seen, the conferences tend to cluster according to style, with Style 4 placing the greatest restrictions on the participant's use of time during the conference period. Such conferences, however, last only a fraction of the time of other conferences (see Table 4).

---

*This index was constructed in the following manner: the total number of days of the conference was taken as a starting point. For every 7 days of a conference, 2 were subtracted to derive a 5-day workweek. This number was then multiplied by 8 (corresponding to an 8-hour day). The result was then multiplied by the number of active participants in the conference. The resulting figure is a rough estimate of the total number of work hours which had elapsed during the conference. This value was then divided into the total number of user hours of that conference. The result is an index of the percent of the working day devoted to use of FORUM per participant.

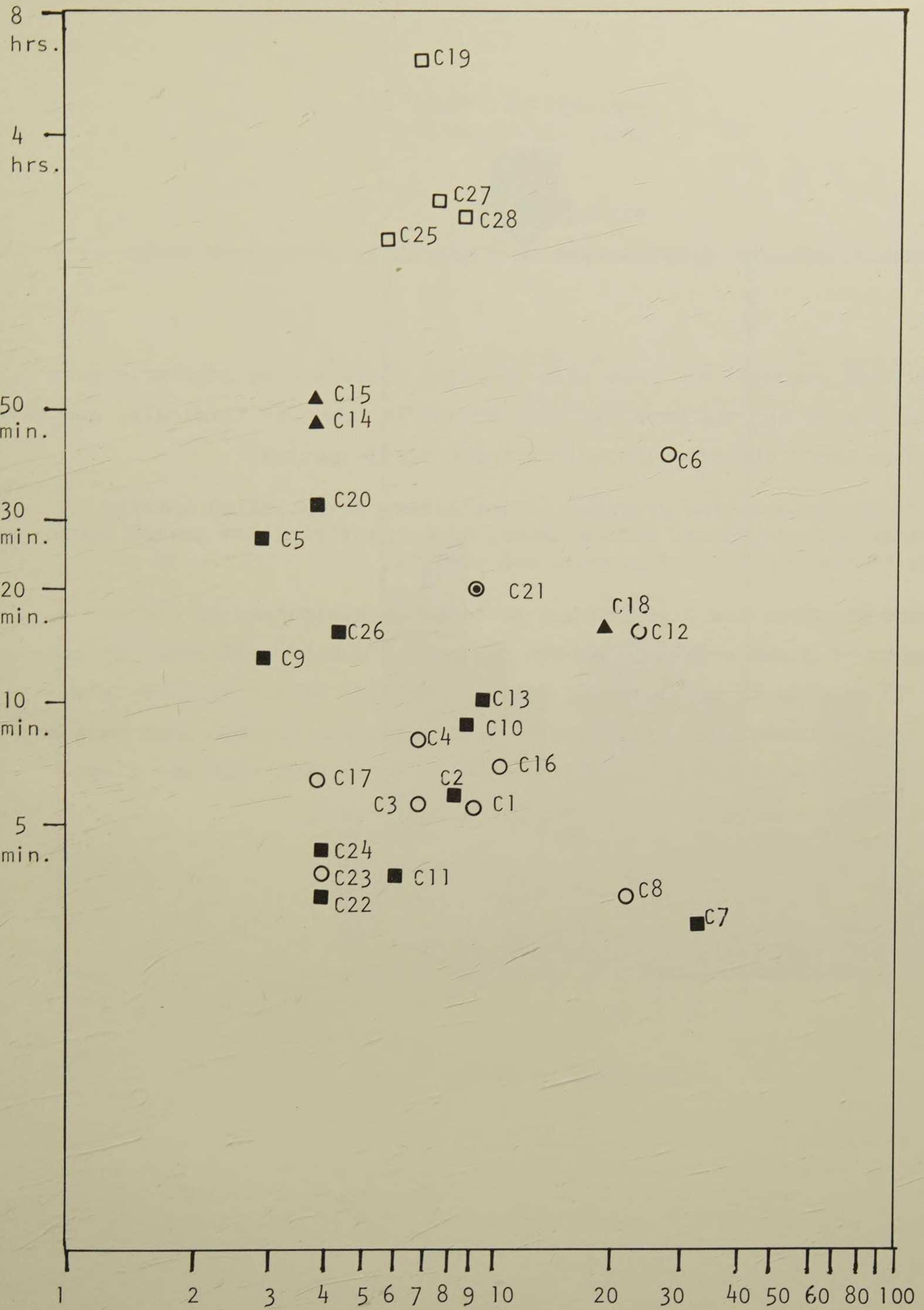


Figure 29. Portion of Workday Spent in Computer Conferencing for Five Conference Styles

PROPOSITION 13

EFFECT OF COMPUTER CONFERENCING ON FLEXIBILITY OF WORKING HOURS

Given six persons* who have used computer conferencing regularly over a two-year period and who have had easy access to computer terminals, and given monitor data about the time (local) of their participation:

> *computer conferencing provides a flexibility to establish working periods outside normal office hours, with "participation peaks" occurring in the morning, afternoon, and evening.*

Figure 30 shows the distribution of total participation of six extended users of FORUM across a 24-hour period and during weekends. As can be seen, 38 percent of all sessions occurred outside of the 8:00-to-5:00 weekday working hours. This finding does not necessarily mean that persons with access to computer conferencing work more hours, but that the flexibility of their working hours is increased considerably.

---

*It should be noted that four of these users had terminals in their homes as well as in their offices for at least part of the time under study.

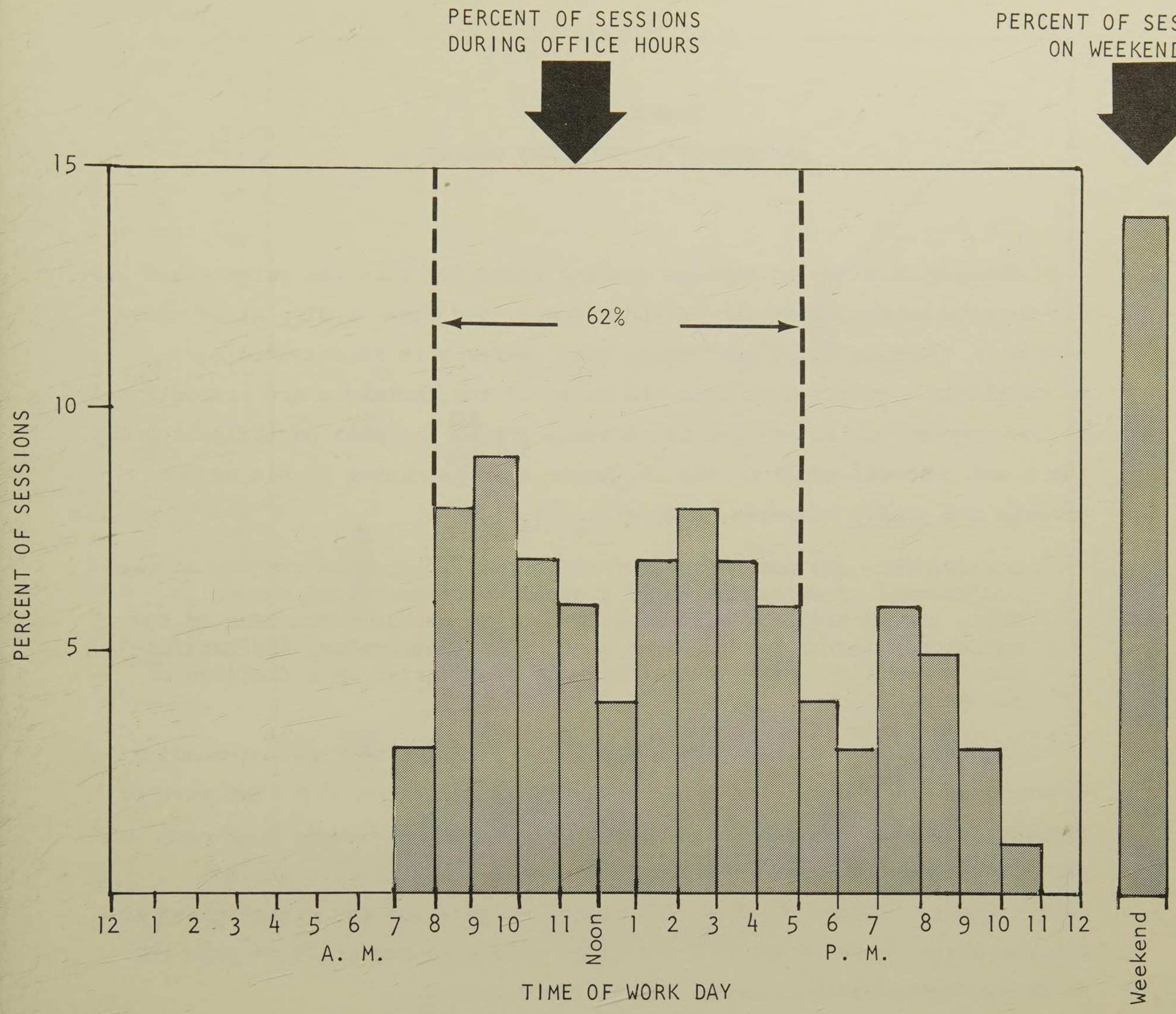


Figure 30. Distribution of Participation of Six Users Across a 24-Hour Period (based on 1,155 sessions)

PROPOSITION 14

MAPPING OF PARTICIPANT BEHAVIOR

Given statistics on message sending rates for both the private and public message sending behavior of individuals, and given a display of these data on a "participation map" where each conferee is represented by a rectangle on a graph, such that the sides of the rectangle are proportional to the average public and private message length for that participant and the *x* and *y* coordinates* of the rectangle are the number of his or her private and public messages, respectively):

> *participants are not restricted to a specific area on the map across conferences or across parts of a single multipart conference; in fact, the participant will move across the map as a function of the conference and/or part. Given a multipart conference, the participant's position relative to the group also varies as a function of the part.*

Figure 31 is a participation map which displays the message-sending behavior of the chairman of Conference C18 in relationship to the rest of the participants. As can be seen, his participation changes from part to part independently of the average participation of the rest of the participants. Figure 32 shows the change in position for participants in two companion conferences (C12 and C13). See also Figure 25 on page 102 in *Group Communication Through Computers, Volume 2*.

---

*In computer conferencing, it is possible to derive these statistics directly from software monitor data.

