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**THE EFFECT OF VOICE INPUT  
ON INFORMATION EXCHANGE  
IN COMPUTER SUPPORTED  
ASYNCHRONOUS GROUP COMMUNICATION**

A thesis submitted in partial fulfilment of  
the requirements of the degree of  
Doctor of Philosophy in Computer Science  
at the University of Waikato by

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## ABSTRACT

Computer support for group communication in the business environment is examined. Study of group activities in videotaped business meetings identified information exchange as the most frequent communication task. Existing computer supported cooperative work (CSCW) systems for group communication are typically based on keyboard input, and this may limit their utility. A voice input prototype system for asynchronous (time separated transactions) group communication (AGC) with simulated conversion to text was developed and tested to determine if advantages over conventional keyboard input computer conferencing existed, and whether this method would have any effect on the information exchange task. An experiment utilizing 12 groups of 5 subjects compared the voice input prototype to an existing keyboard input computer conferencing system for an information exchange task, and over all test subjects, voice input resulted in an increase of the number of words contributed by 151% and an increase in the information facts disclosed by 38%. For test subjects holding a high proportion of available facts, voice input resulted in increases of 204% in words and 39% for facts. Effective input speed was 150 words per minute for voice input. These results imply that for future asynchronous group communication systems supporting information exchange, incorporation of voice input capability, coupled with large vocabulary, connected word, speaker independent speech recognition should be considered.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Thesis Statement

Computer supported group communication can be successful if supported by appropriate technology and focussed on specific requirements. A voice input interface for asynchronous, computer mediated group communication (AGC) will improve the effectiveness of the information exchange component of group communication when compared to an existing system that uses keyboard-based input.

### 1.2 Aims

The aim of this research is to look at the area of computer supported asynchronous group communication, determine an aspect of it where improvements can be made, develop a prototype system incorporating those improvements, design an experiment to test whether the improvements are effective, run the experiment, evaluate the results and draw conclusions.

### 1.3 Problem under Examination

The general problem under examination is whether computer supported technologies for group communication can become an effective tool for business organizations, and effectively used as an alternative or supportive channel of communication for face-to-face group meetings.

An important function within any business organization is co-ordination, which requires effective channels of communication to exchange information among the individual members of that organization. Group communication is an effective channel, in that it allows two way flow of information and reaction. The most frequently used form of group communication is the face-to-face business meeting, typically 5 to 8 people sitting around a conference room table for an hour or so.

One important part of business communication, both group and one-to-one, is synchronous (at the same time), such as face-to-face meetings and interviews, and telephone calls. Synchronous communication is primarily oral (the spoken word), easy

to initiate, and rich in content. As a word is spoken, it is simultaneously received by all listeners present.

A second important part of business communication is asynchronous ("speaking" and "listening", or transmission and reception take place at different times), and includes examples such as memos, letters, reports, notes, electronic mail, faxes and voice mail. All except voice mail are textual in nature, requiring writing or typing and some kind of physical transmission of paper to get the information to the recipient. Asynchronous communication is less disruptive, and easier to keep or file for future reference.

Using computers to support asynchronous group communication is not new, but acceptance of this technology into business organizations has not been as widespread as might be expected. Why is this, and what can be done? This research looks at what makes up synchronous group communication in business meetings, and then examines how computer technology has been used in the past, and may be used in the future, to support asynchronous group communication.

Therefore, there is a particular narrow focus of the problem examined by this research:

1. group communication
2. in business environment
3. asynchronous, computer assisted
4. task: information exchange

#### **1.4. Group Communication Issues Relevant to this Focus**

This work examines the feasibility of providing an alternative (or additional) medium for group communication, beside that of face-to-face group discussion. Face-to-face discussions provide duplex (simultaneous forward and reverse) communication channels, and both verbal and non-verbal means of passing information.

For the speaker to listener forward channel, verbal information is carried by words, but also through voice tones, word emphasis, and rate of speaking. In this same speaker to listener forward channel, non-verbal information can be transmitted through eye contact, body kinesics, and facial expression.

For the listener to speaker reverse channel, information which provides feedback to the speaker can be provided through audible sounds, such as grunts, laugh, or a sigh, while visual feedback can be given by eye contact (or lack of), body kinesics and

position, and facial expression. Therefore, addressing word exchange alone may not be sufficient to enable effective group communication.

What percentage of information content in group communication is carried in the speaker's words alone? How important is the reverse channel (listener to speaker) in on-the-fly modification of the speaker's information being delivered through the forward channel? The tradeoffs here seem to be clear. Old skills in face-to-face group communication may be complemented by new skills dealing with computer technology. The sociability of a face-to-face meeting may have to be exchanged for the improved effectiveness and efficiency (if possible) of computer mediated communication.

### **1.5. Changes in Business Relevant to this Focus**

Business organizations are today undergoing dramatic change. However, the next decade of change may well be evolutionary rather than revolutionary, with continuance of the changes already underway. What are those changes? Trends established over the last twenty years include continued growth in the service sector, and a decline in the numbers of people employed in manufacturing, both as absolute and as a percentage, and both are likely to continue. This means more workers in a business organization will be considered to be "information workers", and they will need the information technology tools to acquire and manipulate that information. Tariff barriers and protectionism are likely to continue to drop, forcing more companies to compete in global markets, again putting emphasis on acquisition of timely information.

At the individual business level, smaller staffs will handle larger turnovers. Faster and faster reactions and decisions will be required to remain competitive. Firms will continue to put a high priority on increasing the effectiveness of communication, and the present rapid growth of some supporting communication technologies (cellphone, fax, email) may indicate more is to come.

The rate of growth in the use of information technology by business is perhaps more open to speculation. Will the elusive "one pc/terminal per desk" become a reality in the next few years? Will technical advances in networking, computer interconnection, and digital telecom services be reflected in rapidly increasing use of these techniques? New technologies which will likely become economically viable include the continued power and capacity enhancement of PC on the desk, the evolution of the networked PC as an alternative to mainframe processing, the continued refinement of speech recognition, data compression and manipulation of video images and other large binary objects, and enhanced availability of cheap, high capacity disks.

In speculating what might happen in the use of information technology by business, it is interesting to draw the analogy of the telephone. Here was an interesting toy that evolved into an essential business tool. Use followed the technology, rather than a need defining technology requirements. The saturation level coverage today of the telephone could be examined through its adoption cycle, cost curve, and ratio of units per head of population. The characteristics of interconnectability, a shallow learning curve, and a convenience advantage (cut down travel time) managed to offset the major disadvantage of not being able to see the other party.

## **1.6. A Narrow Focus on Information Exchange**

There are many activities undertaken during a group face-to-face business meeting. Making decisions, achieving consensus, and team building are important, but information exchange is perhaps a foundation for all of them. Current technology may not be appropriate for all of these tasks, but the "fit" for the information exchange component of group business meetings may be sufficient. Therefore, this work will focus on the information exchange part of group meetings.

## **1.7 Summary - Objectives of this Research**

This thesis therefore addresses the following objectives:

1. To investigate the nature of group communication, particularly as applied to a business environment.
2. To investigate how computer technology has been used, and might be used, to support group communication in a business environment.
3. To specify a new aspect of a group communication software system which may improve this capability.
4. To construct, for the purposes of testing, a prototype asynchronous group communication system, with the improvement implemented.
5. To design and undertake an experiment to test the prototype in comparison to other forms of group communication, both face-to-face (meeting) and electronic (computer conferencing)
6. To report on the findings of the experiment
7. And to draw conclusions

## CHAPTER 2

# LITERATURE SURVEY OF SUPPORTING TECHNOLOGIES FOR GROUP COMMUNICATION

### 2.1 Introduction

This chapter will cover the current literature under the main groupings of:

- asynchronous group communication
- other computer supported group communication
- group psychology and sociology
- voice capture and processing

### 2.2 Asynchronous Group Communication

#### 2.2.1 Definition and categories

Group communication can take place through a number of media. The most common and widely used is the face-to-face meeting, which can be characterized by a high bandwidth (amount of information transferred per unit of time), high interactivity (turn sharing), multi-channel (both forward and reverse channels between speaker and listeners), and synchronous (all participants temporally linked).

The last characteristic, time, can be used to divide group communication media into two major categories:

a) Synchronous (all participants interacting at the same time)

- simultaneous face-to-face meeting
- simultaneous video & voice teleconference
- simultaneous telephone conference call
- computer supported group decision systems

b) Asynchronous (participants connect at different times; contributions stored and retrieved/replayed)

- the voice input Moot prototype discussed later
- computer conferencing
- electronic mail

-exchange of paper documents (copy lists)

Synchronous group communication, using the medium of face-to-face meetings, is a well understood, and well researched area. Technologies which support synchronous group communication from remote locations, such as telephone conference calls and videoconferencing, have appeared over the last few decades, but have not yet attracted widespread popularity.

Asynchronous group communication requires two important shifts from the dominant face-to-face meeting. First, some kind of technology must come between speaker and listener, to enable time delay between contribution and review of comments (capture, storage, replay). Second, the words used to convey information and ideas are likely to be in a textual form rather than oral form, for reasons of efficiency of transmission, storage, and review.

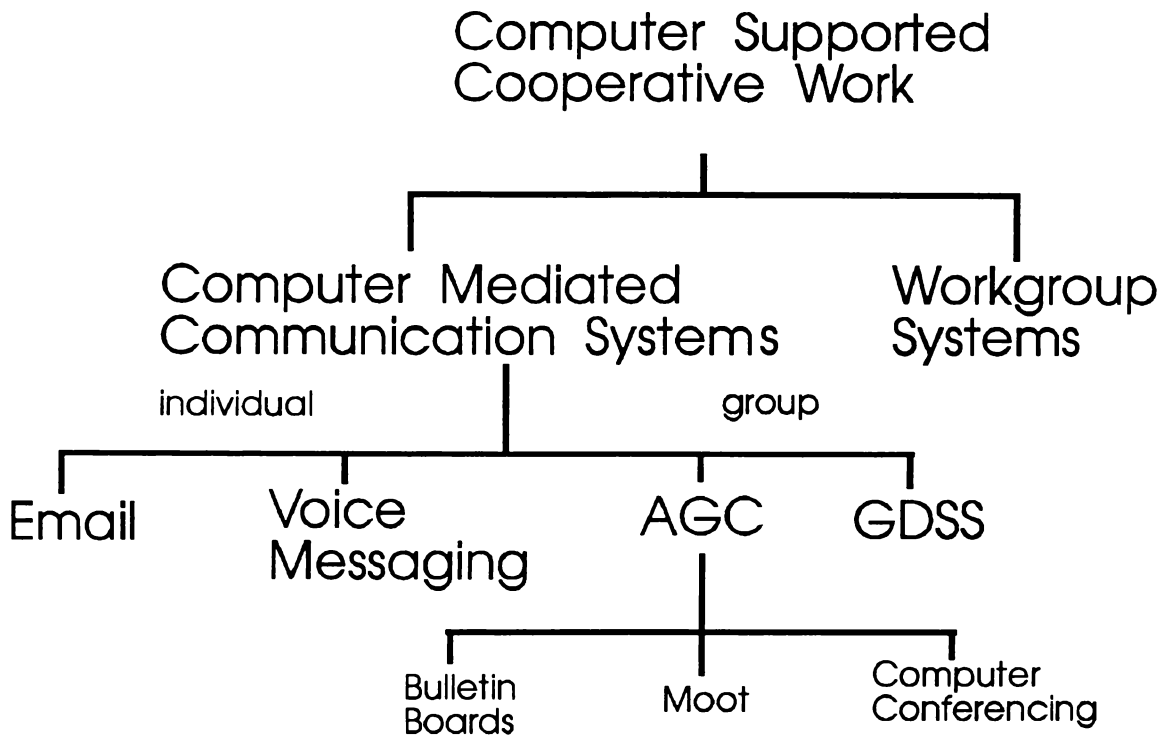
These shifts would be seen by most participants as diminishing the richness, ease of use, and interactivity of face-to-face group communication. If asynchronous group communication is to flourish, then ways must be found to minimize these barriers to use, while maximising the benefits that may be obtained.