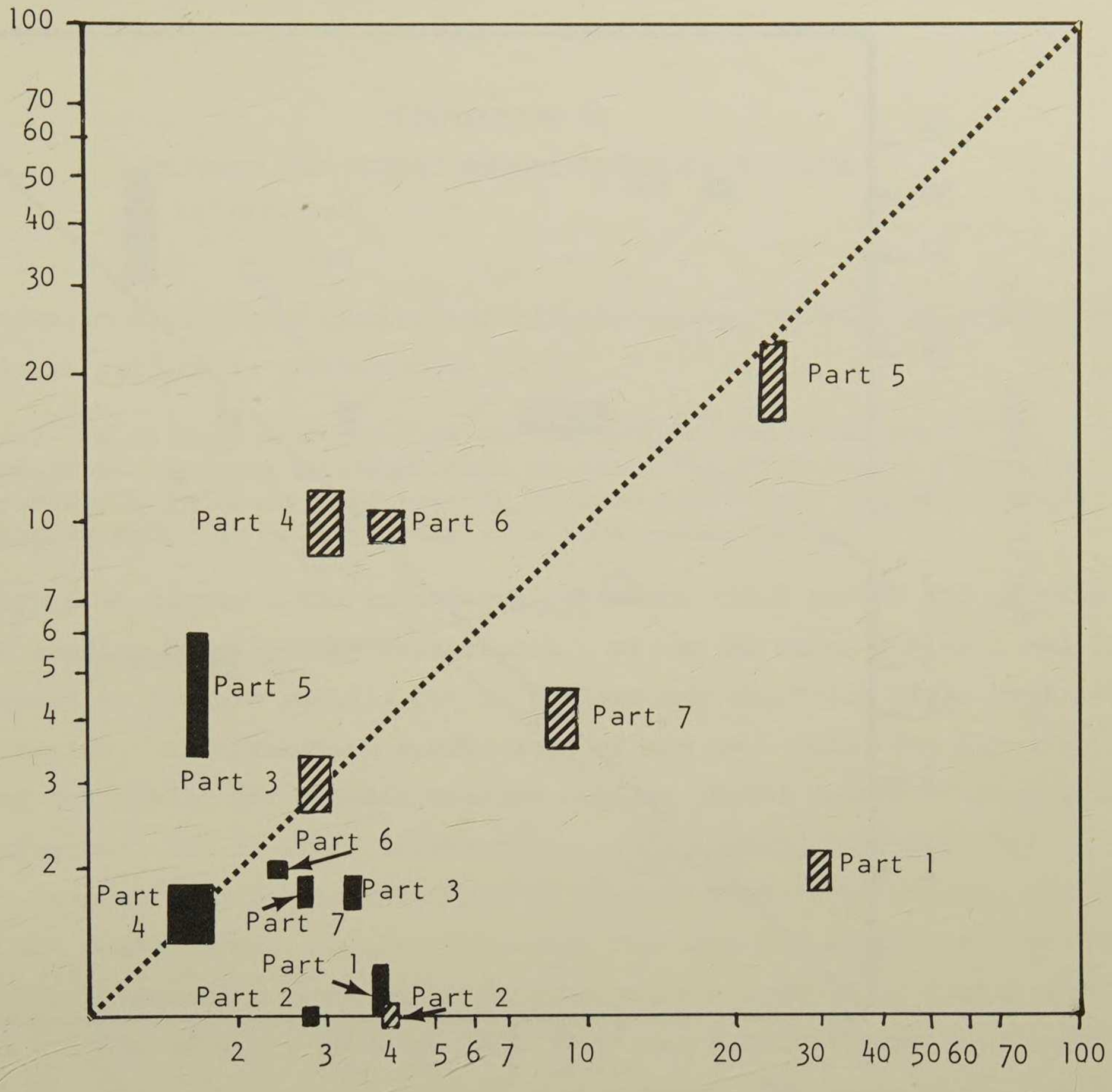
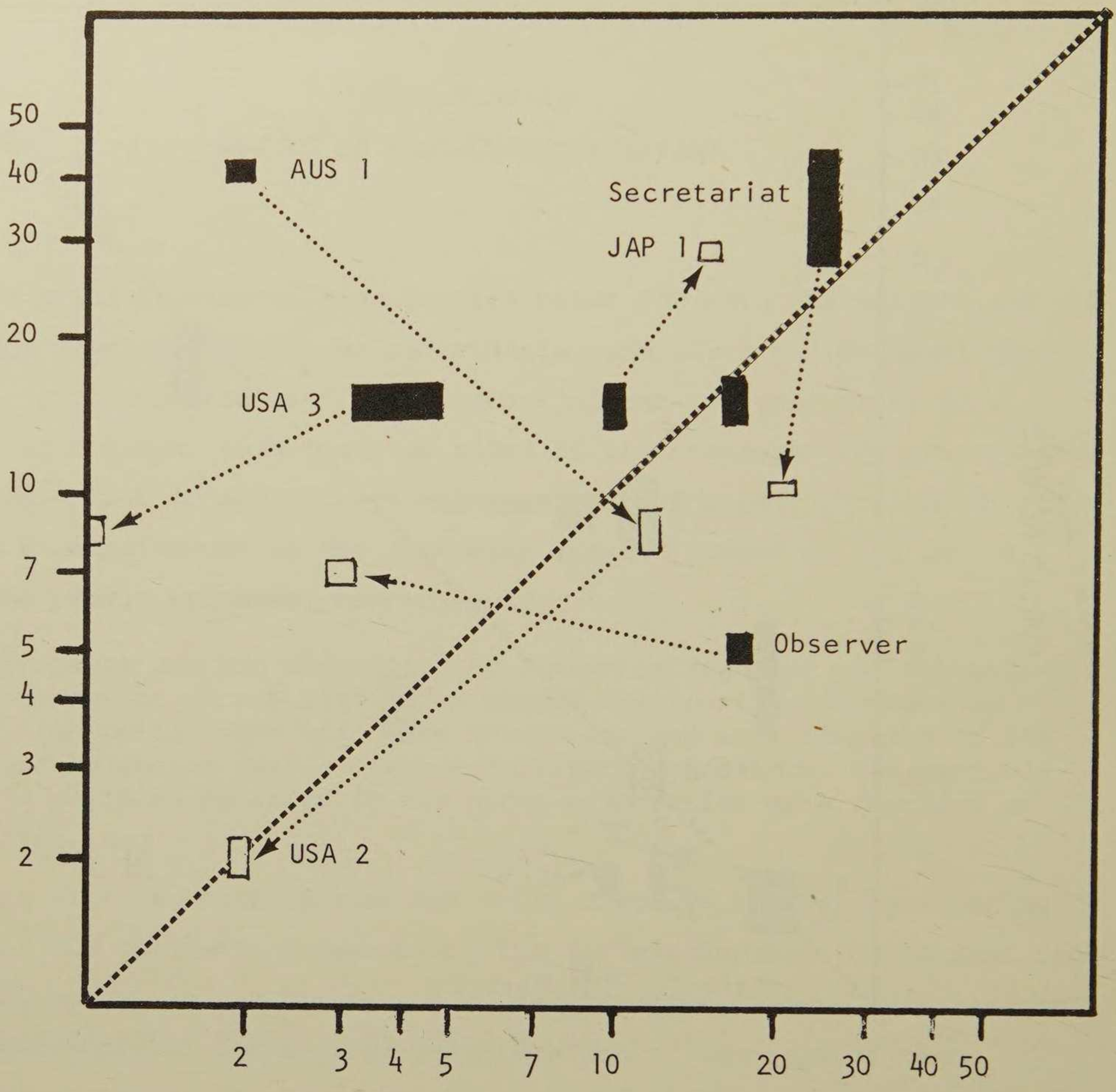


Figure 31. Participation Map for Seven Parts of the BNL Conference (C18)



Number of characters per message:

C12 ■ 500

500

C13 □

Figure 32. Participation Map Showing Changes in Participation Patterns in Conferences C12 and C13

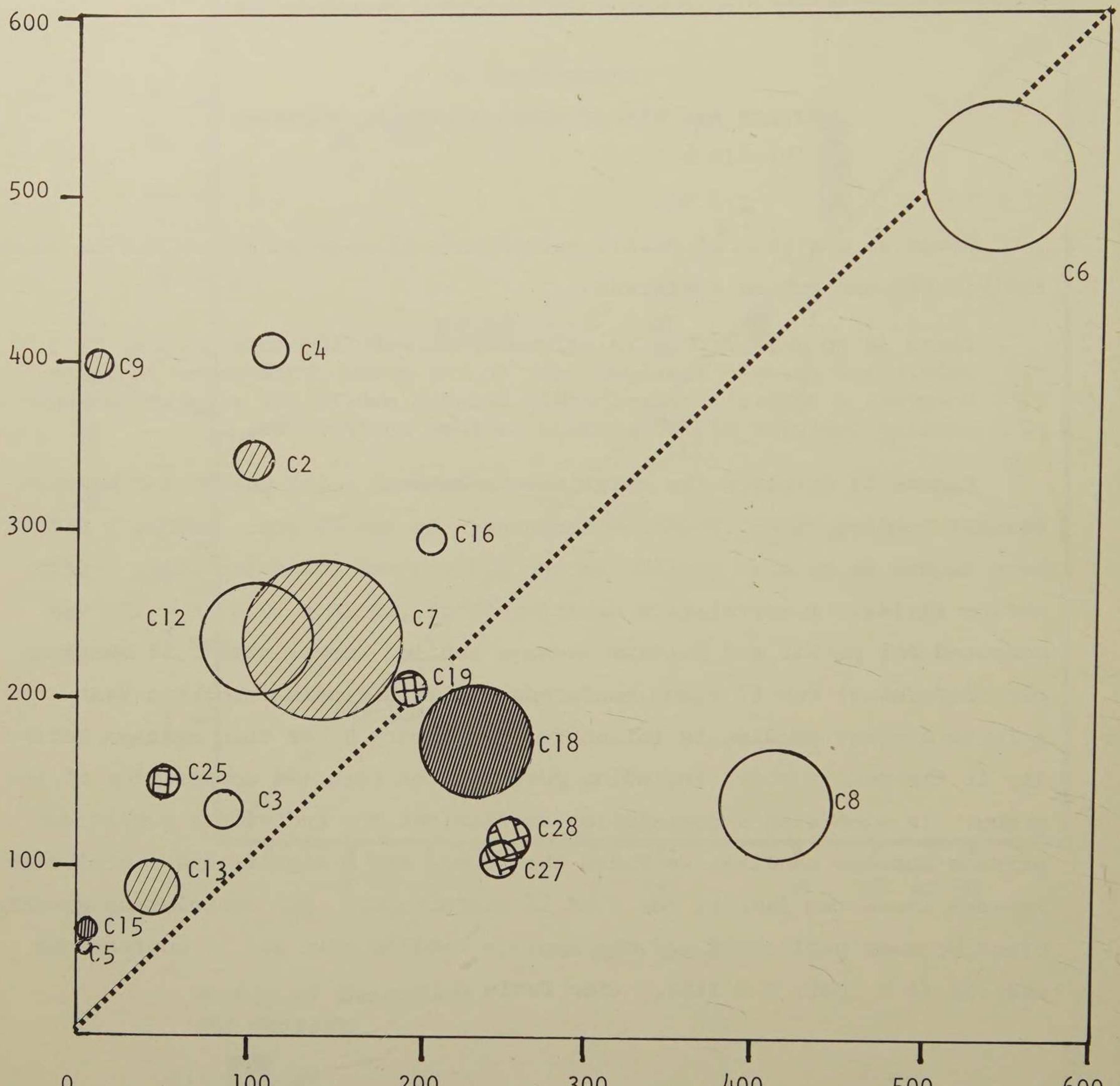
PROPOSITION 15

PRIVATE AND PUBLIC MESSAGE-SENDING PATTERNS

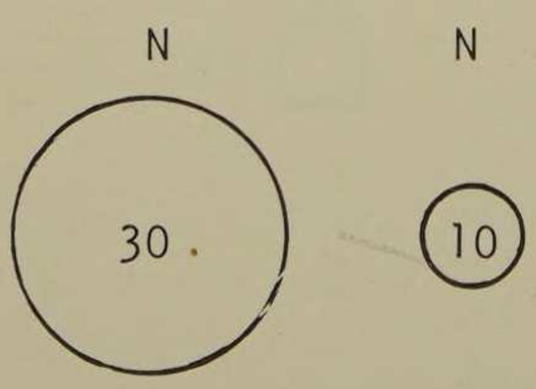
Given an analysis of public and private message-sending behavior across individuals and across conferences:

> *there is no significant relationship between the total number of public and private messages sent in any given conference; there is, however, a moderate relationship between public and private message-sending behavior of individuals in some conferences.*

Figure 33 displays the relationship between total public and private message sending for 17 FORUM conferences. As can be seen, Styles 1 and 2 have tended to be more public, but no pattern was found for other conferencing styles. A correlation coefficient of .19 (P = .228, N = 17) was computed for public and private message sending (total number of messages per conference) for 17 FORUM conferences. This finding suggests that private message sending is influenced by factors other than message activity in the public mode, including possibly the task and composition of the group. In computing a correlation coefficient for individual public and private message sending, we found that there was a significant correlation between these two factors for 6 of 14 conferences. The correlation coefficient between public and private message sending over all 14 conferences was .55 (P < .001, N = 215). (See Table 8.)