### **2.2.2 Where do AGC systems fit in?**

Asynchronous Group Communication (AGC) refers to a class of computer hardware, software and network systems which support and enhance the communication of facts, information, ideas and opinion amongst a group of participants. To focus on the "group" aspect of this definition, the number of members of the group in question is defined for the purposes of this research to be three or more.

Figure 2.1 shows where AGC fits with other group communication technologies. AGC systems may be considered to be a component of Computer Mediated Communication Systems (CMCS). CMCSs comprise a set of communication functions, usually asynchronous, including AGCs (which as group tools include computer conferencing and bulletin boards), other forms of computer supported communication methods which are primarily used in one-to-one communication (such as electronic mail and voice messaging systems), and group decision support systems (GDSS). CMCS and workgroup systems comprise computer supported cooperative work (CSCW) systems.

Figure 2.1 Where AGC Fits



In turn, CMCSs are complementary to the traditional ways in which people communicate with each other. Common forms with a high degree of interaction include telephone calls, face-to-face discussions, and the traditional formal business meeting, while forms with low or zero interaction include a lecture, television broadcast, and print media such as letters, books and newspapers.

Table 2.1 Communication and Interactivity

<u>high interactivity communication</u>		<u>low interactivity communication</u>	
<u>two people</u>	<u>group</u>	<u>two people</u>	<u>group</u>
-telephone	-meeting	-letter	-television
-chat	-video conference	-email	-lecture
	-teleconference	-voice mail	-AGCs

Note that AGCs have been placed in the low interactivity category.

### 2.2.3 Electronic mail

The ancestry of AGC systems can be traced to electronic mail (email), which began to rise in popularity in the early 1970s, as computer systems changed from batch processing financial systems to terminal based on line transaction systems. Terminals began appearing outside the computer department at remote locations, and email became a useful tool for those who had terminal access. The cognitive model for electronic mail was the familiar postal system, and the terminology for common email features included in and out baskets, carbon copies, forward, and delivery confirmation.

Email was rapidly adopted by a number of communities, including computer department technical staff within an organization (who were likely to have a terminal already on their desk) and the academic community of university researchers, who had the benefit of easy access to computer terminals, and the need to have a cheap and fast way of communicating with colleagues at remote locations. Both of these groups had a high level of computer literacy, and when the services were introduced, were quick to embrace email as an essential communication tool.

The first email systems restricted message exchanges only to other users of a particular computer system. The pioneering work of the ARPA network, designed to provide message and data exchange among US Government-funded researchers, showed the benefits of inter-organization connectivity, and was one of the main incentives in the development of various networks of linked computers, such as BITNET, CSNET, EARN and the Unix networks. These networks, primarily spawned in the US university community, ultimately led to standards and protocols for inter-network message exchange on a world-wide basis. [Jennings et al., 1986]

There are a very large number of electronic mail systems in operation today. Most manufacturers of mainframe and minicomputer equipment provide an electronic mail system as part of the operating system or as a very low cost application program. Almost all computer installations have some form of email in operation, at least for the technical people in the computer department, if not for other users in the organization.

While the large mainframe sites automatically provided populations of thousands of users to fuel growth for their inhouse email systems, interconnection and exchange of email between mainframes was slower in coming. The RFC series of header, naming and format standards developed in the ARPA community permitted interchange of email across large numbers of machines, and showed the benefits of interconnection standards. The X400 set of protocols has shown steady, if not spectacular growth since

introduction in the mid 1980s, and will likely form the basis for email interchange in future commercial products. [Vaughan-Nichols, 1990]

LAN email growth began when the explosion of microcomputers in the '80s, turned from standalone machines to local area networks. The characteristic of the typical LAN is still one of relatively small numbers (perhaps 20) on a single LAN segment, but with a growing capability to connect to other LANs and mainframes through bridges, routers and gateways. As the number of people accessible through a LAN email system grows from the tens to the hundreds, the motivation for becoming a regular user of LAN based email also increases rapidly.

#### **2.2.4 Computer conferencing**

As users of email systems gained experience, the limits of the cognitive model of the postal system began to be challenged by desired enhancements. Email could be used for group communication by the use of the carbon copy (cc) feature, which could send copies of the message to a previously defined list of users with a minimum amount of effort on the part of the sender.

However, work was also proceeding on several systems that used the cognitive model of a meeting as the basis for their design. The work of Murray Turoff [Hiltz & Turoff, 1978] in the development of the EIES system at the New Jersey Institute of Technology, and Jacob Palme [Palme, 1985] in the KOM (COM) system developed at Stockholm University deserve particular mention. These new systems were called Computer Conferencing systems, and provided a **contextual** order, both for contributor and reader.

Messages were grouped by broad and narrow subject titles, and generally followed the hierarchy of conferences, topics and messages. Rather than a stream of unrelated and randomly arriving messages on a variety of topics, messages were placed, and reviewed, in the context of previous and subsequent messages on the same topic. Selective membership in each of the conferences permitted groups to control their membership, and individuals to only participate in discussions of personal interest. This organization more closely matched the paradigm of a meeting of a group of people, while email functionality closely matched the model of a memorandum, letter or telephone call between two people.

By the mid 1980s, there were perhaps two dozen computer conferencing systems in operation, primarily based on university machines, and having populations of active users up to several thousand. University systems were in operation at NJIT (EIES), Stockholm (KOM), Michigan (Confer) and Guelph (CoSy). Some vendors (both

educational and commercial) were offering commercial versions of conferencing software for in-house installations, including Parti, CoSy, PortaCOM, Notes and Caucus. [Osgood, 1985]

Among the first purely commercial conferencing system service bureaus was the Byte Information Exchange (BIX), launched by Byte magazine in the US. BIX users had reached the level of 25,000 by 1987. Other popular information services providers in the US (CompuServe, Dialog) have user populations of several hundred thousand, and provide a bulletin board / computer conferencing function as one of their services. It is interesting to note that the BIX system was introduced as a prototype of how electronic and printed page publishing of technical material might evolve in the future, and was strongly funded as a development project by Byte's parent organization, McGraw-Hill.

The characteristic features of most computer conferencing systems would include a conference-topic-message hierarchical organization, a selective group membership scheme, and a current message pointer. The following discussion is based on the CoSy conferencing system [University of Guelph, 1986].

The hierarchical organization is structured to provide context to the comments made by conference members. Conferences are the highest level of structure, and have the analogy of a normal face-to-face meeting. Topics are sub-discussions, like agenda items, within the main conference area of interest. Members contribute individual messages, or comments, in chronological sequence. These comments can be linked to previous or subsequent comments, thus creating possible multiple threads of linked sequences of comments within a topic discussion.

The selective group membership of conferencing systems permits people to join, and stay current, with a large number (10 to 20 or more) of ongoing discussions of particular interest to that person, but that number is likely to be a small subset of all discussions (perhaps hundreds) currently active on the system. Conferences have differing membership subsets of all system users, like a meeting might contain a subset of all employees of an organization. Some conferences are open entry, like a public meeting; others are closed (invitation only) or confidential. The moderator of the conference assumes some of the roles of a meeting chairperson, such as granting entry, in some cases granting permission to speak, removing participants, and possibly summarising discussion sequences.

A current message pointer is maintained for each user, in each of the topics of the conferences of which they are a member. This pointer indicates the "last seen" comment in that conference/topic's chronological sequence of comments. When the

user signs on the next time, the system can automatically present all new comments entered since the "last seen". Previously seen older comments can be reviewed as needed. All comments are kept on the system, subject to available space constraints.

The growth of computer conferencing, since the first systems were introduced in the 1980s, has not been spectacular, compared to growth in other areas of the computer industry. There are still only a relatively small number of full featured computer conferencing systems operating today (less than 500) with perhaps only 20 having active user populations above 2000.

### **2.2.5 Bulletin boards**

While the development of email and computer conferencing systems resulted from traditional mainframe system development methodologies, the introduction and rapid spread in popularity of microcomputer based bulletin board systems (BBS) followed the introduction of cheap hardware which allowed the enthusiast with a home computer, some free software and a modem hooked to a telephone jack to be in operation as a provider of a number of services [Bowen & Peyton, 1988]. While not fitting easily into the category of asynchronous group communication systems, BBSs are important to consider because of the number of installations, and their popularity among their users.

One of the primary reasons for the popularity of the BBS is the ability to upload free software at no cost. BBS operators stock their machines with programs uploaded from other BBSs, and usually provide access at no charge. As the name implies, BBSs have a noticeboard capability, where users can post notices that any other user could read, as well as providing private email to other users of the system. Some BBS developed a protocol and message exchange technique (FidoNet) where private messages could be rippled across co-operating BBSs until they found their way to the intended recipient on a remote BBS. There are a large number of BBSs in operation today (perhaps 20,000 worldwide), with the major portion being IBM PC or compatible based, and running a version of one of a few types of popular BBS software (RBBS, Opus/Fido)

### **2.2.6 Academic network group systems**

The growth and interconnection of large numbers of academic computers on the research networks [Landweber et al., 1986] was driven to a large extent by the facility of electronic mail exchange. However, some specialized group communication support systems began to appear.

Bitnet provides a service called listservers, which distribute copies of email messages posted to a specific topic "list" to users registered for that list. Not every Bitnet node operates a listserv, but there are several (in the order of 20) operating on machines connected to the network. Users send a request to the list moderator, and ask to be added to the mailing list. New email messages "posted" to the moderator of a specific list on the listserv node, are added to the list, and subsequently re-mailed to all members of that list.

Usenet, the network of Unix machines, developed a similar service called "News", which takes advantage of the Unix UUCP program to easily transfer files from one site to another. News is now available on the internet for all connected machines, and management software has been made available for a number of operating systems [e.g. Huston, 1990]. It presently allows for hierarchies of local and network "conferences", where users can read incoming messages on their local machine and send contributions to one or more of the over 1000 newsgroups active. Megabytes of new contributions flow through the networks each day.

### **2.2.7 Experiences in the use of AGC systems in organizations**

Reviewing 20 studies of information workers, Rice [1984] reports that

"managers spend most of their time communicating (75-80%), of which 60% is oral (phone, face-to-face with individuals, group meetings); only a small amount of managerial time is actually spent in making decisions; communication is greater in situations of greater innovation and uncertainty; and written communication is less likely to capture attention."

Easy physical access to terminal facilities has been reported as positively associated with usage of an electronic messaging system [Rice & Shook, 1988].

Productivity enhancement through the use of computer-mediated communication was examined by Hiltz [1988]. Productivity in the study of research workers was composed mainly of perceived improvements in the quantity and quality of the work, the overall usefulness of the system, and improvements in the ease of reaching people. Time on-line, system software attributes, and subjective satisfaction were found to not be strongly related to productivity improvements. She concluded that social context (characteristics of the individuals, the user groups, and the organizational social structure) have a stronger influence on productivity improvement than hardware and software characteristics of the system.

When introducing new office communication systems, care should be taken to design an appropriate implementation strategy. Ehrlich [1987] provides a set of nine such strategies that were helpful in the implementation of a voice messaging system.

### **2.2.8 Strengths and weaknesses of present AGC systems**

#### **a) Asynchronous connection**

Choosing when to connect allows more efficient scheduling of a day's activities. The flexibility of being able to use a few unscheduled minutes to catch up on group communication, at a time of convenience, is of particular benefit to many AGC users. Connection to an AGC is non-disruptive, unlike a telephone call, pop-in visit, or scheduled meeting might be to the other items on a person's daily agenda.

#### **b) Interactivity**

AGC systems can never achieve the rapid exchanges that are characteristic of face-to-face meetings. What might be covered in five minutes of a face-to-face meeting, can take several weeks in an AGC system for the same number of exchanges to take place.

#### **c) Location independence**

Present AGC systems can effectively be reached through data communication connections, avoiding the need to be present in person at a location that may be quite some geographical distance from the home base of operations. While not perhaps as easily accessible as a telephone call (say from a cellphone), AGC systems provide definite travel reduction advantages.

#### **d) Typing versus talking**

All present AGC systems (except the Moot prototype discussed later) require the user to type comments through a keyboard, instead of simply talking. This raises difficulties for those who have no typing skills. Alternately, users have commented that the ability to edit typed text before it is posted (and to think a bit about how the words will be received) is a significant advantage of AGC systems.

#### **e) Reading from a screen**

Muter et al. [1982] reported that reading text from screens took 25% longer than from paper, although comprehension was about the same, while other studies [Osborne & Holton, 1988] have found no differences when the experiment detail was addressed in a different way. Some users have refused to interact directly with the computer to view messages, and have a secretary print out their messages on paper for review.

## **2.3 Other Group Communication Technologies**

Several other developing technologies are important to note at this point, but will not be discussed in detail.

### **2.3.1 Workgroup systems**

Workgroup systems are tools which support collaborative development of end products. Capital costs for installing these systems are presently quite high, but they serve some particular needs where the economics make sense over traditional methods. Examples include the following:

an editing tool which allows multiple authors to asynchronously contribute to and suggest revisions to a group document

a real time video camera and graphics display system that allows group members at different locations to work with and modify graphic objects, and also see video pictures of other participants and artifacts.

WYSIWIS (what you see is what I see) expresses the idea that all participants can see the same text and graphical information, as well as where users are "pointing". The Colab project at Xerox PARC [Stefik et al., 1987] is a good example of this type of system.

### **2.3.2 Voicemail systems**

Voicemail systems are becoming popular as the newer technology digital telephone PBXs are installed in larger organizations [Perdue et al., 1990]. One of the reasons behind this growth is that the add-on cost of providing the voice mail capability to a digital PBX is relatively low, and all telephone users instantly have the "terminal" sitting on their desk.

Basic manipulation of digitized voice mail messages is possible through a telephone touch-tone keypad, with copying and forwarding functions easy to accomplish. The Etherphone system developed at Xerox PARC [Terry & Swinehart, 1988] is a research base for more advanced integration of voice, text and graphic objects, and the manipulation, editing and storage of those objects.

The development of the voice message Olympic message system is described by Gould et al. [1987]. It is a case history of how a user interface design for a complex system, to be used by many people from a spectrum of cultural and language backgrounds, can be successful if behavioural principles of design are followed.

However, the advantages of voice mail for one-to-one communication may not be easily translated to be of use for interactive group discussion.

### **2.3.3 Teleconferencing (telephone) and video conferencing**

Teleconferencing generally refers to the use of the telephone system to set up a conference call where a number of people in different locations are simultaneously connected and involved in the discussion. New PABX switches usually have features which allow local operators to set up such a call, although many are still handled by the telecom company's operators. Difficulties are often encountered in turn sharing, and as the number of participants increases above four or five, the dissatisfaction level tends to rise as well. It seems that the telephone medium, considered very good for one-to-one communication, does not perform as well in a group communication environment.

Video conferencing involves the use of special video conference centres, connected by a high bandwidth communication channel which permits the two way transmission of both sound and video images. For highly interactive video conferences, the number of centres used is usually two, with perhaps 4 or 5 participants located at each centre. Low interactivity video conferences follow the model of a lecture or panel discussion from a central site, with (usually) audio-only questions or responses from a larger number of sites (perhaps 20 or more) fed through a satellite downlink. Some large organisations have installed video conferencing rooms in their major facilities, allowing managers and others to communicate in group discussions without the cost and disruption of travel. However, these facilities are themselves costly, and somewhat inconvenient to use spontaneously.

### **2.3.4 Group decision support systems**

Hirokawa & Poole, [1986] provide a useful review of group communication, particularly in the area of decision making. Characteristics of group communication have been measured [Vogel et al., 1990] in experiments to determine relationships between group communication and decision quality, group communication and consensus, and group communication and choice shifts

In general, poor group communication usually leads to poor results from the group's activities; therefore, improvement of group communication will not decrease, and likely increase, the quality of the work of the group.

Group decision support systems are typically synchronous, technology supported means of assisting groups to brainstorm ideas, move toward decisions in a planning environment, and address the idea generation stage of a group meeting. The participants meet in a special room, with each having a microcomputer at their place. Ideas and comments made by each participant can be seen (through controlling software) by all other participants. Anonymity is possible, and usually provided during part of the session for contributed opinions.

Group decision support systems, while usually used in a single place, single time mode, are an important area related to asynchronous group communication. They often use the delphi technique for opinion collection, which is inherently asynchronous. They are an important area of current research, and have benefited from significant research funding. Finally, the interface to the GDSS technology between speaker and listener is similar to that required for AGC.

### **2.3.5 Face-to-face meeting augmentation**

Some group communication technologies cover broader areas than just decision support. Cook et al. [1987] describe the activities of software design teams as "brainstorming, exploring, defining design structure, analyzing issues, making task assignments, and resolving problems". They describe the goal for their Project Nick as "meeting augmentation and analysis", which encompasses pre-meeting, face-to-face meeting, and post-meeting aids.

## **2.4 Effects of Technology Support on Group Communication**

### **2.4.1 Information giving / receiving**

In a study of users of the COM conferencing system, Adrianson and Hjelmquist [1988] found that information exchange played the key role in motivating users. When asked why they *started* to use COM, 53% (the highest ranked reason) gave "need for information" as the reason. When asked how COM was useful for work related activities, 83% (again the highest) gave getting information as the reason. Decision making ranked near the bottom as a suitable activity for COM.

### **2.4.2 Problem finding**

Problem finding is the identification of the cause of a problem, where the existence of a problem has been acknowledged, and whose presence is indicated by problem symptoms. Gallupe et al. [1988] investigated the use of a GDSS for the problem finding phase of group decision making. Their findings, in the somewhat narrow context of their experiments, were that use of a GDSS increases the number of alternatives considered, and improves the resulting decision quality. These results held for small (3 person) groups for a problem finding task, for high task difficulty, and to a lesser but still significant level for lower task difficulty problems.

### **2.4.3 Support for problem solving**

Because of human cognitive limitations, (short term memory, distraction), problem solving can be aided by tools that overcome these limitations (i.e. blackboard, piece of paper, recording of minutes). Anecdotal observations of experimental groups using a GDSS [Gallupe et al., 1988] was that use of the system allowed more efficient use of time.

"The system kept track of alternatives that had already been discussed, so that repetitive analysis of the same limited number of alternatives was avoided. The use of the GDSS allowed members to dissociate themselves from alternatives they had entered, enabling more objective evaluation of the alternatives without the necessity of defending previously stated postures."

### **2.4.4 Equality of participation**

Shifting group member participation in the direction of equal participation results in higher quality decisions [Van Gundy, 1981; Zander, 1982]. The use of electronic communication media may increase participation by otherwise reticent members [Foster and Flynn, 1984; Sproull and Keisler, 1986; Siegal et al., 1986]. However, whether reliance on electronic communication will tend to equalize, or merely shift the participation imbalance from those with verbal skills to those with computer literacy skills, is in question.

### **2.4.5 Equity of participation**

Equity relates the quantity of a group's time used when a member speaks, and the contribution of that member to the group task. An obvious inequitable participation example is the blowhard, speaking long but saying little. Electronic communication

can assist in improving equity through the change from "listening" to "reading". In a face-to-face meeting, one can tune out an irrelevant speaker, but cannot simultaneously contribute to the group task. Electronic media permit skimming of contributions deemed to be of less value. Even if the entire content is absorbed, reading is usually faster than listening (typically 300 words per minute reading; typically 110 words per minute listening, constrained by speaking rate). Electronic communication allows the listener more effective control over the proportion of "listening" time given to each speaker, rather than that control resting mainly with the speaker alone. Thus, if the listener is deemed to be the best judge of value of contribution, then shifting control from speaker to listener must improve the equity of the group discussion.