PRIVATE MESSAGES



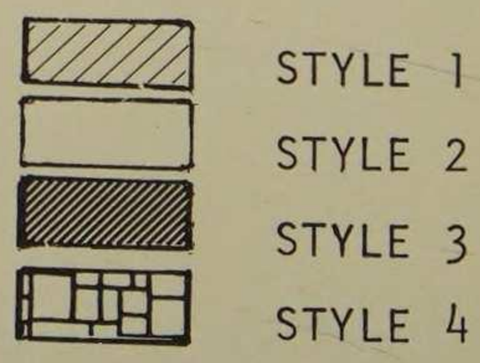


Figure 33. Total Public and Private Message Sending in 17 FORUM Conferences

Table 8. Summary Display of Correlations in Public and Private Message Sending, along with Other Basic Statistics*

	Conf. No.	Name	Style	Group Size	No. of Messages: Public	No. of Messages: Private	r	Duration (days)	Sessions	% sync msgs	% public msgs
Significantly Correlated	C2	Staff Meeting	1	7	341	102	.86	122	328	37	77
	C7	Users 1	1	30	233	141	.38	120	910	36	62
	C6	Tradeoff	2	29	510	543	.83	22	480	81	48
	C13	CCITT Reactions	3	14	86	42	.64	44	221	53	62
	C18	BNL	3	19	175	235	.52	49	415	26	43
	C28	CRISIS-2	4	9	137	238	.67	1	28	100	33
Possibly Correlated	C3	Experiment Design	1	7	133	86	.61	125	232	67	61
	C4	XYZ	1	7	407	113	.61	51	-	-	78
	C16	CSG	1	11	292	208	.46	70	315	54	58
	C12	CCITT	3	22	231	104	.34	44	313	44	69
Uncorrelated	C8	Users 2	1	19	135	411	.21	111	696	70	25
	C19	NISS	4	7	204	196	.01	1	34	100	51
	C25	Freeway	4	6	155	50	.17	1	6	100	77
	C27	CRISIS-1	4	8	115	255	.36	1	9	100	31

*Only for conferences where complete data were available.

PROPOSITION 16

PARTICIPATION PATTERNS OF GROUP LEADERS

Given participation maps of all participants in a conference:

the conference facilitator and the substantive chairperson tend to be high private and public communicators respectively.

In some FORUM conferences, there have been clearly identifiable facilitators and chairpeople. The facilitators, as described in Chapter 3, offered support to conferees as they learned about communicating via FORUM; they also made periodic procedural suggestions about the direction of the discussion. The chairpeople tended to focus only on the substantive aspects of the conference from a leadership point of view.

These roles can be described in terms of typical positions on the participation map (see Figure 34*). Table 9 shows the participation rates of the chairpeople and/or facilitators in 17 FORUM conferences.

---

*See also the participation maps in *Group Communication Through Computers, Volume 2*, pp. 50, 102, and 121-125.

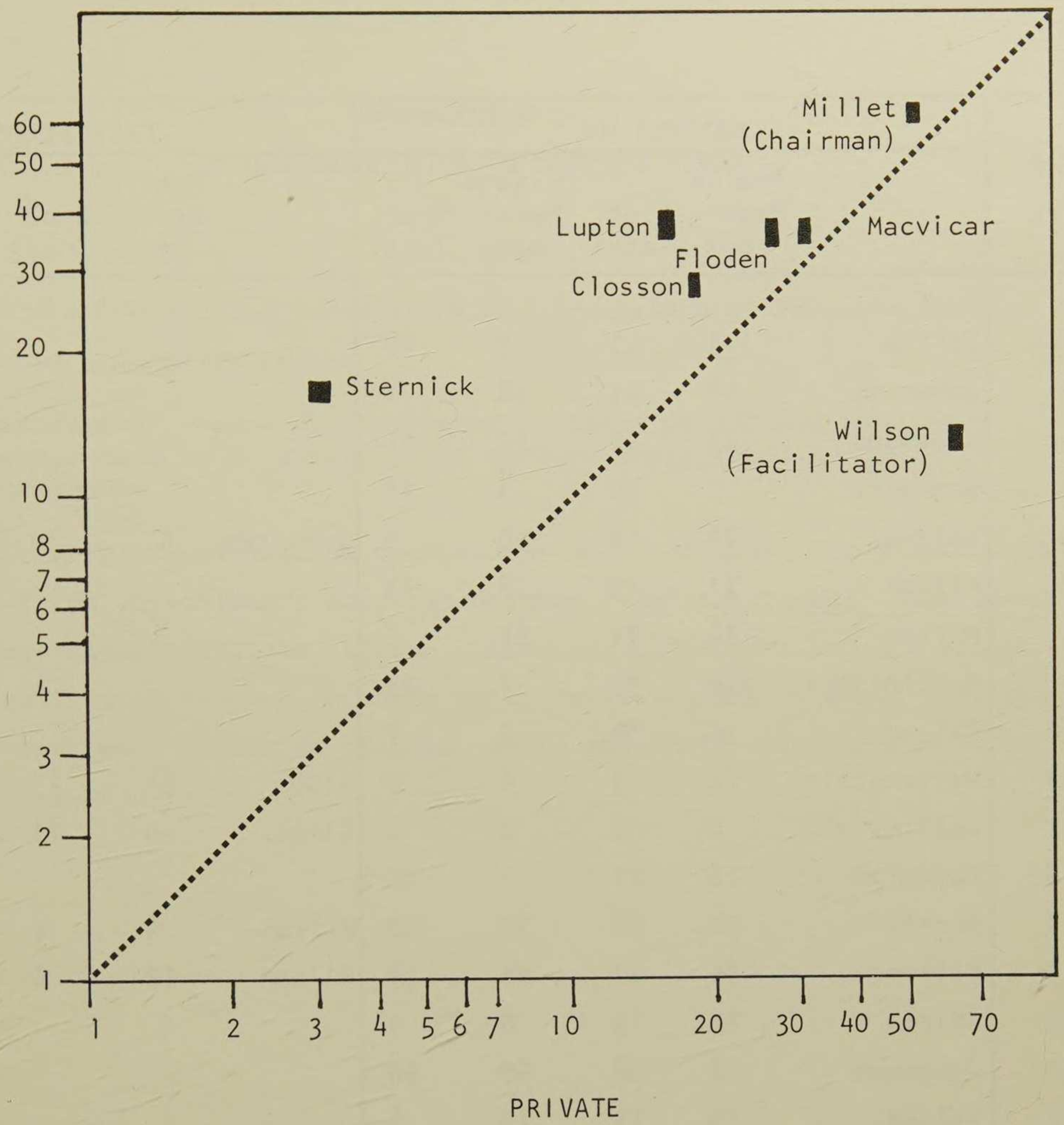


Figure 34. Participation Map for the NISS Conference (C19)

Table 9. Comparison of Chairperson and Facilitator Behavior

Conference	CHAIRPERSON					FACILITATOR				
		Public Messages	% of Total	Private Messages	% of Total		Public Messages	% of Total	Private Messages	% of Total
C2	Vallee	111	33	19	19					
C3	Johansen	58	13	18	21					
C4	Johansen	133	32	35	31					
C5	Schwartz	7	50	3	75					
C6	Kollen	74	14	50	9	Johansen	51	10	187	34
C7	Miller	21	9	18	13					
C8	Miller	34	24	21	5					
C9	A. Lipinski	236	59	2	33					
C10	Balzer	32	14	5	7					
C12	Wallenstein	22	9	6	6	Gibbs	34	15	23	22
C13	Wallenstein	0	0	0	0	Gibbs	10	11	20	37
C15	Randolph	16	27	1	50					
C18	Morris	50	28	75	32	Wilson	4	2	55	23
C19	Millett	56	27	48	24	Wilson	12	6	58	30
C25	Shirts	23	15	0	0					
C27	Johansen	23	18	50	20					
C28	Vallee	19	13	10	4					

PROPOSITION 17

INFLUENCE OF ROLE ON PARTICIPATION

Given a division of roles in CRISIS-simulation conferences between staff roles and nation roles:

> *participants form clusters, based on their public and private message-sending behavior, which reflect their roles in the conference.*

In the CRISIS-simulation conferences (C27 and C28), the staff roles have no "game objectives"; they can neither "win" nor "lose." All nation roles have clearly defined, though differing, objectives and are rated periodically with respect to these objectives. Figure 35 shows that the nation roles were primarily private, while the staff roles tended to be primarily public.

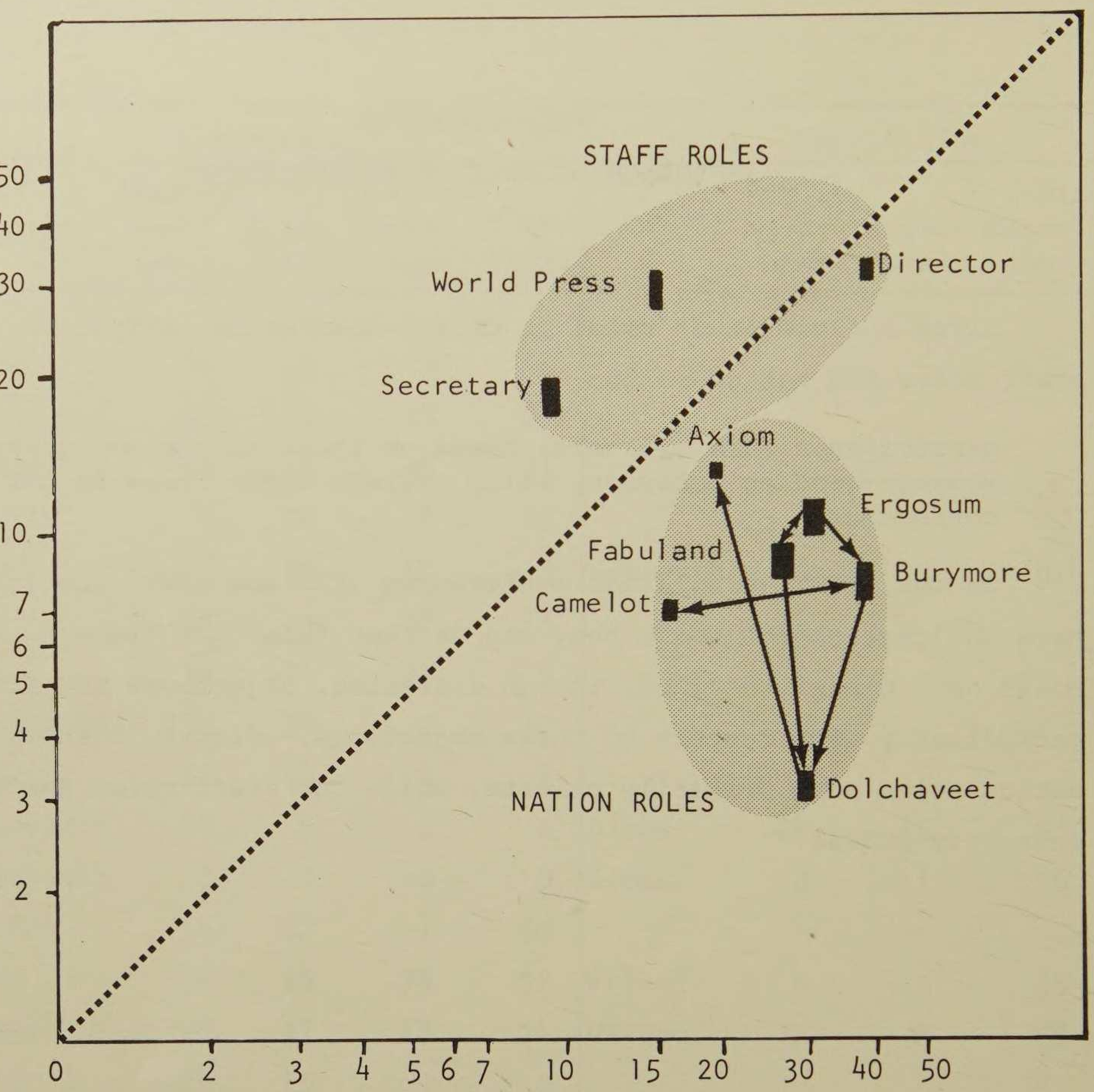


Figure 35. Participation Map for CRISIS-2 (C28)

PROPOSITION 18

INTERACTION PATTERNS ACROSS TASKS

Given conferences in which participants are assigned different tasks, and given an analysis of their interaction according to Bales'* categories for Interaction Process Analysis:

> *the public and private message-sending patterns of participants differ across categories as a function of their tasks.*

Figures 36 and 37 show the public and private message-sending patterns of two participants in Conference C27 (CRISIS-1). The curves characterize the involvement in the conference of these individuals. It remains to be seen whether they would remain constant across many different participants or different tasks for the same participant.

---

*See page 66.