However, in a study [Jarvenpaa et al., 1988] of the effect of groupware on medium sized (7) teams of computer literate software designers, it was concluded that conventionally supported meetings resulted in higher levels of communication thoroughness than technology supported meetings. No improvement was determined in equality of participation, perceived equity of participation or satisfaction levels, although there may have been other factors which affected these outcomes. The authors conclude that

"...group technology can be of limited benefit if the technology is not mature. Additionally, group technology can be counter-productive if the technology does not balance the need for alternative communication channels with the participants ability to manage multiple channels."

#### **2.4.6 Quality of decisions reached**

The impact of computer support on the quality of meeting decisions has been measured in experimental settings by measuring individual's deviation from initial preferences and demonstrating greater choice shift [Siegal et al., 1986] and co-relation between pre- and post-meeting consensus [Watson et al., 1988]. Decision quality of experimental studies may also be evaluated by comparing participant's decisions with those of a panel of experts. No clear picture emerges of whether or not computer support necessarily improves decision quality.

#### **2.4.7 Satisfaction and decision confidence**

Research results on satisfaction with the group decision making process using GDSS have been mixed. Experimental settings with small groups have shown that GDSS use reduces the satisfaction of participants with the group process [Gallupe et al., 1988] or

has no effect. Other studies of GDSS in non-experimental environments show the opposite [Dennis et al., 1990]. This indicates that the actual technology used by researchers (facility, hardware, software, user interface, functionality) is likely an important factor in the satisfaction results. Face-to-face settings for small group decision making using a GDSS result in significantly more satisfaction than those in remote, or distributed settings [Gallupe and McKeen 1990].

#### **2.4.8 Consensus and choice shifts**

Watson et al. [1988] investigated the effect that GDSS had on improving group consensus. Eighty-two small groups (3 and 4 person) were provided one of three structures to support a group task designed to test movement from individual positions to group consensus. Measurement of pre- and post-meeting consensus against the three discussion structures (baseline-no support; manual-paper based procedure; and computer based procedure) indicated that a structure (manual or computer) for discussion aided in reaching consensus over discussions using no structure, but that the computer based version was in fact less helpful than the manual methodology. Use of the computer based GDSS may have imposed additional cognitive load on participants which resulted in less successful outcomes than the non-computer based manual structured discussion technique.

Gallupe and McKeen [1990] confirmed the results of Keisler et al. [1984] that there was less choice shift in groups using GDSS than those that did not, indicating that those using the computer technology were less subject to the persuasive arguments of influential group members.

#### **2.4.9 Large groups**

Much of the published experimental findings have been on small groups (3-6 members). Dennis et al. [1990] report on the usage of a GDSS facility at the University of Arizona by a large (31 members) group from a company for a strategic planning meeting. They find the label of Electronic Meeting Support (EMS) as more descriptive of the use of these class of systems, which have "been used for idea generation, topic discussion, information sharing, knowledge elicitation and consensus building, as well as for decision making".

## **2.5 The Psychology of Group Communication**

### **2.5.1 Small group psychology**

It is beyond the scope, and would dilute the focus of this research to incorporate previous work on the psychology of group communication, which has been extensively studied and reported. The work of Bales [1970; 1972; Bales & Strodtbeck 1969; Bales & Cohen 1979] is frequently cited. Giles & Street [1985] provide a comprehensive bibliography, and discuss some of the important factors under the following structure:

- a) Psychological Variables
  - Self monitoring
  - Extraversion/introversion
  - Dominance/submissiveness
  - Machiavellianism
  - Reticence
  - Apprehension/anxiety
  - Cognitive complexity
  - Field dependence/independence
  - Affiliation/approval
  - Interpersonal distances
  - Attentiveness
  - Pauses
  
- b) Sociodemographic Variables
  - Sex (male/female)
    - verbal behaviours
    - non-verbal behaviours
  - age
  - socio-economic status
  - status/power
  - race/culture
  - handicaps
  
- c) Listener's Evaluation of Speaker
  - Dialect/accent/language used
  - Speech rate
  - Pauses
  - Vocal intensity
  - Vocal pitch
  - Talk duration
  - Self disclosure
  - Language intensity
  - Hedges, polite forms, hesitation
  - lexical diversity

Clearly, face-to-face communication is an extremely rich medium, and the insertion of a computer screen between speaker and listener must decrease the communication

information transferred. However, interpersonal communication does go on without face-to-face exposure; the telephone is the best example, where convenience and distance independence can offset the reduction in communication information.

This is perhaps the objective of computer mediated communication: it will probably never be as rich in signals as face-to-face communication, but perhaps it can have other attributes that partially or wholly offset these shortcomings.

### **2.5.2 Comparison of face-to-face and present AGC**

How can work on asynchronous group communication build on this extensive knowledge base about face-to-face group communication? Perhaps a brief comparison of the two media is appropriate.

The present "typed input" AGC environment is quite different than the environment of a face-to-face meeting. AGC is asynchronous - the interaction between group members is not in "real time". This means participants have more time to reflect before contributing. They are able to seek other sources of information and opinion off line, with no apparent disruptive delay, before responding. Conversely, there is a greatly reduced visual content for AGC participants compared to that experienced by face-to-face participants, which results in a lack of instantaneous support/dissent indicators from other participants. Typed input also results in greatly reduced emphasis and intonation signals readily available in face-to-face discussions.

The research on face-to-face small group communication can be helpful in determining the importance of these non-text carriers of information, and providing ideas on how these shortcomings might be minimized for new AGC designs.

## **2.6 Voice Input and Speech Recognition**

The desire to use speech recognition for computer applications has preceded the ability of this technology to support the common modes of speaking. Human beings (and other sentient animals!) can recognize speech which is connected word (no pauses between words) and speaker independent (understand a variety of people).

Gould et al. [1983] investigated the effect of a simulated listening typewriter without having an automatic speech recognition system in operation. They located a subject in one room and a human typist in a second room, and experimented with both isolated and connected word speech input to their simulated listening typewriter. They were

able to draw conclusions about the application of speech recognition to the problem of interest, without actually having the technology operating.

Newell et al. [1990] followed Gould's study with an examination of a voice input word processing system. The "man behind the curtain" used a machine shorthand transcription system (potential speed 180 wpm; actual operator speed 120 wpm) rather than Gould's 80 wpm typist, allowing the possibility of faster input speeds if required. The subjects used voice input for editing commands as well as raw text. In a partial replication of Gould's experiment, word composition rates were lower (7.9 wpm vs Gould's 11.5 wpm) despite the faster speeds. Efficiency rates (words on final document vs words spoken) were low (39%), reflecting the large number of words required for "hands off" editing, capitalization and punctuation functions.

Both of these researchers were concerned with the required result being a "perfect" typed document, in the same way that a business letter is only sent in perfect form. Their intent was to provide in their simulations the ability to give punctuation and capitalization instructions through speech input, as well as the raw words for the text itself.

Using speech input as commands to a computer software package is another potential use of the technology. Martin [1989] describes a study using speech input for a VLSI design package, as an alternate to keyboard command entry. They found that speech input is faster than typed input, as well as increasing user productivity by providing an additional response channel.

Office applications of speech recognition are reviewed by Noyes & Frankish [1989]. They discuss potential applications in the areas of voice messaging, word processing, data entry, information retrieval, and environmental control. They conclude that currently available speech recognition technology has shortcomings which may be critical for projected office applications. They comment that "there is a suggestion here that the superficial attractiveness of speech recognition technology has cast it as a solution in search of a problem". However, they argue that research should follow application investigation as well as research into voice input interface design.

Several organizations are active in developing speech recognition devices that have potential office application potential. Kurzweil, Dragon Dictate and IBM have large vocabulary products available on the market.

## 2.7 Summary

Asynchronous group communication, supported by computer, is an existing and well studied area. A number of electronic media communication systems have provided a basis for examining the factors involved, and a foundation on which successive iterations of system designs can be built. To date, most of these systems are based on keyboard input of text. The extensive literature on small group interaction and a growing body of work on the effects of computers on interpersonal communication patterns is supportive of further research in this area.

The area of automatic speech recognition is both developing rapidly and failing to meet inflated expectations of worthwhile applications. From the work that has been undertaken on listening typewriters, it may be concluded that voice input as the exclusive input and control mechanism for both commands as well as text input is simply too clumsy and inefficient compared to alternative methods. However, a combination of voice input for the words and a direct manipulation pointer for command execution and editing may be a happy compromise.

## **CHAPTER 3**

### **BUSINESS MEETINGS**

#### **3.1 Introduction**

This chapter looks at sharpening the focus of asynchronous group communication systems by concentrating on one specific area of group communication: business meetings. This focus enables a close look at an area where there is a huge potential for application of AGC technology. What is required is an understanding of how existing methods of group communication work within the context of business organizations, and extracting from this some insights on how a better business AGC system might be constructed. In this environment, there is a significant potential for development and testing of prototype AGC systems, and large numbers of sites where further experimental and development work can be undertaken. Finally, the motive for looking closely at business meetings is to acquire an understanding of what goes in these group discussions and why, rather than simply looking for an easy model on which to build the functionality of computer system.

#### **3.2 What Is A Business Meeting?**

A meeting, as defined by Holland [1984], includes an exchange of ideas or information among people; this implies more than one person is going to talk. A meeting may be considered to occur when two or more people interact. With only two participants, there is often no formal structure. With three or more participants, there becomes a need to apply a formal structure to the discussion so that the necessary flow of information will occur. Business meetings are often differently structured from social gatherings, have different motivating factors, and participants are being paid to attend and achieve results from the meeting. Therefore, we define a business meeting, for the purposes of this research, as an assembly of typically 4 - 15 people, who are attending as part of their employment responsibilities.

This section discusses business meetings primarily from the perspective of traditional face-to-face meetings, but also provides comment on the implication of some of these characteristics on potential electronic communication systems.

The organization of business meetings could be generally categorized into formal and informal. Formal meetings are scheduled in a room at a designated place and time,

have a defined or implied leader, and usually an informal or formal agenda. Informal meetings represent a much higher proportion of business meetings, and comprise get-togethers during coffee breaks, chance meetings in the hall, pop-in visits, and other informal discussions not constrained by a pre-determined location or time.

### 3.2.1 Types of meetings

Holland describes four **types** of meetings :

**Passing information** - this can be a dedicated meeting for this function alone, and is usually an important component of all meetings. While one way transfer of information can often be done in written form, such as a memo, doing it in a way that encourages feedback and allows for clarification usually results in better acceptance in the long term. In particular, distribution of both good and bad news may be best handled in a group meeting.

**Reviewing progress** - This type of meeting is often a regular meeting, such as weekly or monthly, and will usually include the same set of participants on a recurring basis. It allows participants to find out what progress has been made by all members, and what they have learned to date.

**Solving problems** - The more people that are looking for a solution to a difficult problem the more likely it will be that a solution can be found, although there is often a maximum size of meeting beyond which it may be impossible to converge on a solution. Similarly, a group can help in the process of deciding which solution out of a possible number of choices is best.