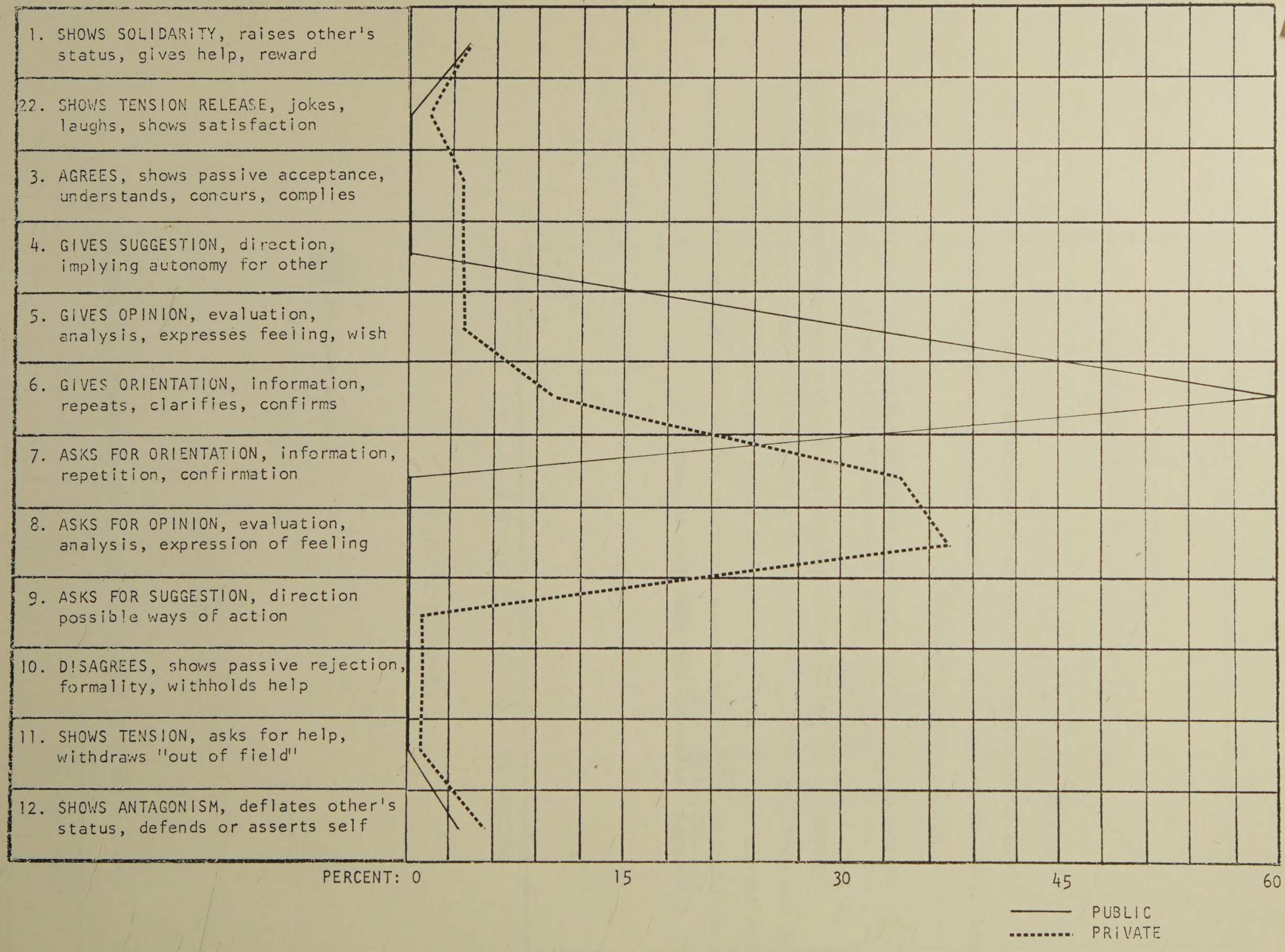


Figure 36. Interaction Process Analysis of Public and Private Messages by World Press in CRISIS-1 (C27)

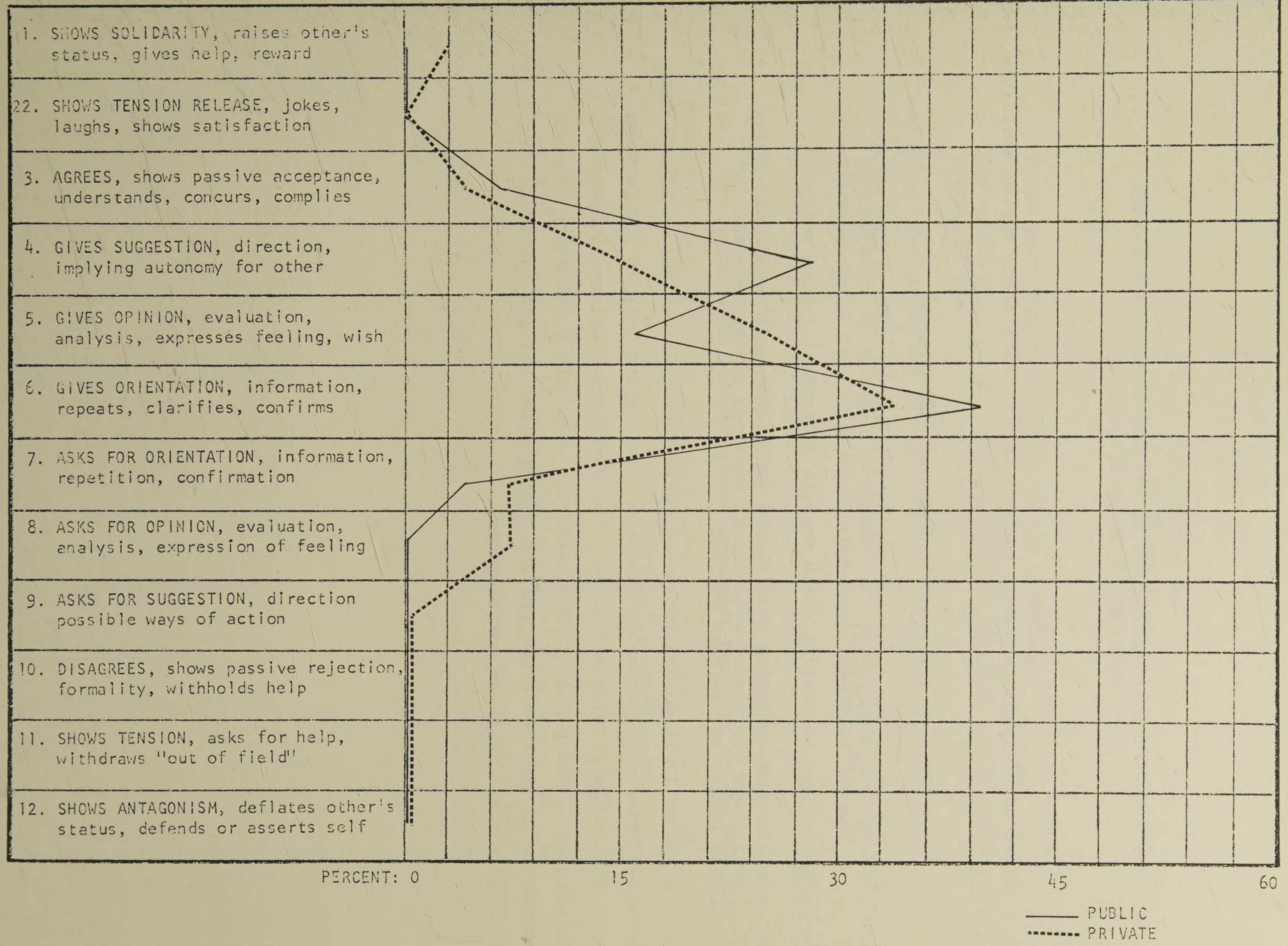


Figure 37. Interaction Process Analysis of Public and Private Messages by Axiom in CRISIS-1 (C27)

PROPOSITION 19

MEASUREMENT OF TYPING ABILITY

Given participant responses to questions probing their typing ability and familiarity with computers, specifically

1. How familiar are you with the use of computers?

2. How would you rate your typing ability (or that of the person who typed for you)?

and given system statistics which measure individual typing rates:

both expressed typing ability and familiarity with computers are positively correlated with actual measures of typing rates for both public and private entries.

Based on 12 responses following Conference C18, we found that the correlation between responses to question 1 and typing rate in public mode was .62; in the private mode, .54. The correlation between responses to question 2 and public typing rates was .57. The correlation between responses to question 2 and private typing rates was not significant. $P \leq .05$ for all of these correlations.

PROPOSITION 20

INFLUENCE OF TYPING ABILITY ON TIME SPENT IN THE CONFERENCE

Given participant responses to the question

> How would you rate your typing ability (or that of the person who typed for you)?

and given statistics for participant time online:

> *participants with higher expressed typing skills remain online for a longer total time than those with lower expressed skills.*

Twelve participants responded to this question following Conference C18, rating their typing ability as excellent (4), good (3), fair (2), and poor (1). The correlation between these responses and time online was .60 (P = .02, N = 12).

PROPOSITION 21

LEARNING TO USE COMPUTER CONFERENCING

In synchronous conferencing, given an analysis based on a skill rating index for nine measures of messages sent, editing characters used, and participant familiarity with various subcommands available within FORUM:

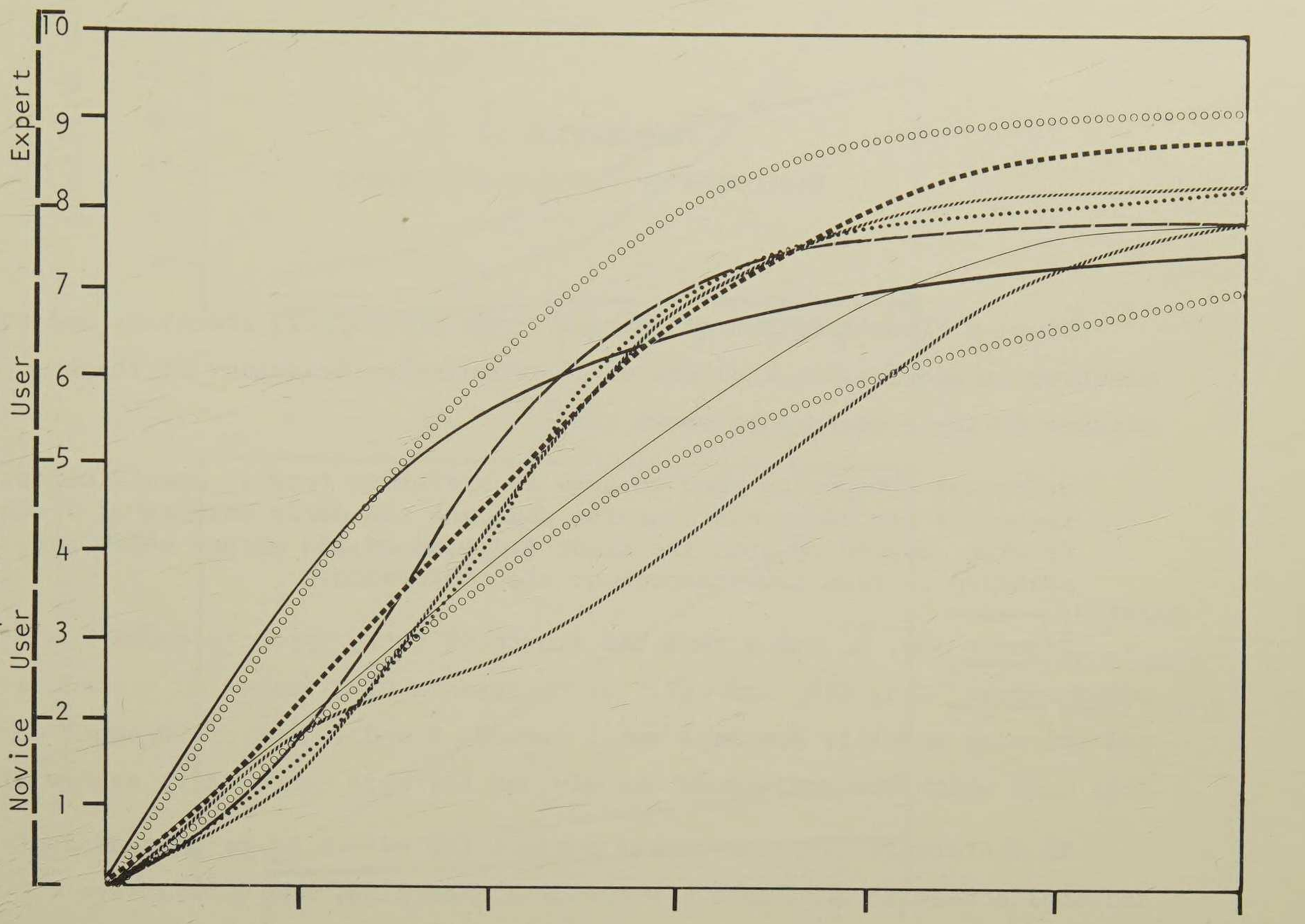
> *participants generally acquire basic conferencing skills in approximately 1 hour. While previous experience does affect skill ratings, it accounts for only a small variation in the participant's overall skill. Typing skill is not correlated with overall skill at any point in time.*

A skill rating mechanism was introduced in FORUM-6 for Conference C28 only. Figure 38 shows the adaptation growth for all nine participants over the course of the conference. With both conferencing skills and previous experience of the participants quantified, all users began at skill = 0 and reached skill >2 after one hour (on a scale of 10 points). After 1-1/2 hours, all users had skill >4; after 2-1/2 hours, their skill ratings were all higher than 6; and at the end of the conference, all users had a skill rating higher than 7.