**Creating something new** - This kind of meeting is often referred to as brain storming. It is used to introduce fresh ideas into an organization, to invent new products, to forge new and better procedures, and to develop new philosophies.

### 3.2.2 Purpose of meeting

Business meetings can also be analysed according to **purpose**, from the viewpoint of the meeting organizer, as well as from the viewpoint of the participant/attendee. Some of these purposes are:

- give information
- give opinion
- receive information

receive opinion  
 expound "strength of position"  
 receive other's strength of stated view  
 solve a problem  
 brainstorm  
 review progress  
 act as a milestone for task completion  
 assign tasks to be done  
 develop goodwill  
 develop team spirit, common sense of purpose  
 announce important good, bad news  
 reach consensus  
 adopt a solution  
 agree on action to be taken

Meetings can also serve other purposes. One of the most commonly discussed is socializing, which can be effectively used to relieve pressure if there is tension. In a similar fashion, meetings can be an effective device for encouraging goodwill and co-operation. On the other hand, bad news can also be effectively disseminated in a meeting by allowing people to get grumbling and complaints out of the way all at once and prevent the building up of dissension.

### **3.3 Modes of Business Meetings**

A mode is a state of activity or operation. Similar actions will have different effects when different modes are present. For example, turning the steering wheel sharply to the right will have little harmful effect when the mode of operation of an automobile is stationary, engine off, and in the driveway, but drastically different effect when the mode is moving at the speed limit, on a multi-lane motorway, during the 5 o'clock rush hour.

Business meetings may be considered to regularly pass through a number of modes. Actions and activities that are perfectly appropriate and constructive for one mode of operation may have a negative or destructive effect during another mode.

#### **3.3.1 Information exchange mode**

This mode involves information gathering and participant contribution of information and commentary from agenda items raised, and is likely to be the predominant mode of most business meetings. It also incorporates information dispersal, where either the chairman or members of the meeting wish to formally announce or disperse some information. Topics are discussed one at a time, usually as presented in the agenda, from first to last. Discussion builds each succeeding comment on the previous, or a recent comment. There is one speaker at a time (hopefully!). The right to allocate

speaking privilege usually rests with the chairman, but in most meetings this is done informally.

### **3.3.2 Information retrieval mode**

Group meetings are often seen to be synergistic; that is, the knowledge and information that is available from the group is likely to be greater than the sum of the individuals. One area where this is apparent is in retrieval of specific pieces of information such as "who was the supplier of that piece of equipment?", where individual group members may have fragments of the complete answer, or be able to confirm other's partial answers. The information retrieval tasks that are likely to be successful in a group setting are usually specific, and usually have a single correct answer. The duration of this mode during a meeting is likely to be brief and intermittent, and interspersed with the other more prevalent modes. More generalized information retrieval, which might be called unstructured browsing, such as is typical when reading a magazine or browsing the shelves of a library, is more likely to be an individual activity rather than one undertaken at a meeting.

### **3.3.3 Opinion gathering mode**

This mode is different from the dominant information exchange mode, in that all members of the group may be directly solicited for opinions. In a face-to-face meeting, this can be done effectively by going around the group, one by one, and asking each to state their opinion. Alternatively, each person could be asked to write their opinion on a piece of paper and hand it to the chairman, who reads them out in a group. This mode allows reaction to information or opinion already given, and is often used to draw in those who have not actively participated in the discussion so far. It is often the preliminary stage to entering the consensus building and decision making modes.

### **3.3.4 Consensus building mode**

The consensus building mode is often the preliminary step before entering the decision making mode. After a tentative decision has been reached (or imposed) on the group, the chairperson may wish to allow participants to make a final statement of their support or opposition to the result. This may be used to allow initial opponents to find a way to accept the decision, and indicate their willingness to abide by it, perhaps by suggesting acceptable conditions or modifications which will then attract their support for the main issue.

### **3.3.5 Decision making mode**

This mode of a meeting selects or ranks choices from among alternatives. It often follows on from the brain storming or idea generation modes and allows the group to define a random list of ideas into a small number that can be discussed further. Various methods of ranking, elimination, strengthening, or selection can be discussed.

## **3.4 Communication Models of Business Meetings**

In considering the tasks undertaken in a business meeting, and the implications of supporting those tasks through a AGC system, it is important to consider some models of the types of group meetings that take place. This section categorizes these models on characteristics of group size, participation, and level of interactivity between speaker and listeners.

### **3.4.1 Small and medium sized group model**

Participation among group members may be influenced considerably by the perception of what type of group meeting is taking place. The common model of a group meeting is one of equality of discussion, where all participants have more or less equal opportunity to speak if they desire. However, this expectation of reasonable degrees of participation from all members, would usually be limited to group sizes under 15 participants.

### **3.4.2 Large group models**

There are forms of group discussion which allow larger numbers of participants to be involved, albeit primarily as listeners. The titles and descriptions below (after Zelko, 1969) briefly describe these forms.

#### **a) The Lecture**

A lecture is primarily one way communication from a speaker to a group of listeners. The speaker may obtain feedback from attentiveness signals of audience, and modify the material presented accordingly. There is also some possibility of questions for clarification passing from the listeners to the lecturer, again providing a feedback and alteration mechanism. The lecture model is very suitable for large numbers of listeners.

**b) The Forum**

In a forum discussion, the entire group may actively participate, usually after discussion material has been presented by one (lecture) or more (panel) speakers. Questions asked and answers given should be for the benefit of all participants, not just the questioner/answerer. Turn sharing is important in forums, although it is likely a small subset of the participants may contribute the majority of the contributions.

**c) The Panel**

A panel discussion is usually focused on the contributions of the panel members, with some opportunity for questions from the audience. This meeting model is suitable for large number of listeners (in the hundreds, perhaps), but usually with a small (3-5) number of panelists. This model provides an opportunity for a diversity of points of view to be presented, and there is usually a broad range of knowledge represented on the panel. The discussion can be either a majority of comments from a small number of contributors (the panel) for the entire session, or each panelist can give a brief introductory statement, then the larger audience asks questions or comments.

**d) The Workshop**

A workshop is usually a hands-on experience for the audience, and may be led by a single person knowledgeable about the subject. Under the direction of the leader, participants often form smaller groups (3-5 people) to carry out exercises during the course of the workshop. A high degree of interactivity between leader and participants is encouraged. There might be a number of connected, well structured sessions that would comprise perhaps a whole day's workshop activities, and a component of skill building is often present in many workshop situations.

**e) The Symposium**

A symposium usually begins with prepared position statements from all participants being distributed in advance. There are no pure "listeners" - everybody has earned the right to be there, and participate, by preparing this information in advance. Symposium sizes are usually under twenty, to allow all participants to take part.

**f) The Debate**

A debate is a very formal, structured contention between two people, or two teams of people, who undertake to prove or disprove the postulation put forward for discussion. Each debater has a fixed point of view, and that point of view does not change during the debate. The debaters are well prepared, with a host of data and examples available to support their positions. Usually, two participants (or aligned groups) will contribute all of the contributions, with no input from the listeners. The views held are usually opposite choices for a course of action. The number of listeners in a debate can be

quite large, and a debate is often used as a entertainment, rather than a discussion moving toward some conclusion. At the end of a debate, there is usually some voting mechanism whereby the audience can choose which person or side has been most persuasive.

### **3.5 Group Tasks, Activities and Enabling Mechanisms**

#### **3.5.1 Group tasks**

The following **tasks** are undertaken in most business meetings. These tasks are described as group tasks, and generally require the contribution, co-operation and agreement of a majority of the individuals participating. They are presented in the chronological order in which they are likely to occur.

**Establishment of relative rank of participants** - this may not be a major task for a group which meets regularly, but for a group called together for a one-time function, establishment of relative rank (pecking order) may absorb a considerable amount of time before the business at hand can be dealt with. Some of the techniques used to establish rank include seating position, duration of speaking time, etc.

**Establishment of goals of the meeting** - this is not often done explicitly, especially for routine meetings, but may be a valuable first step for long or special purpose meetings. This goal setting may also impose a time constraint for completion of the meeting.

**Acceptance of authority of the meeting** - this reflects the individual participant's willingness to be bound by the decisions arrived at by the meeting. Positive indications that the individual is willing to be bound may include active participation in discussion and compromise stages of the meeting. Negative signals that the individual may not accept the results of the meeting include late arrival or early departure, lack of participation (although by itself this is not a clear signal), disruptive or unsupportive behaviour.

**Problem statement** - a clear statement of the issues to be covered, possibly with alternative solutions proposed.

**Fact gathering** - collection of the facts relevant to the discussion. One person may be called on to present the facts, although the presentation may be heavily biased with an implied action plan. This phase would normally terminate as soon as others had made their contributions, and all available facts were exhausted. It would not be proper

procedure to introduce a new "fact" late in the opinion/decision phase of the discussion.

**Missing fact identification** - determining that certain facts are missing, which cannot be provided by meeting participants, and that the course of discussion must wait until those facts are available.

**Opinion exchange** - the chance for members to support, challenge, or otherwise comment on other's information, facts, opinions or proposals. This phase may be heavily influenced by the actions of the chairman in selecting who is to speak.

**Idea proposal** - an individual member puts forward the core of an idea for discussion. This idea may result from an organized brainstorming activity, may be stimulated by an unrelated comment, or may have been prepared in advance by the contributor.

**Idea enhancement, expansion** - comments from others fill out the form of the core idea, incorporating modifications that strengthen acceptability.

**Formulation of alternatives** - reduce the proposals and ideas put forward, reduce to a small set of non-overlapping alternatives. This is often undertaken by the chairman.

**Compromising** - formulating positions and modifying proposals so that they will receive a necessary amount of support from competing factions.

**Discussion of the proposals** - simultaneous discussion of multiple alternative choices may occur in less formal meetings.

**Proposal of a single course of action** - this is usually the "motion" stage of a formal meeting, which puts a single proposal forward for a clear acceptance or rejection vote. The proposal may undergo some wording changes, or be modified by amendment.

**Consensus agreement** - it may be left to the chairman to weigh the discussion and inclinations of the participants, and then say "is it agreed that we will.....?". If no objections are raised, the decision has been made. Silence is seen to bind each member to acceptance of the decision.

**Selection from alternatives** - If two or more clear alternative choices are available and there is little chance of compromise or consensus, then a vote is held to select one.

**Additional task assignment** - identification of specific activities which must be carried out after the formal completion of the meeting, and assignment to, and

acceptance by, the individual(s) who will undertake those activities. The task assignment may include a completion deadline.

### **3.5.2 Mechanisms used in undertaking group tasks**

To accomplish these tasks, the business group and its participants must adopt some procedures and protocols so that the meeting can be productive.

**Location, duration, delay** - a physical location is selected and reserved, a date and starting time identified, and a nominal duration may be specified. Implicit in the selection of the date of the meeting (delay until meeting, after notification) is the time allowed for participants to prepare their contributions.

**Agenda** - advance notice to the participants of the items to be discussed, and the order they will be processed. May contain attachments of background material which participants are expected to have read in advance of the meeting.

**Formal rules of order** - frequently used in large groups where an issue must be decided between two strongly held views. Can be used to control debate, restrict repetitive contributions, and bring an issue to resolution.

**Absent opinions** - how opinions of those not at the meeting are introduced into the discussion. Often accomplished by proxy speaker. Common when a missing person is of high rank.

**Working parties** - used to pre-digest large or complex issues into a form which can be presented efficiently and without bias at the meeting. A small number of people (3-4) can save the larger group significant amounts of time in coming to grips with the main issues.

**Advance disclosure** - allows time for participants to become comfortable with radical or unpalatable proposals which might create strong negative opinions if "sprung" on participants at the decision making meeting.

**Subgroup discussions** - communication about the issues of the main meeting, during coffee breaks, by subsets of main group.

**Stage management** - secret advance selection of a well regarded participant to speak in support of a proposal at a pivotal point during the discussion. Makes it very difficult for opposition to marshal support before the decision is made.

**Handouts** - written material distributed at the meeting (one copy for each participant) which contains detailed information relevant to the item under discussion.

**Visual aids** - a chart, diagram, picture or point form outline used by the participant to support or clarify his presentation. May be an overhead transparency, flip chart page, writing on a blackboard, slide, film or video segment.

**Control of speakers** - usually a function of the chairman allocating the right to speak. May be used to provide equal rights to all, or may be used to bias the information presented.

**Negative opinion** - intractable negative positions, forcefully presented, may result in significant movement of the majority consensus position, especially in a group where conflict is abhorrent.

**Air time** - may be used by a speaker to filibuster the meeting into avoiding a decision against the speaker's view, or burn up discussion time so that opposing opinions do not receive a balanced presentation.

There are some additional techniques that may be used by the chairman or other meeting participant to alter the atmosphere of the meeting. Preparing the group to undertake unpleasant activities, make tough decisions, or move into a decision making mode may be especially important.

**Social interaction** - allowing or encouraging "social noise" before or during the meeting may send signals to participants.

**Hierarchical challenges** - participants may challenge or confirm implied authority or rank indicators, which may have significant effect on subsequent activities.

**Intensity control** - changing the tone of the meeting from a friendly gathering to a tense, "watch every word" environment; conversely, undertaking steps to relieve intensity.

**Ego stroking** - used to enhance both the stroker's and the strokee's rank in the meeting.

**Putdowns** - devastating personal attacks used to reduce the effectiveness of an opponent in presenting information.

## **3.6 Individual Roles in a Business Meeting**

### **3.6.1 Chairman/organizer**

For a business meeting to become a reality, it must be initiated and executed. The following roles may all be assumed by one person, or may be distributed among several people, but all will present in some form. Some of the important initiation/execution roles are:

**Convener** - either unilaterally sets or negotiates a mutually acceptable place and time for the next gathering of the group. This function may either be clerical or manipulative (i.e., at a time when an opponent is not available). This function may also include the creation of the business group by selection of meeting attendees.

**Membership Selection** - selects who is to attend the meeting, and what special roles (full member, ex-officio, liaison, information giver) those participants are to be given.

**Agenda Setter** - identifies the items which will be discussed, and the order in which they will be taken. This can be either a simple clerical role, or manipulative (i.e. putting contentious issues at the end of the agenda when time will be limited).

**Chairman** - controls the flow of discussion in the meeting, and often has a strong influence on the meeting's results.

**Agenda Execution** - determines which items are to be discussed, in what order, and may invite specific members to give item introductions.

**Minutes** - arranges for minutes of the meeting to be recorded, and subsequently distributed to meeting attendees.

**Participation Enhancer** - specifically asks for the opinion of a group member who has not actively participated in the discussion so far.

**Returning Officer** - calls for votes, decides on outcomes.

**Consensus Seeker** - proposes a compromise solution to two alternative proposals. This may also be undertaken by members of the group other than the chairman.

**Concluder** - declares meeting at an end.

### 3.6.2 Other participants

Beyond the organizational and operational roles, each individual at a meeting will assume one or more of the following participant roles:

**Listeners** - do not contribute to a particular segment of a meeting, but may have strongly held views, or important information which is being withheld. They absorb both information and opinions, and may develop a comprehensive understanding of what is happening in the meeting. On the other hand, they may be bored, asleep, or being forced to attend.

**Information Givers** - must be present in the meeting to provide the information needed by the group to do its work. The information givers often deliver their information only in oral form.

**Information Receivers** - must be present in the meeting to receive specific information given by others. They are often the senior managers in the group, who attend the meeting to gain perspective.

**Task Assigners** - people with rank in the organization, or an acknowledged task assignment role within the group, who assign tasks to be performed by individuals after the end of the meeting.

**Decision Makers** - usually only one person in a meeting assumes the role of highest ranking decision maker, even though the group itself may appear to be empowered to make decisions. Sometimes, this is the chairman, when the group members are all of equal rank. Often, it is the highest ranking member of the organization present at the meeting who fills this role. A murmur of dissatisfaction about a proposal by a decision maker is often interpreted as a de facto veto.

Members of the group may assume certain unofficial roles for portions of the meeting. Some of these characteristic roles are:

**Devil's Advocate** - perhaps not personally supporting the negative view, but concerned that all sides and implications should be discussed.

**Faction Spokesperson** - seen to speak for a set of views held by a group which may or may not have significant representation at the meeting.

## **3.7 Participant Motivation and Behaviour**

### **3.7.1 Incentives and disincentives to attend**

Why do people come to a meeting? Why do they contribute/not contribute to the discussion? If they know the norms and expectations for contribution and behaviour, why do they or don't they contribute or behave in the prescribed way?

Individual participants in a group discussion may have divided loyalties with respect to whether they participate and how they contribute to a meeting. From a selfish viewpoint, the self-improvement of their own personal political position may be important. They may attend to support or present opposition to other participants. They may wish to exert or be seen to exert influence over other group members.

Alternatively, they may wish to attend so as to benefit the organization as a whole. Job security for all may be improved if the best actions are taken at the meeting. If choosing to work toward desirable outcomes from the meeting, they may also personally benefit through increased personal influence or public recognition of their ability, knowledge, and influence in that discussion. Their attendance may also be intended to avoid undesirable outcomes, such as increased workload or reduction of personal prestige if not present.

#### **3.7.1.1 Incentives for an individual to attend**

Why would an individual attend a particular meeting? The following may include some of the more common motivations.

- a) Gather useful information
- b) Provide information to others that may be either accurate or shaded and flavoured to gain advantage.
- c) Influence decisions that will be taken
- d) Establish or confirm their right to group membership
- e) Avoid missing "something important"
- f) Socialize
- g) Maintain key links to influential people. The meeting may be an opportunity to be seen or heard by the "bosses' boss", if private access to that person is usually infrequent.
- h) Attendance may be required as part of their job duties, and penalties or unpleasantness may result if they don't attend

### 3.7.1.2 Disincentives to attend

Alternatively, there may be disincentives to attend a particular meeting.

- a) Past poor productivity, and lack of benefit from previous attendance at meetings of the same group
- b) Individual personality clashes, particularly with meeting organizer or chairman
- c) Nothing to be discussed (as per agenda) of direct interest
- d) Other competing uses of time
- e) Unproductive time linked with attendance, such as travel

### 3.7.2 Behaviour during a meeting

Zelko [1969] describes four major purposes for a participant to speak up in a meeting:

- to offer or seek information
- to offer or seek opinion
- to offer or seek solutions
- to summarize, make transitions, or otherwise "lead".

Based on those purposes, we will now look at the types of behaviour by meeting participants that either contribute to attaining meeting objectives for that particular component, (constructive), or inhibit the productivity or objectives of the meeting segment (destructive), or that are neither constructive nor destructive (neutral).

It is with difficulty that some borderline activities are categorized into either constructive or destructive, and cases could be made for the movement of several of the activities into a different category. As well, the categorization of behaviour into constructive or destructive should be evaluated as to the impact on the meeting's productivity, but is destructive behaviour which prevents the group moving towards a disastrous conclusion really destructive?

However, activities that are strongly constructive and clearly seen to be so, need to be highlighted and supported in the design of any electronic form of meeting support. Similarly, those items and activities which are clearly destructive do not need to be supported. In fact, it would be desirable to filter or make it difficult to perform these activities in the electronic meeting environment.

#### 3.7.2.1 Constructive activities

- a) exhibit a cool, professional manner
- b) be willing to listen to all sides

- c) be concise
- d) recapitulate and recognize opposing positions
- e) balance time pressures with allowing ample discussion
- f) support other participant's positions

### 3.7.2.2 Destructive Activities

- a) swerving off the topic under discussion
- b) emotional outbursts
- c) rambling on; wasting time
- d) refuse to contribute
- e) withhold needed information
- f) personal attacks on other participants
- g) late arrival, early departure (if key participant)

The whole middle ground of activities, either mildly constructive, neutral, or mildly destructive, can thus be viewed with discretion as to the amount of effort that is taken to either encourage or discourage these type of activities in a support system for a prospective participant.

## 3.8 Participant Status in the Group

The status of the participant with respect to the group may be a factor in the willingness of that participant to contribute. The following categories may assist in clarifying this characteristic.

A participant is one of the following:

1. A member of a newly formed group
2. A new member of an established group
3. An established member of an established group

In each of these categories, the participant will have (or lack) important knowledge about the group's character and history. These could include:

- personal knowledge about, or acquaintance / friendship with other members
- knowledge about the group's norms, practices, relationships
- personal comfort / unease in contributing in that environment

For example, a new member of a group with which he has little familiarity can be expected to be reluctant to contribute until he has acquired a basic amount of information about the group norms, personalities, expectations, etc., even though that new member may have significant and important information to contribute. Conversely, an established member of an established group, comfortable with his position and status within the group, may be very comfortable in frequently contributing, even if those contributions are disruptive or counter-productive.

### **3.9 Skill Sets Required by a Meeting Participant**

A participant is defined broadly as one who is physically present at a meeting. Skill sets fall into the three categories of listener, contributor, and moderator. The following describes the basic skills needed to undertake each of the participant activities, and provides an approximate measure of how many meeting participants, out of an average population of 100, would possess "basic" and "skilled" ratings of performance.