Previous experience with FORUM correlated with skill at 1 hour, 1-1/2 hours, and 2-1/2 hours. It did not correlate with skill either at the beginning (1/2 hour) or at the end (3 hours) of the conference.

---

*See page 81 for an explanation of the way in which skill ratings are assigned.



	TYPING RATE	PREVIOUS EXPERIENCE	TIME / SKILL 30 MIN.	60 MIN.	90 MIN.	120 MIN.	150 MIN.
User 1	170	10	2	6	7.5	8.5	9.0
User 2	118	8	2	4.5	6.5	7.5	8.5
User 3	90	6	1.5	4.0	6.5	7.0	7.5
User 4	39	3	1.5	4.0	5.5	6.5	7.5
User 5	182	10	1.5	5.0	6.5	7.0	7.5
User 6	126	2	1.5	2.5	4	5.5	7.0
User 7	178	7	1.5	3.5	5.0	6.5	7.0
User 8	185	5	1.5	5.5	6.0	6.5	7.0
User 9	54	2	1.5	3.5	4.5	5.5	6.5
Correlation of FORUM experience with skill rating at each time period:			.56 P=.06	.70 P=.02	.83 P=.003	.86 P=.002	.70 P=.02

Figure 38. Adaptation Growth For Nine Participants in CRISIS-2 (C28)

PROPOSITION 22

EVOLUTION OF CONFERENCE CONTENT

Given a classification of content* into procedural, learning, and substantive categories, an analysis of the cumulative frequency of these classes during a conference shows that:

> *different categories tend to grow at different rates. Specifically, issues of procedure and learning dominate the early entries of a conference, depending upon the prior training of the group; while substantive entries grow throughout the conference.*

Figures 39a, b, and c show the growth of entry types in three FORUM conferences: C12, C19, and C27. In Conference C12, issues of procedure and learning actually dominate until periods 6 and 7 (out of 10 equal periods into which the conference was divided for this comparative analysis).

In Conference C19, the curves reflect the effect of prior training and good access to terminals. Procedural, learning, and substantive entries all begin at an equivalent level; substantive entries are never suppressed by other entry types and, in fact, grow much faster than other types.

In Conference C27, the effects of introducing procedure and attempting to coordinate the group can be seen. Here, as in C12, procedure dominates until period 7, when substantive entries begin to increase.

---

*The unit of measurement is the complete thought rather than a FORUM message in C27. It is the message in C12 and C19. Also, only public messages were analyzed in all three conferences.

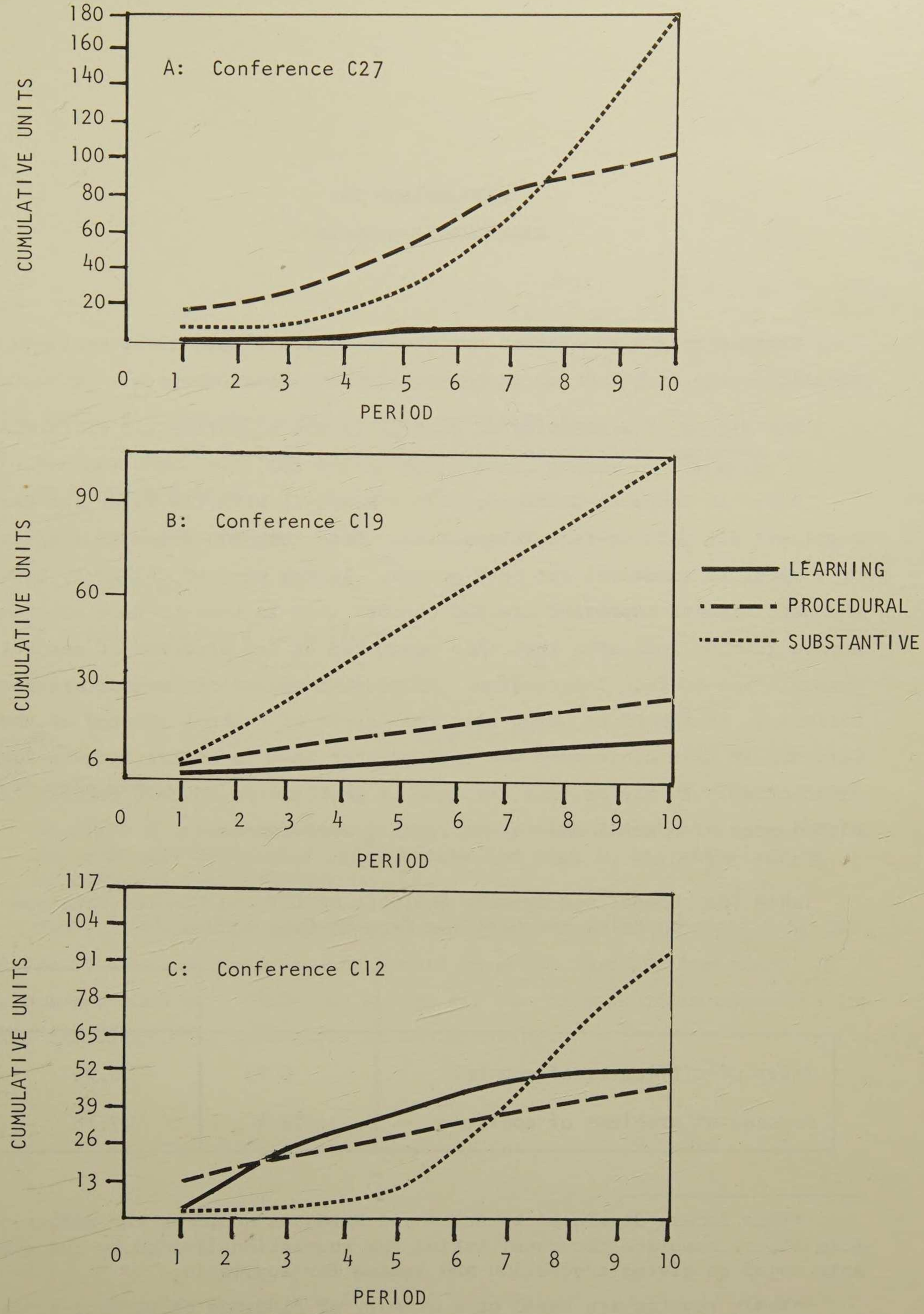


Figure 39. Growth of Entry Types in Three FORUM Conferences

PROPOSITION 23

DIFFICULTY OF CONTROL

Given a crisis simulation conference (Style 4) and given an index of the difficulty of the group in controlling its behavior:*

> *the degree of difficulty of control is not significantly different in computer conferencing from known face-to-face behavior.*

Table 10 compares Conference C27 (CRISIS-1) with the Bales and Hare results** for face-to-face interaction. Note that the index of difficulty of control is identical for both groups. In the case of CRISIS-1, however, the participants expressed greater concern than in face-to-face interaction. Such a finding indicates that this group had as few problems of control as general face-to-face interaction. Although problems of control are not different, it should be noted that the degree of control exerted by the director in this conference was much greater than in normal face-to-face interaction. It may be that the lack of problems of control reflect the high degree of control maintained in this conference.

Table 10. Comparison between Analysis of C27 and Results Obtained by Bales and Hare for Face-to-Face Groups

	C27	Face-to-Face
Index of difficulty of control	0.03	0.03
Percent of problems of control	22.4	7.16

---

*This index, developed by Bales and Hare, is coded as the number of acts (i.e., complete thoughts) asking for suggestion divided by the sum of acts coded as giving suggestion and asking for suggestion.

**These results are based on a summary of findings of 21 face-to-face interactions varying in group size, task, experimenters, and constituents in Robert F. Bales and A. P. Hare, "Diagnostic Use of the Interaction Profile," *Journal of Social Psychology*, 1965, pp. 239-258.

PROPOSITION 24

CONFERENCING PRESSURE

Given conferences of Styles 2, 3, and 4, and given participant responses to statements probing their perception of information overload and their ability to express their views; specifically

> Thinking back over the entire conference, please indicate the extent to which you felt
>
> 1. pressed for time
>
> 2. confused
>
> 3. under pressure to perform
>
> 4. overloaded with information
>
> 5. able to express your views completely

Given such responses:

> *in Style 4, there is evidence that participants feel more pressed for time and overloaded with information than in the other styles of computer conferencing.*

Table 11 shows the responses of participants in Conferences C18, C27, and C28 to these statements. It should be noted that the "pressure" in Style 4 may also be a source of energy for the intense group communication which is possible in this style of conferencing.

Table 11. Responses to Questions about Feelings of Pressure in Computer Conferencing

Question	Conference								
	C18			C27			C28		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Pressed for Time	9	3.67	1.00	7	3.71	1.11	8	3.25	.84
Confused	8	2.75	.71	7	2.71	.76	8	2.63	.81
Under Pressure	6	2.67	.52	7	2.86	1.57	-	-	-
Overloaded	6	1.83	.98	7	2.86	1.22	8	3.00	.38
Able to Express Views	8	2.50	1.2	7	3.29	1.11	8	3.50	1.07

Based on a scale from 1 = Never to 5 = Always

PROPOSITION 25

INFLUENCE OF FEELINGS OF PRESSURE ON LENGTH OF ENTRY

Given participant responses to statements probing the extent to which they felt pressed for time and less intimidated, specifically

> Thinking back over the entire teleconference, please indicate the extent to which you felt
>
> 1. pressed for time
>
> 2. threatened or intimidated in some way

Given such responses:

> *those participants who felt pressed for time and less intimidated were those who made longer public entries.*

For Conference C18, the correlations between public messages sent and responses to statement 1 were .57 (P = .03, N = 11); to statement 2, -.72 (P = .05, N = 6).

PROPOSITION 26

INFLUENCE OF PROFESSIONAL MOTIVATION ON PARTICIPATION

Given participant responses to questions probing their motivation and their professional stake in the conference, specifically

1. How strong was your professional or personal "stake" in the substantive outcome?

2. How strong was your motivation to participate actively?

and given system statistics on a session-by-session basis:

> *participants with greater motivation and with a greater professional stake send more messages with more characters per message both publicly and privately, with more typing time and more time online than those who are less motivated.*

These questions were asked following Conference C18, with 13 participants responding. The correlation between responses to question 1 and public message sending was .57; public characters, .55; private messages, .59; private characters, .55; public typing time, .58; private typing time, .55; and log-in time, .57.

The correlation between responses to question 2 and public message sending was .49; public characters sent, .49; private messages sent, .54; private characters sent, .54; private typing time, .53; and log-in time, .48. Public typing time was not significantly correlated with responses to this statement. $P \leq .05$ for all of these correlations.

PROPOSITION 27
SENSE OF PERSONAL INTERACTION

Given participant responses to statements probing the participant's sense of personal interaction, specifically

1. One gets no real impression of personal contact with the people at the other end of the link.

2. It is easy to tell if other participants are following the discussion.

3. The communications equipment distracts one from the ongoing conversation.

4. One does not get a good idea of how other people at the other end are reacting.

Given such responses:

> *reliability of the medium and the synchronous nature of the interaction are critical factors in determining the participant's sense of personal interaction.*

Table 12 shows the responses of participants in Conferences C18, C27, and C28 to these statements. System failures are a strong factor in the negative responses to statements 3 and 4 in C18. Participants in C27 and C28, which were both synchronous conferences, were either neutral or positive in their responses.