#### **3.9.1 Listener**

Listening is the easiest and most frequently used skill set required in a face-to-face business meeting.

##### **a) Listening Basic Skill Set:**

- find the meeting location
- show up on time
- find a suitable seat (may have significant implications as to location)
- make presence known (possibly)
- avoid disruptions (noises, actions)
- show some listening signals
  - eye contact
  - interest, boredom
  - take notes
- decide what implications/subsequent actions will be required of you
- determine when over

Out of 100 people, perhaps 90 would possess a basic listening skill set.

##### **b) Advanced Listening Skill Set**

- active listening techniques

- analysis, categorization of what is said as it happens
- observe other listeners, to see if message received by observer is confirmed by reactions of others.

Zelko [1969] suggests that while active listening is most easily accomplished in one-to-one communication, the "extra" time available between comprehension speed (450-600 words per minute) and the average speaking rate (150 words per minute) can be put to good use by listeners in a group discussion to analyse and actively listen. However, because group communication may involve rapid switches between speakers, effective analysis and active listening is less likely to occur in groups.

Out of 100 people, perhaps 20 would possess an advanced listening skill set.

### **3.9.2 Contributor**

Contributing is a major step up from listening.

**Contributing Skill Set:**

- intense listening and analysis of other's contributions
- deciding if a contribution is appropriate
  - time in discussion
  - relevance of contribution to foregoing contributions, agenda
  - not already given
  - offensiveness of contribution to others
  - estimation of other's reaction
- organize thoughts into coherent and concise words
- obtaining permission to speak
  - request chairman
  - interrupt others
- public speaking skills
  - gains the respect of the listeners
  - can't revise, backtrack on the fly
  - one shot to get it right
- political skills
- weighing feedback to your last contribution, to improve your next one

Out of 100 people, perhaps 90 might be able to do the basics of "saying something" in a meeting, while perhaps only 50 would be perceived as doing it well.

### 3.9.3 Chairman - moderator

Chairing a meeting and guiding it toward some productive result is generally perceived as something only a few can do.

Chairman - Moderator Skill Set:

- appearance of neutrality
- appearance of intention to get things done, while balancing with letting everyone have their chance to speak.
- summarizing skills
- formulation of acceptable compromise positions
- appearance of having respect of participants
- varying roles as contributor, process leader
- ability to be decisive, but not unfair in dealing with disruptive behaviour

Out of 100 people, perhaps only 15 would consider themselves as capable of performing the basic functions, and only 5 would be considered sufficiently skilled and capable of handling large or important groups.

### 3.10 Rates of Data Flow

Confirming the findings of Zelko above, Pease & Garner [1985] found that the average person talks at the rate of approximately 125 words per minute, but has the ability to listen at the rate of 400 words per minute. These rates can be compared to typing rates (two finger typist!) of 10 to 20 words per minute, dictation for subsequent typing of up to 120 words per minute, and reading ranges of between 250 and 350 words per minute for an adult reader with adequate comprehension [Rozin & Gleitman 1977].

Thus, talking is the easiest and most efficient method of transferring ideas and opinion for the speaker, but very inefficient, especially in large meetings, for the listeners.

In terms of efficiency, a face-to-face business meeting is a compromise between providing an easy and efficient forum for the speakers, while being inefficient and often frustrating for most of the listeners.

### **3.11 Facilities Required for the Primary Task Categories**

The "end products" of a business meeting have been described above, but there are additional separate but complementary activities that are required to fuel the "process" of the business meeting. What would be the ideal support environment to facilitate each of these task groups?

#### **3.11.1. Facilities required for information exchange**

Information exchange has been discussed as the highest volume activity of a business meeting. Required facilities may be quite different for the categories of information contributor, information receiver, and facilitator. Information exchange facilities must accommodate both verbal and non-verbal forms of information, or at least recognize the constraints and implications if non-verbal forms are not permitted.

##### **a) For the contributor:**

- ease of contributing information
  - effort required to deliver: i.e. typing vs speaking
  - little or no preparation required prior to when information is given
- feedback - acknowledgement by others that information is worthwhile
- an incentive to share information which might be of personal power value if not shared
- contextual triggers - spark to contribute information which seemingly has little relevance or importance to the contributor
- synergy .... you show me yours, and I'll show you mine

##### **b) For the receiver:**

- filters ... ability to skim over information of little interest
- contextual organization
- correctness ...time to check other sources before claiming incorrectness
- consistency .... good stuff not mixed with trivia
- availability in summarized or precis form
- efficiency ... time spent vs value received
- ease of calling up referenced material if needed
- search facilities
- documentation and archives for later reference
- automatic referencing and cross indexing
- graphic triggers and indexes- for right brain association and recall

c) For the facilitator:

- ability to actively request a contribution from specific/all participants
- ability to trim, eliminate irrelevant contributions, contributors

### **3.11.2. Facilities required for idea creation**

Idea creation is described by Delbecq et al. [1975] as being quite different from the usual processes in a business meeting, and requiring special techniques to be successful. Some of the facilities required for this task, often referred to as brainstorming, are listed under the categories of participant and facilitator.

a) For the participant:

- sensory stimulation; sights, sounds, smells
- sense of urgency, importance
- recognition and acceptance of contribution (writing it on a pad)
- absence of judgement, opinion
- absence of status, rank symbols
- finite time frame
- ease of contribution ...talking versus typing
- ability to modify, shape, change own contribution
- ability to modify, append to, change other's contribution

b) For the facilitator:

- tools for facilitator to solicit contribution from quiet participant
- tool to eliminate/prevent disruptive contribution (possible danger of suppressing innovative contribution)
- methods to create sense of team membership, identity, building
- way to invite / include known good idea generators
- way to make the participation come from as broad a base of participants as possible

### **3.11.3. Facilities required for decision making**

Decision making processes in a business meeting are diverse and complex. While most of the facilities required could be considered to be primarily for the facilitator, there is also a need for each participant in the decision making process to "buy in" to the decision that will be made. Some of the facilities that might be useful for this task follow.

- establishment of rank and status symbols for participants
- establish acceptance of authority of group, and willingness to support outcome

- impose time constraints: all comments in by ....., speak now or hold your peace
- auto issue of reminders/request for opinion -frequency, forcefulness
- possible different ordering of comments by rank (most important first?)
- discussion of alternatives ... way to organize .... by alternative, by alternative pairs, how to handle three, four, etc.?
- rearrangement of comments as pro/con a specific alternative
- special powers for chairman: deletion of comment, removal of participant, editing of others' contributions
- informal votes (how the wind is blowing, possibly anonymous)
- formal votes (stand up and be counted)

### **3.12 Individual Communication and Needs Support**

The individual participant in a meeting may have a set of needs that are separate, and different from those of the group, in the areas of

- listening
- contributing
- group membership confirmation
- power, prestige reinforcement
- private, non-group subsets of communication (over a coffee)

### **3.13 Measuring the Effectiveness of Business Meetings**

Although not straightforward, it may be possible to measure the effectiveness of a business meeting through the following structure. For each item in each category, it may be possible to assign some measure of the success in achieving those particular goals.

#### **1. Was the planning and preparation effective?**

- Goals set
- Goals communicated to participants
- Goals achieved
- All/important views represented, presented

#### **2. Was the decision making and consensus gathering process useful?**

- Collection, sharing of background information
- Reduction of complex set of data to a simple structure
- Construction of set of alternatives to discuss
- Full disclosure of implications of each alternative

**Construction of compromises****Accurate weighing of support for each alternative****Concurrence of****all interested parties****all essential parties****all affected parties****Means of resolving differing views****compromise to an ineffectual solution acceptable to none****choose -majority-****-loudest-****-most powerful- proponents of a view****All participants "buy in" to group decision****3. Was there an effective, productive use of time?****how might this be measured****4. Was there free, but efficient flow of information to and from participants?****did the important pieces of information get out****5. At the end, did group members have a positive attitude toward future similar meetings?****3.14 Implications for AGC Designers**

This chapter has addressed the diversity of activities that take place during a business meeting, and what structures in a face-to-face meeting support these activities. The question for AGC system designers is what subset of activities is of primary importance for the target users of their system, as it is unlikely that any one system can service all requirements.

The high interactivity of face-to-face meetings is unlikely to be achieved by an AGC system. Perhaps closely coupled to this is the socializing aspect, which again is unlikely to be better served in an AGC than a face-to-face meeting. However, slower interactivity and less satisfactory socializing through an AGC may be worse than a face-to-face meeting for those geographically close and with time available, but it is better than not interacting or socializing *at all* for those who are not close or do not want to spend large amounts of time. Therefore, some return for effort spent in this area by AGC designers is possible.

The roles played by contributors, listeners, and moderators is very significant for AGC designers. Each user of an AGC system may undertake any or all of these roles, in any or all of the discussions in which they participate on the system. AGC designers must make it easy and efficient for users to carry out their contributing, listening and moderating tasks that are necessary to the group discussion process. This could be narrowed to emphasize **ease of contributing** for contributors, and **efficiency and selectivity of listening** for listeners.

Designers must also be aware of the great differences (both positive and negative) in the communication channels of an AGC system compared to a face-to-face discussion, and not just try to simply replicate where possible the functions of the synchronous face-to-face medium on the asynchronous computer based medium. There are some things that are not done well in face-to-face meetings that can be supported in AGC (documentation, archiving, minimizing the effect of disruptive speakers), and those opportunities should not be lost when developing new AGC systems.

### **3.15 Summary**

This chapter has examined a number of ways of looking at the process and content of business meetings. The types of meetings, purposes of meetings, modes of meetings, and a communication model have been discussed. Enabling mechanisms and activities required to support tasks, both group and individual, have been presented. The roles of chairman and other participants in the meeting have been covered in an attempt to understand in detail what is required of the media supporting these meetings. The discussion then covered individual motivation and behaviour. Finally, facilities which are needed to support the primary task categories and the difficulty in measuring the effectiveness of business meetings are discussed. The chapter ends with a brief comment on what this implies for AGC designers, and in particular the support required for contributors and listeners.

## **CHAPTER 4**

### **A FIELD STUDY OF BUSINESS MEETINGS**

#### **4.1 Introduction**

Asynchronous group communication (AGC) systems support group interpersonal communication through the use of computing and data communication technologies, and are likely to become an important part of future office automation systems. Development of many current AGC systems has often been driven by the perceived feature and function requirements of the designers, rather than an analytical view of user needs. Face-to-face business meetings are a widely used method of group interaction, and a rich source of data on what actually happens in group discussions. This chapter describes a field study of ten business meetings which were videotaped and subsequently analysed. Participant contributions were coded, and the data summarized. Findings are discussed within the context of requirements for designers of AGC systems.