Table 12. Responses to Questions about Feelings of Interpersonal Interaction in Computer Conferencing

	C18			C27			C28		
	Number of Responses	Mean	Standard Deviation	Number of Responses	Mean	Standard Deviation	Number of Responses	Mean	Standard Deviation
No Impression	9	3.89	1.45	7	2.28	1.38	8	2.63	1.51
Others Following	8	2.50	1.69	7	2.51	1.11	7	3.42	1.40
Equipment Distracts	8	4.38	1.07	7	2.86	1.58	--	--	--
Other Reactions	7	4.28	1.11	7	3.42	1.51	8	3.13	1.55

Based on a scale from 1 = Disagree Strongly to 5 = Agree Strongly

PROPOSITION 28

PREVIOUS COMPUTER EXPERIENCE AND ATTITUDES TOWARD THE MEDIUM

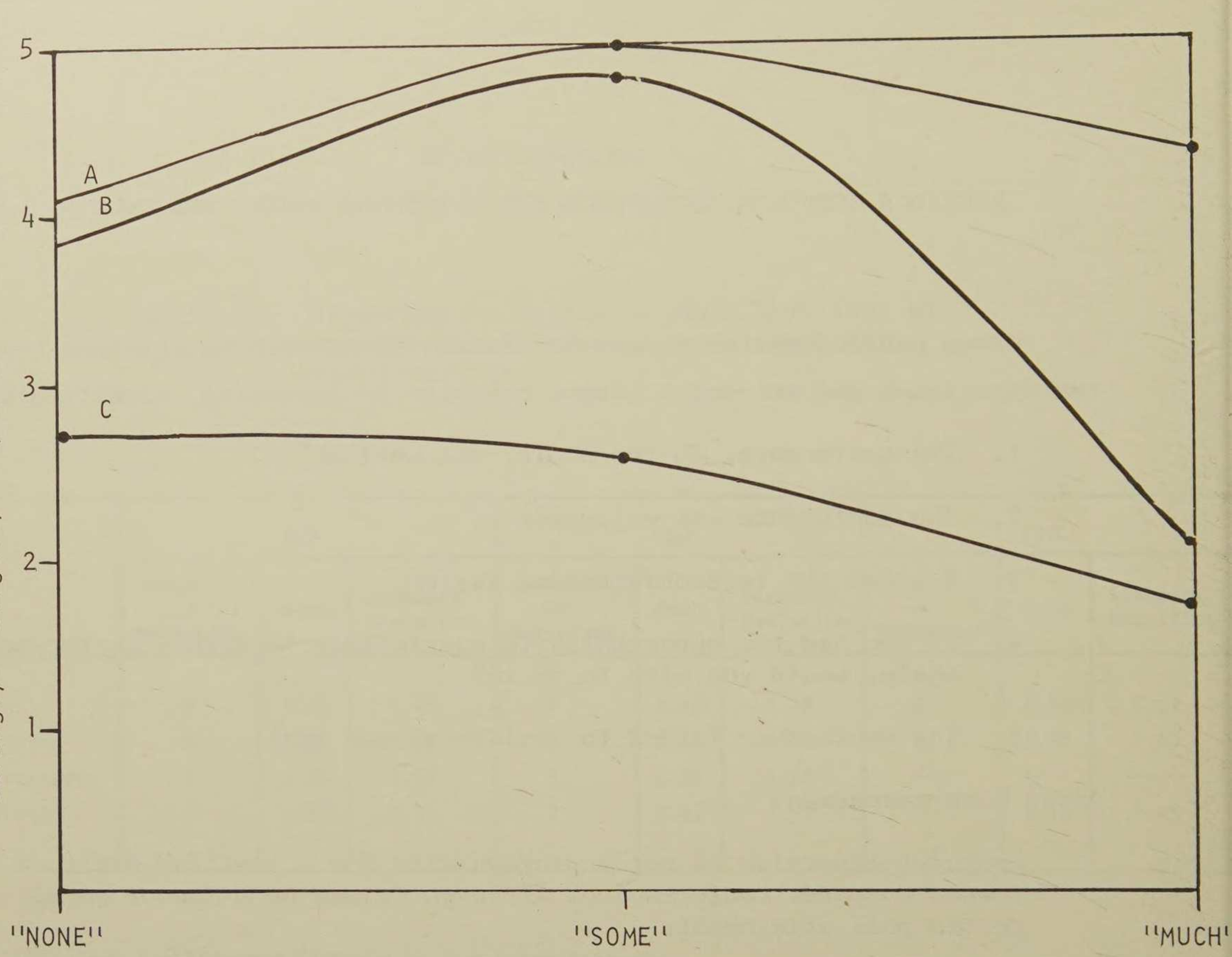
Given participant responses to statements concerning previous computer experience and attitudes toward computer conferencing, specifically

1. The conference, on the whole, was worthwhile.
2. The conference was enjoyable.
3. I liked the teleconferencing system.
4. If you had the opportunity to participate in such a conference again, would you wish to do so?
5. The conference failed to satisfy my own goals.

Given such responses:

> *computer expertise is not a prerequisite for a positive attitude toward computer conferencing, although it may be a factor in reported goal attainment.*

Computer experience was not a factor in responses to statements 2, 3, and 4. Participants with greater computer experience were more satisfied with the attainment of their goals than those with less experience. In Style 4 conferences, the responses to statement 1 were more extreme for people with average computer experience; in Style 3 conferences, participants with much computer experience were more negative in their responses to statement 1 (see Figure 40).



A. RESPONSE TO STATEMENT: THE COMPUTER CONFERENCE WAS WORTHWHILE (FOR C27 AND C28)

B. RESPONSE TO STATEMENT: THE CONFERENCE FAILED TO SATISFY MY GOALS (FOR C28)

C. RESPONSE TO STATEMENT: THIS CONFERENCE WAS WORTHWHILE (FOR C18)

Figure 40. Relationship Between Previous Computer Experience and Attitudes toward the Medium

PROPOSITION 29

PRECONFERENCE ATTITUDES

Given a Style 2 conference with participant responses to standard semantic differential scales:

> *the most important factor for the participants prior to experience with computer conferencing is the success of the medium. Four other significant factors are: "stability," "stimulation," "comfort," and "sociability."*

Table 13 shows the rotated factor matrix for pre-FORUM attitudes for Conference C12; five factors can be identified. In order of their importance for participants, the first factor is "success." The high loading on this factor is that of the unsuccessful-successful scale. This factor, before rotation, accounts for 29 percent of the variance. The second factor is a "stability" factor. High loadings on this factor are pleasurable-painful and stable-changeable. It accounted for 18.1 percent of the variance. The third factor was labeled "stimulation." High loadings on it were boring-interesting, complex-simple, and good-bad. It accounted for 11 percent of the variance. The fourth factor extracted was labeled "comfort." High loadings on this factor were relaxed-tense and personal-impersonal. This factor accounted for 10.1 percent of the variance. The last factor extracted was labeled "sociability." High loadings on this factor were public-private, informal-formal, unsociable-sociable, and impersonal-personal. In general, it would seem that participants were looking at FORUM in terms of how stable (reliable) it was; the amount of stimulation that it could provide; and how important, meaningful, or successful the medium would be.

Table 13. Rotated Factor Matrix for Responses to Semantic Differential Questionnaire before Conference C12*

SCALE	FACTORS				
	I "SUCCESS"	II "STABILITY"	III "STIMULATION"	IV "COMFORT"	V "SOCIABILITY"
Boring-Interesting	.022	-.170	.838	.059	-.202
Relaxed-Tense	-.040	-.090	.155	.769	.010
Complex-Simple	.051	-.052	-.751	-.259	-.156
Free-Constrained	.137	-.151	.017	-.462	.085
Good-Bad	.462	-.116	-.553	.007	-.089
Important-Unimportant	.672	-.209	.007	-.381	-.106
Meaningless-Meaningful	-.556	.338	.235	.499	-.136
Pleasurable-Painful	.214	-.966	.102	.014	-.008
Public-Private	-.311	.098	.241	.066	.792
Stable-Changeable	.068	.833	.089	.197	.316
Unsociable-Sociable	-.112	.530	.083	-.204	.478
Unsuccessful-Successful	-.808	.164	.026	.273	.228
Friendly-Hostile	.708	.011	-.052	.126	-.034
Impersonal-Personal	.061	.047	.261	.610	.502
Informal-Formal	-.002	.239	-.311	-.091	.632

*The numbers indicate the degree of relation between responses to each scale and each of the five factors identified. For instance, responses to the "Boring-Interesting" scale are most related to the factor labeled "Stimulation," and so on.

PROPOSITION 30

DIFFERENCE BETWEEN PRE- AND POSTCONFERENCE ATTITUDES

Given participant responses on semantic differential scales for importance and meaningfulness before and after use of the medium:

> *computer conferencing was considered more meaningful and important after it had been used by a group than prior to such use.*

Table 14 compares the responses of 22 participants in Conference C12 before and after the conference.

Table 14. Comparison of Preconference and Postconference Responses on Two Semantic Differential Scales

	PRE		POST		P
	Mean	Standard Deviation	Mean	Standard Deviation	
Important-Unimportant	2.13	.74	1.53	.52	.007
Meaningless-Meaningful	4.13	.64	4.40	.51	.041
Based on a scale from left term = 1 to right term = 5					

GLOSSARY

GLOSSARY

CONFERENCE (ACTIVITY)	In FORUM, a structure that gives a group of persons equipped with terminals ("participants") the ability to communicate through computer files.
SESSION	The period during which a participant is present in a particular conference.
JOINING TIME	Time at which a given participant enters a particular conference.
LEAVING TIME	Time at which a given participant leaves a particular conference.
SESSION DURATION	The difference between leaving time and joining time.
ACTIVE PARTICIPANT	In a particular conference, a participant who has sent at least one message.
SYNCHRONOUS PERIOD (OF ORDER n)	The period during which n participants are present in a particular conference, with $n > 1$.
SYNCHRONOUS INTERACTION	The sum of all synchronous periods during a particular conference.
SYNCHRONOUS SESSION	A session during which synchronous interaction occurs.
ASYNCHRONOUS SESSION	A session during which no synchronous interaction occurs.
MESSAGE (ENTRY)	In FORUM, a sequence of characters terminated by two carriage returns.
PUBLIC MESSAGE (PUBLIC ENTRY)	A message that may be read by any participant.
PRIVATE MESSAGE (PRIVATE ENTRY)	A message that is directed to a single participant and cannot be read by others.
ANONYMOUS MESSAGE (ANONYMOUS ENTRY)	A public message whose author is unknown.

SYNCHRONOUS MESSAGE	A message that is sent while there is more than one participant present in a particular conference.
ASYNCHRONOUS MESSAGE	A message that is sent when there is only one participant who is currently present in a particular conference.
PARTICIPATION RATE	In a given conference, the percentage of all messages sent by a given participant.
MESSAGE (WORD, CHARACTER) TRANSMISSION RATE	Respectively, number of messages (words, characters) transmitted per unit of time. Note: We have based all statistics on 5-character words.

BIBLIOGRAPHY

BIBLIOGRAPHY

Aircraft Armaments, Inc. and Institute for Defense Analyses, *An Experimental Task*, Arlington, VA: Research Paper P-111, November 1963. NTIS*: AD-601 929.

Amara, Roy, and Jacques Vallee, "FORUM: A Computer-Based System to Support Interaction among People," *Proceedings of the International Federation of Information Processing Congress*, August 1974.

Anonymous, "Appendix N," *The 1972/73 New Rural Society Project*, Report to the U.S. Department of Housing and Urban Development, May 1973.

————————, *An Experiment in Conducting a Computer Based International Conference*, Cybernetic Systems Program, San Jose State University, July 12, 1974.

————————, *The 1972/73 New Rural Society Project*, Report to the U.S. Department of Housing and Urban Development, May 1973.

————————, *Teleconference Canada Research Plan*, Report of the Socio-Economic Planning Branch, Department of Communications, Canadian Federal Government, August 1972.

Bailey, Gerald C., Peter G. Nordlie, and Frank Sistrunk, *Literature Review, Field Studies, and Working Papers*, Arlington, VA: Institute for Defense Analyses Research Paper P-113, October 1963, revised March 1966. NTIS*: AD-480 695.

Bales, Robert F., *Interaction Process Analysis: A Method for the Study of Small Groups*, Cambridge, MA: Addison-Wesley Press, Inc., 1951.

————————, and A. P. Hare, "Diagnostic Use of the Interaction Profile," *Journal of Social Psychology*, 1965, pp. 239-258.

Baran, Paul, *Communications, Computers and People*, The Rand Corporation, P-3235, November 1965.

---

*National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22151. NTIS is an information retrieval system with a 300,000+ document data base. These documents date back to 1964 and were submitted to NTIS by all major departments and agencies with the Federal Government as well as by leading private organizations with state and Federal grants or contracts. The NTIS system was computer searched as a part of this study.

———————, Hubert M. Lipinski, Richard H. Miller, and Robert H. Randolph, *ARPA Policy-Formulation Interrogation Network*, Semiannual Technical Report to Advanced Research Projects Agency, April 1973.

Bavelas, Alex, *Teleconferencing: Background Information*, Arlington, VA: Institute for Defense Analyses Research Paper P-106, November 1973. NTIS*: AD-601 924.

———————, *Teleconferencing: Guidelines for Research*, Arlington, VA: Institute for Defense Analyses Research Paper P-107, November 1963. NTIS*: AD-601 925.

Becker, Howard, *Systematic Sociology*, New York: John Wiley and Sons, 1932.

Belden, Thomas G., *Teleconferencing: Procedures*, Arlington, VA: Institute for Defense Analyses Research Paper P-111, November 1963. NTIS*: AD-601 928.

Bennett, John L., *User Acceptance of Decision Support Systems: The Role of an Integrating Agent*, IBM Research Laboratory, RJ1502, January 22, 1975.

Berkeley, Edmund C., "The Personality of the Interactive Programmed Computer," *Computers and Automation*, December 1969.

Boies, Stephen J., *User Behavior on an Interactive Computer System*, IBM Report RC 4169, January 1973.

Bretz, Rudy, *Omaha Veterans Hospital Closed-Circuit TV System: A Case Study*, Rand Corporation Working Note WN-8901-MRC, December 1972.

———————, *Selection of Appropriate Communication Media for Instruction: A Guide for Designers of Air Force Technical Programs*, Rand Corporation Report R-60-PR, February 1971.

———————, *Taxonomy of Communication Media*, Rand Corporation Report R-697-NLM/PR, January 1971.

———————, *Teleconferencing: Research and Development in Britain*, Rand Corporation Working Note WN-8393, August 1973.

———————, *Two-Way TV Teleconferencing for Government: The MRC-TV System*, Rand Corporation Report R-1489-MRC, April 1974.

British Columbia Telephone Company, *An Experiment in Conference T.V.*, 1974.

Brockhoff, Klaus, D. Kaerger, and H. Rehder, *The Performance of Forecasting Groups in Computer Dialog and Face-to-Face Discussion*, Brussels: European Institute for Advanced Studies in Management, EIASM WP 74-11, March 1974.

Campbell, Donald J., and Julian C. Stanley, *Experimental Designs for Research*, Chicago: Rand McNally, 1963.

Carroll, J. Douglas, and Myron Wish, "Multi-Dimensional Scaling: Models, Methods, and Relevance to Delphi," in M. Turoff and H. Linstone, eds., *The Delphi Method: Techniques and Applications*, Reading, MA: Addison-Wesley, 1975.

Carter, George, *Second Generation Conferencing Systems*, Computer-based Education Research Laboratory, University of Illinois, 1973.

Casey-Stahmer, Anna E., and M. Dean Havron, *Planning Research in Teleconference Systems*, McLean, VA: Human Sciences Research, Inc., October 1973.

Cavert, C. Edward, *Procedures for the Design of Mediated Instruction*, State University of Nebraska Project, 1972.

Champness, B. G., *Attitudes Towards Person-Person Communications Media*, London: Communications Studies Group, 1972.

————————, *The Effectiveness and Impact of New Telecommunications Systems*, Stockholm: Symposium on Human Factors and Telecommunications, 1972.

Chapanis, Alphonse, "The Communication of Factual Information through Various Channels," *Information Storage and Retrieval*, vol. 9, 1973, p. 224.

————————, "Interactive Human Communication," *Scientific American*, March 1975, p. 36.

————————, "Prelude to 2001: Explorations in Human Communications," *American Psychologist*, November 1971.

————————, R. Ochsman, R. Parrish, and G. Weeks, "Studies in Interactive Communication: The Effects of Four Communication Modes on the Behavior of Teams during Cooperative Problem-Solving," *Human Factors*, December 1972.

————————, and Charles M. Overbey, "Studies in Interactive Communication: III. Effects of Similar and Dissimilar Communication Channels and Two Interchange Options on Team Problem-Solving," *Perceptual and Motor Skills*, vol. 38, 1974.

Communications Studies Group, *Annotated References*, December 1969. (Address: 22 Gordon Street, London WC1H OQB, England; Telephone: 01-387-7255).

————————, *Bargaining at Bell Laboratories*, London: CSG, E/71270/CH, 1971.

————————, *Conflicts of Interest and Conflicts of Opinion in an Experimental Bargaining Game Conducted Over Three Media*, London: CSG, E/71245/SH, 1971.

————————, *Conflicts of Opinion and Medium of Communication*, London: CSG, E/72001/SH, January 1972.

————————, *Cooperation and Competition in an Experimental Bargaining Game Conducted Over Two Media*, London: CSG, E/71160/SH, 1971.

————————, *The Costs of Travel and Telecommunication*, London: CSG, P/70220/RD, October 1970.

————————, *The Effects of Medium of Communication on Persuasion, Bargaining, and Perceptions of the Others*, London: CSG, E/73100/SH, 1973.

————————, *The Efficiency of Information Transmission: A Preliminary Comparison Between Face-to-Face Meetings and the Telephone*, London: CSG, P/70240/CH, May 1970.

————————, *Experimental Research Team: October 1971 to January 1972*, London: CSG, P/72050/CH, January 1972.

————————, *Face-to-Face Contacts in Government Departments*, London: CSG, P/71270/RD, September 1971.

————————, *Final Report*, London: CSG, P/73273/EL, September 1973.

————————, *The Impact of Telecommunications and Automation on the Office Function*, London: CSG, P/71349/RD, 1971.

————————, *Interim Report: July 1971*, London: CSG, B/71218/RD, July 1971.

————————, *Needs, Technology, Effectiveness, and Impact*, London: CSG, P/71128/RD, May 1971.

————————, *Projections of Office Location in Great Britain at Year 2001*, London: CSG, P/72048/PY, January 1972.

————————, *The RMT Teleconference System*, London: CSG, P/72024/RD, January 1972.

————————, *The Scope of Person-to-Person Telecommunications in Government and Business*, London: CSG, P/73272/EL, September 1973.

————————, *Support Research Team: February 1971 to May 1971*, London: CSG, P/71136/RD, May 1971.

————————, *Support Research Team: June 1971 to September 1971*, London: CSG, P/71275/RD, September 1971.

————————, *The Telecommunications Impact Model, Stages I and II*, London: CSG, P/72031/CL, January 1972.

————————, *The Telecommunications Impact Model, Stages III and IV*, London: CSG, P/72031/PY, January 1972.

Connell, Stephen, *The 1973 Office Communications Survey*, London: Communications Studies Group, P/74-67/CN, 1974.

Connors, Mary M., *Teleconferencing Systems: Current Status and Effects on the User Population*, Stanford University Area Exams, Department of Communications, December 1973.

Conrath, David W., "Teleconferencing: The Computer, Communication, and Organization," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications*, The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 145-146.

————————, and James H. Bair, "The Computer as an Interpersonal Communication Device: A Study of Augmentation Technology and its Apparent Impact on Organizational Communication," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 121-128.

Davies, Donald W., Christopher R. Evans, and David M. Yates, "Human Factors in Interactive Teleprocessing Systems," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 491-496.

Day, Lawrence H., "The Future of Computer and Communications Services," *AFIPS Conference Proceedings*, 1973.

Dickson, Edward M., and Raymond Bowers, *The Video Telephone, A New Era in Telecommunications*, National Science Foundation Report NSF-RA-S-73-004, 1972.

Elton, Martin, *The Use of Field Trials in Evaluating Telemedicine Applications*, in cooperation with Busch Center, University of Pennsylvania, 3733 Spruce Street, Philadelphia, PA 19174, 1973.

Englebart, D. C., "The Augmented Knowledge Workshop," *1973 Joint Computer Conference, AFIPS Conference Proceedings*, 1973.

————————, "Coordinated Information Services for a Discipline-or-Mission-Oriented Community," *Second Annual Computer Communications Conference*, January 1973.

————————, "Intellectual Implications of Multi-Access Computer Networks," *Interdisciplinary Conference on Multi-Access Computer Networks*, April 1970.

Etzioni, Amitai, "Minerva: An Electronic Town Hall," *Policy Sciences*, vol. 3, no. 4, 1972.

————————, et al., *Preliminary Findings of the Electronic Town Hall Project (MINERVA)*, Report to National Science Foundation, 1972.

Ewald, William R., Jr., *ACCESS, Santa Barbara Regional Pilot Process*, National Science Foundation, July 1973.

————————, *Graphics for Regional Policy-Making, A Preliminary Study*, National Science Foundation, August 1973.

Glenn, Edmund S., *Language and Cultural Factors*, Arlington, VA: Institute for Defense Analyses Research Paper P-109, November 1973. NTIS*: AD-601 926.

Goldmark, Peter C., *Communications Technology for Urban Improvement*, Committee on Telecommunications, National Academy of Engineering, 1971.

————————, *The New Rural Society*, Fairfield, CN: Fairfield University, 1973.

Gould, John D., Walter J. Doherty, and Stephen J. Boies, *Bibliography of Behavioral Aspects of On-Line Computer Programming*, IBM Report RC 3513, August 1971.

Hall, Thomas, *Implementation of an Interactive Conference System*, Proceedings of the 1971 Spring Joint Computer Conference, 1971.

Hare, A. Paul, Edgar F. Borgatta, and Robert F. Bales, *Small Groups: Studies in Social Interaction*, New York: Alfred A. Knopf, 1966.

Harkness, Richard, "Communication Innovations, Urban Form and Travel Demand: Some Hypotheses and a Bibliography," *Transportation*, no. 2, 1973.

————————, *Telecommunications Substitutes for Travel: A Preliminary Assessment of Their Potential for Reducing Urban Transportation Costs*, Ph.D. Dissertation, University of Washington, University Microfilms Catalog No. 73-27, 662, 1973.

Havron, M. Dean, "Obstacles to the Acceptance of Teleconference Systems," *18th International Congress of Applied Psychology*, July 1974.

————————, and Mike Averill, *Questionnaire and Plan for Survey of Teleconference Needs among Government Managers*, Human Sciences Research, Inc., November 30, 1972.

Hebditch, David Leroy, "Terminal Systems for Real People," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 497-504.

Heiliger, Edward M., *Teaching Information Retrieval Using Telediscussion Techniques*, Kent State University, 1972. NTIS*: ED-058 905.

Hemphill, John K., and Charles M. Westie, "The Measurement of Group Dimensions," *The Journal of Psychology*, vol. 29, 1950, pp. 325-342.

Hormann, Aiko M., *A Man-Machine Synergistic Approach to Planning and Creative Problem-Solving*, Parts 1 & 2, Systems Development Corporation, April 1970.

Institute for the Future, *Social Assessment of Mediated Group Communication: A Workshop Summary*, March 1974.

Johansen, Robert, and Richard H. Miller, *Commentary on the Use of FORUM in a Research Environment*, Institute for the Future, September 1973.

————————, Richard H. Miller, and Jacques Vallee, "Group Communication through Electronic Media: Fundamental Choices and Social Effects," *Educational Technology*, August 1974.

————————, and J. Schuyler, "Computerized Conferencing in an Educational System: A Short-Range Scenario," in M. Turoff and H. Linstone, eds., *The Delphi Method: Techniques and Applications*, Reading, MA: Addison-Wesley, 1975.

Katzman, Natan, *The Impact of Communication Technology: Some Theoretical Premises and Their Implications*, prepared for National Institutes of Health Information Science Training Program Colloquium, Stanford University, Spring 1973.

Kite, W. Richard, and Paul C. Vitz, *Teleconferencing: Effects of Communication Medium, Network, and Distribution of Resources*, Arlington, VA: Institute for Defense Analyses, March 1966. NTIS*: AD-636 143.

Kollen, James H., and Jacques Vallee, eds., *Travel/Communication Relationships*, Bell Canada, July 1974.

————————, and John Garwood, *The Replacement of Travel by Telecommunications*, 18th International Congress of Applied Psychology, July 1974.

————————, and John Garwood, *Travel/Communication Tradeoffs: The Potential for Substitution Among Business Travellers*, The Business Planning Group, Bell Canada, April 1975.

Kupperman, Robert H., and Richard H. Wilcox, "Interactive Computer Communications Systems--New Tools for International Conflict Deterrence and Resolution," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 469-471.

————————, Richard H. Wilcox, and Harvey A. Smith, "Crisis Management: Some Opportunities," *Science*, February 7, 1975, pp. 404-410.

Laffal, Julius, "Contextual Similarities as a Basis for Inference," in George Gerbner, ed., *The Analysis of Communication Content*, New York: John Wiley, 1969.

————————, *Pathological and Normal Language*, New York: Atherton Press, 1965.

Lakin, Fred, *Media Design for a Working Group Display*, Palo Alto, CA, January 1974.

Larimer, George S., and W. Ward Sinclair, "Some Effects of Two-Way Television on Social Interaction," *AV Communication Review*, vol. 17, no. 1, Spring 1969.

Leonard, Eugene, et al., "Minerva: A Participatory Technology System," *Bulletin of the Atomic Sciences*, November 1971.

Licklider, J.C.R., and R. W. Taylor, "Computers as a Communications Device," *Science and Technology*, April 1968.

Lipinski, Andrew J., Hubert M. Lipinski, and Robert H. Randolph, "Computer-Assisted Expert Interrogation, A Report on Current Methods Development," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications*, The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 147-154.

Lipinski, Hubert M., and R. H. Miller, "FORUM: A Computer-Assisted Communications Medium," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974.

————————, and Robert H. Randolph, "Conferencing in an On-Line Environment: Some Problems and Possible Solutions," *Proceedings of the Second Annual Computer Communications Conference*, 1973.

Lucas, Henry C., Jr., "Computers in the Service of Man: The Computer Professional in an Alien Subculture," *Proceedings of ACM 73* (Annual Conference), Atlanta, August 1973.

Macon, Nathaniel, and John D. McKendree, "EMISARI Revisited: The Resource Interruption Monitoring System," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 89-92.

Mann, William C., James A. Moore, James A. Levin, and James H. Carlisle, *Observation Methods for Human Dialogue*, Information Sciences Institute, University of Southern California, ISI/RR-75-33, June 1975.

McGrath, Joseph E., and Irwin Altman, *Small Group Research*, New York: Holt, Rinehart & Winston, 1966.

Mitre Corporation, *Technical and Economic Analysis of Interactive Television*, November 1973.

Morris, S., and G. Morgan, *Human Responses to Sulfur Pollutants: Proceedings of a Computer-Based Conference*, Brookhaven National Laboratory, Upton, NY, November 1974.

National Academy of Engineering, *Communications Technology for Urban Improvement*, June 1971.

Noel, Robert, *Polis: A Computer-Based System for Simulation and Gaming in the Social Sciences*, Department of Political Science, University of California, Santa Barbara, September 1972.

O'Neill, John J., Joseph T. Nocerino, and Philip Walcoff, *Benefits and Problems of Seven Exploratory Telemedicine Projects*, The Mitre Corporation, MTR-6787, February 1975.

Orlansky, Jesse, *Feasibility of a Research and Development Program*, Arlington, VA: Institute for Defense Analyses Research Paper P-105, October 1963. NTIS*: AD-601 923.

Osgood, C. E., G. H. Suci, and P. H. Tannenbaum, *The Measurement of Meaning*, Urbana, IL: University of Illinois Press, 1957.

Paulden, Sidney, "Talking through your computer," *The Financial Times*, January 27, 1975, p. 6.

Pierce, J. R., *Communication and Computers*, Bell Labs, 1967.

————————, *Future Technology of Communications*, Bell Labs, 1970.

Polishuk, Paul, "Telecommunications and The Energy Crisis," *Telecommunications*, February 1974, pp. 23-24, 56.

Political Institutions Simulation Laboratory, Department of Political Science, University of California, Santa Barbara, "The 'POLIS Network' for Resource-Sharing in Simulation and Gaming" (descriptive outline), Spring 1974.

Price, Charlton R., *Conferencing via Computer-Cost/Effective Communication for the Era of Forced Change*, Washington, DC: George Washington University, IIAP/PPSST Special Report, January 1974.

Pye, Roger, Brian Champness, Hugh Collins, and Stephen Connell, *The Description and Classification of Meetings*, London: Communications Studies Group, P/73160/PY, June 1973.

Reid, Alex, *New Directions in Teleconferencing Research*, a report prepared for the Sloan Commission on Cable Communications, June 1971.

————————, "What Telecommunication Implies," *New Society*, December 30, 1971.

Renner, Rod, *Conference Systems User Guide*, TM-225, Office of Emergency Preparedness, AD-756-813, November 1972.

————————, et al., "EMISARI: A Management Information System Designed to Aid and Involve People," *COINS* (International Symposium on Computer and Information Sciences), December 1972.

Rouse, William B., *SOLVER, A Group Computer Interactive Package for Problem-Solving*, Cambridge: Massachusetts Institute of Technology, Community Dialog Project, Report No. 4, July 1973.

————————, and Thomas B. Sheridan, *Utility Approach to Group Decision Making*, Cambridge: Massachusetts Institute of Technology, Community Dialog Project, Report No. 2, July 1973.

Schneidman, Edwin S., *The Logics of Communication: A Manual for Analysis*, China Lake, CA: U.S. Naval Ordnance Test Station, 1966.

Schuyler, J., and R. Johansen, "'ORACLE': Computerized Conferencing in a Computer-Assisted Instruction System," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications*, The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 155-160.

Seyler, A. J., *On Some Fundamental Aspects of Teleconferencing*, Melbourne, Australia: Research Labs, Australian Post Office Headquarters (to be published).

Shannon, Claude E., and Warren Weaver, *The Mathematical Theory of Communications*, Urbana, IL: University of Illinois Press, 1949.

Sheridan, Thomas B., "Citizen Feedback and Societal Systems," *Technology Review*, January 1971.

————————, "Technology for Group Dialogue and Social Choice," *Proceedings of the Fall Joint Computer Conference*, 1971.

Short, J. A., *Telecommunications Systems and Negotiating Behavior*, Stockholm: Symposium on Human Factors and Telecommunications, 1972.

Sinaiko, H. Wallace, *Teleconferencing: Preliminary Experiments*, Arlington, VA: Institute for Defense Analyses Research Paper P-108, November 1963. NTIS*: AD-601 932.

Stapley, Barry, *A Comparison of Field Trials of Teleconferencing Equipment*, London: Communications Studies Group, P/74244/ST, 1974.

Stephan, F., and E. Mishler, "The Distribution of Participation in Small Groups: An Exponential Approximation," *American Sociological Review*, vol. 17, 1952.

Stetten, Kenneth J., and John L. Volk, *Interactive Television*, vol. 1, The Mitre Corporation, May 1973.

Stewart, Thomas R., and Jeffrey E. Carter, *POLICY: An interactive computer program for externalizing, executing, and refining judgmental policy*, Boulder, CO: Institute of Behavioral Science, University of Colorado, Report No. 159, June 1973.

Thompson, Gordon B., *An Assessment Methodology for Evaluating Communications Innovations*, Bell Northern Research, July 1974.

————————, "A Socially Responsible Approach to Communication System Design," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 445-448.

————————, *The Greening of the Wired City*, Ottawa: Bell Northern Research, 1971.

————————, "Moloch or Aquarius," *The*, February 1970.

————————, "Three Characterizations of Communications Revolutions," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications*, The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 36-37.

Turoff, Murray, "Computerized Conferencing and Real Time Delphis: Unique Communication Forms," in *Computer Communication Today and Up to 1985*, The Second International Conference on Computer Communication, Stockholm, August 12-14, 1974, pp. 135-142.

————————, "DELPHI + Computers + Communications = ?," in Cetron and Ralph, eds., *Industrial Applications of Technological Forecasting*, Wiley-Interscience, 1971.

————————, "Delphi and Its Potential Impact on Information Systems," *AFIPS Conference Proceedings*, vol. 39, 1971.

————————, "Delphi Conferencing: Computer-Based Conferencing with Anonymity," *Technological Forecasting and Social Change*, no. 2, 1972.

————————, "Human Communication," *EKISTICS*, June 1973.

————————, "Human Communication via Data Networks," *Computer Decisions*, January 1973.

————————, "'Partyline' and 'Discussion' Computerized Conference Systems," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications*, The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 161-171.

————————, "Potential Applications of Computerized Conferencing in Developing Countries," *Herald of Library Sciences*, April-July 1973.

Umpleby, Stuart A., "Is Greater Citizen Participation in Planning Possible and Desirable?," *Technological Forecasting and Social Change*, no. 4, 1972.

————————, "Structuring Information for a Computer-Based Communications Medium," *1971 Fall Joint Computer Conference, AFIPS Conference Proceedings*, 1971.

————————, and Valarie C. Lamont, *Social Cybernetics and Computer-Based Communications Media*, Report to National Science Foundation, Grant GZ 2538, June 1973.

Vallee, Jacques, "Network Conferencing," *Datamation*, May 1974.

————————, and Gerald Askevold, "Geologic Applications of Network Conferencing: Current Experiments with the FORUM System," Proceedings of the Annual Meeting of the American Chemical Society, August 1975.

————————; Robert Johansen; Robert H. Randolph, Consultant; and Arthur C. Hastings, Consultant; *Group Communication through Computers, Volume 2, A Study of Social Effects*, Institute for the Future, Research Report R-33, November 1974.

————————, R. Johansen, and K. Spangler, "The Computer Conference: An Altered State of Communication?," *The Futurist*, June 1975.

————————, Hubert M. Lipinski, and Richard H. Miller, *Group Communication through Computers, Volume 1, Design and Use of the FORUM System,* Institute for the Future, Research Report R-32, July 1974.

————————, et al., letter to the editor, *Science,* April 18, 1975, p. 203.

Weber, Dianne, *Teleconferencing, A Bibliography,* Madison, WI: EDSAT Center, University of Wisconsin, EDSAT Publication Series, no. 2, February 1971.

Weston, J. R., *Teleconferencing and Social Negentropy,* Montreal: International Communication Association, April 1973.

————————, and C. Kristen, "Dimensions of Interpersonal Atmosphere, Reciprocity, and Perceptual Accuracy in Mediated Groups," *18th International Congress of Applied Psychology,* July 1974.

————————, and C. Kristen, *Teleconferencing: A Comparison of Attitudes, Uncertainty and Interpersonal Atmospheres in Mediated and Face-to-Face Group Interaction,* Ottawa: The Social Policy and Programs Branch, Department of Communications, December 1973.

————————, C. Kristen, and S. O'Connor, *Teleconferencing: A Comparison of Group Performance Profiles in Mediated and Face-to-Face Interaction, Report #3,* Ottawa: The Social Policy and Programs Branch, Department of Communications, April 1975.

Wilcox, Richard H., "Computerized Communications, Directives, and Reporting Systems," *Information and Records Administration Conference,* May 19, 1972.

————————, and R. A. Kupperman, "EMISARI--An On-Line Management System in a Dynamic Environment," in Stanley Winkler, ed., *Computer Communication: Impacts and Implications,* The First International Conference on Computer Communication, Washington, DC, October 24-26, 1972, pp. 117-120.

Williams, Ederyn, *Medium or Message: Interpersonal Preferences and Telecommunications,* Liverpool: Annual Conference of British Psychological Society, 1973.

————————, and Susan Holloway, *The Evaluation of Teleconferencing: Report of a Questionnaire Study of Users' Attitudes to the Bell Canada Conference Television System,* London: Communications Studies Group, P/74247/WL, 1974.

Wilson, Stewart W., "Interactive Lectures," *Technology Review,* January 1972.

Wolek, Francis W., "Preparation for Interpersonal Communication," *Journal of the American Society for Information Science,* January-February 1972, pp. 3-10.

2665

3 9001 01341 4019

DEMCO