#### **4.2 The Field Study Environment and Methods**

The organization studied is a semi-autonomous government regional research centre, employing approximately 400 people at the location studied. A ceiling mounted surveillance type video camera (exposed) and sound-activated video cassette recorder (hidden) were installed in each of two meeting rooms, with respective seating capacities of 25 and 75 people. Meeting room users were advised through the organization newsletter of the presence and purpose of the video cameras.

The data was coded at an off-site location by stop-start viewing of the recording while keying information into a database on a microcomputer. A transaction is defined here as that duration of time between the start and end of a contiguous segment of speech from a participant. On the first pass, a database record was created on every change of speaker (transaction) in the meeting. These transaction records were automatically timestamped. The second pass added additional information into each of the transaction records previously created, such as speaker number, rate of speaking, function of the comment (i.e. opinion giving), linkages to previous speakers, and use of gestures, emotion or visual aids by the speaker. The occasional periods of silence that occurred between speakers were also recorded. Two additional data fields were derived

from the entered data: elapsed time of each transaction, and total words spoken by the speaker in that transaction.

### 4.3 Observations

In the following, transaction refers to a segment of speech or silence, bounded in turn either by silence, or by a segment of speech from another person. Participant refers to a person at the meeting who contributed at least one transaction. There may have been other non-contributing attendees at the meeting.

#### 4.3.1 Meeting summary data

For each meeting coded, the number of participants, number of transactions, elapsed time of meeting (hours:minutes), and total number of words are shown below.

**Table 4.1 Meeting Summary Data**

Meeting	Participants	Transactions	Time	Words
1	4	445	1:31	8921
2	9	377	2:51	*
3	6	995	2:24	15730
4	8	1119	2:29	17261
5	6	914	2:20	15528
6	8	382	0:50	6335
7	13	490	2:30	18025
8	13	113	1:46	*
9	10	227	1:00	*
10	7	311	0:32	3582

\* not coded for these meetings

The total number of transactions coded was 5373. Mean elapsed time per transaction over all 5373 transactions was 12.2 seconds. Mean number of words per transaction, for those meetings where word counts were coded, was 18.3. Of the 5373 transactions, 566 were periods of silence or pauses.

#### 4.3.2 Transaction function summary

All speaking transactions (4807) were tabulated by function, as coded on the apparent verbal intent. For each function category, the mean number of words, and mean seconds per transaction are shown below.

**Table 4.2 Transaction Function**

Function	Transactions (percent)	Means per Transaction	
		Words	Seconds
info giving	55.8	20	14
query	14.0	9	6
opinion giving	11.9	16	15
decision making	5.9	24	12
informal talk	4.3	10	6
support	3.8	7	4
directional	3.0	31	19
consensus making	1.1	28	16
brainstorming	0.2	17	9

### 4.3.3 Use of visual aids

Use of non-verbal aids by each speaker is given below.

**Table 4.3 Visual Aids**

Function	Transactions (percent)	Mean per Transaction	
		Words	Seconds
no aids	80.1	16	11
handout	16.7	25	13
whiteboard	2.5	20	20
overhead trans.	0.7	21	123
35 mm slides	<0.1	*	*

\* consisted of one transaction, 889 seconds in duration

### 4.3.4 Use of gestures

Gestures used by participants when speaking were coded into eight categories. Most transactions had no gestures (92.4%).

### 4.3.5 Other non-verbal communication

Pauses (for effect) were used by participants in 2.5% of all speaking transactions. No pauses were coded for 97.5%. Emotion was shown in only 5 of 4807 transactions.

### 4.3.6 Linkage to other transactions

88.2% of transactions were linked to the immediately previous transaction. A further 3.2% were linked to one of the previous five transactions, and 0.5% were linked to earlier transactions. 8% were not linked to a previous transaction.

### 4.3.7 Dominant speakers

Meeting dominance can be represented by how frequently a participant "takes over" by speaking, or the percent of overall "air time" used. Dominance can therefore be represented by the percent of transactions contributed by a participant, or the percent of total time used. The following table shows in columns 3 and 4 the percentage of speaking transactions and the percentage of total time by dominant (largest number of transactions) speaker in each of the observed meetings. Columns 5 and 6 show the equivalent percentages for the sum of the two most dominant speakers in the meeting. Note the number of participants in the meeting in column 2.

**Table 4.4 Dominant Speakers**

Meeting	Participants	---top one---		---top two---	
		Trans. %	Time %	Trans. %	Time %
1	4	40.5	48.2	72.3	81.3
2	9	18.3	22.3	35.4	52.0
3	6	30.1	29.3	52.4	55.2
4	8	27.6	29.6	47.1	52.4
5	6	28.9	31.2	54.1	58.4
6	8	24.9	37.5	42.4	50.1
7	13	30.0	48.9	51.8	68.2
8	13	21.9	24.2	41.7	49.4
9	10	22.0	21.4	39.5	41.6
10	7	26.9	20.2	51.9	38.8
	Means		31.3		54.7

## 4.4 Discussion

### 4.4.1 Group size

From other studies, the average size of a business meeting has been reported as five people. Much of the sociological small group research has been done with groups of 3 and 4 [Bales, 1970]. This study observed group sizes from four to thirteen, with the median size being six, which is not necessarily indicative of typical group meeting sizes in this organization.

The larger group sizes were of particular interest, as it has been reported [Hiltz, 1988] that the main advantages of electronic group communication over face-to-face meetings were likely to be observed in large (> 10) rather than small (3-5) groups.

#### 4.4.2 Speaking rates

A main concern of potential users of electronic group communication systems is that it seems to be much more inhibiting to free-flowing discussion to be required to type rather than talk [Mayer, 1985]. The data recorded by this study on speaking rates (words per minute) indicated an average rate of 113 words per minute. Current technology for electronic group communication is almost totally keyboard based. The estimated data in the table below may be of some help in putting these rates in perspective.

**Table 4.5 Speaking & Typing Rates**

	words per minute
Speaking rate	113
Skilled touch typist	90
Touch typist	40
Two finger typist	20
Hunt and peck typist	10

This indicates that many fewer words are likely to be generated in an electronic meeting than in a face-to-face meeting, due to the speed and skills required to type the words in.

#### 4.4.3 Characteristics of transactions

Each change of speaker in a face-to-face meeting generates a new transaction. This transaction concept would compare to the distinct typed text messages or comments entered by participants in an asynchronous group communication system. A number of interesting data were collected about the characteristics of these transaction segments in the observed face-to-face meetings.

The observed mean duration of transaction length for each meeting analysed ranged from 6 seconds to 57 seconds, with the mean of all transactions from all meetings being about 12 seconds. This indicates that the nature of each spoken contribution is typically one of a relatively short duration.

The number of words per transaction ranged from means of 12 to 37 for each of the meetings observed, with an overall mean of 18 words. When compared to typed lines of text, this represents typically one to three lines of typed words. This perhaps offsets to some degree the concern over limited typing speed, for even the slowest hunt and

peck typist could type the equivalent of a spoken 12 second, 18 word comment in about two minutes.

If the mean 12 second comment is taken, then an exchange of 30 transactions might take six minutes in a face-to-face meeting. This can be compared to the time duration of an exchange of comments in a AGC, with perhaps 10 to 30 transactions per week in similar sized conferences being typical. This may indicate that discussions requiring a high level of interaction over short periods of time may be less suitable to AGC systems than discussions where the interaction rate required is lower, or can be spread over a longer period of time.

Silent periods (coded when no participant was speaking) amounted to under 11% of the transactions and about 10% of the total meeting time.

#### **4.4.4 Function of transaction**

The function of each transaction was coded into one of nine categories. Over all of the 5373 transactions recorded, the dominant function category was information giving (56%). Querying (14%) and opinion giving (12%) were the only other functions above 10%. Decision making (6%) was in the bottom group of six other functions, which together comprised the remaining 18% of the number of transactions.

This is encouraging data for the developers of group communication systems. It seems likely that current keyboard based technology can readily and effectively support both information and opinion giving functions, and in addition provide a major enhancement in being able to go back and "replay" significant transactions of this type later in the discussion.

Voting mechanisms would appear to be needed only infrequently in electronic group communication systems.

#### **4.4.5 Distribution of participation rates**

General observation of the data in Table 4.4 indicates that regardless of group size, the two most frequent contributors will usually make a combined total of at least 40% of the number of comments (transactions) made in the meeting, and will occupy an even higher percentage of total meeting time. In terms of time, the most frequent single contributor will usually be speaking at least 25% of total meeting time. It is interesting to note that the most dominant single speakers (48 percent of time) occurred in meeting sizes at opposite ends of the size scale, namely 4 and 13 participants.

The more reticent half of all meeting participants typically contributed a group total of under 25% of the speaking time in meetings with less than ten participants, and under 15% of the time in meetings larger than ten. In essence, the lower half were left to divide up the scraps of time left over by the dominant speakers.

From these data, it is clear that meeting participation rates are far from uniform across all participants. In fact, most meetings could be characterized as platforms for one or two dominant speakers to pass their information and opinion on to the generally non-contributing majority.

Similar patterns of contribution (dominant participants) have been observed in electronic group communication [Hiltz 1988].

#### **4.4.6 Listening, reading and speaking rates**

The typical speaking rates reported above were 113 words per minute. Listening comprehension rates up to 275 words per minute are feasible [Foulke & Sticht 1969], but in the context of a meeting, the listening rate is in lockstep with the speaking rate.

The comprehension of written words for an average adult reader, with adequate comprehension, will vary between 250 and 350 words per minute [Rozin & Gleitman 1977]. Therefore, it appears that at least a doubling of "listening" speed for meeting participants could occur if speech was converted into text and read, and thus uncoupled from the talking speed of the speaker.

### **4.5 Implications for AGC Designers**

#### **4.5.1 Primary functions required**

Designers of group communication systems must be needs driven, rather than feature driven. The electronic medium for group communication and the systems to exploit it have been in existence for twenty years [Rice 1987]. Others [e.g. Holland, 1984] have published guides for how to make effective use of face-to-face business meetings. The present study has highlighted some aspects of face-to-face business meetings that deserve consideration when the functionality and capabilities of new AGC systems are being designed.

#### 4.5.1.1 Dominant speakers

The data in this study indicate that the top two participants in any group meeting will contribute half or more of the transactions in the meeting. AGC designers therefore need to provide the tools to enable these dominant participants to easily contribute to the discussion in the volume they desire. For any given group, these dominant speakers will be the heaviest users of the system, especially in the text entry area, and features such as a choice of editors, and micro to mainframe text movement facilities will be crucial. The future incorporation of speech recognition, which will eliminate the keyboard bottleneck disincentive, will likely be very important for this class of users.

#### 4.5.1.2 Listeners

People who contribute relatively little, in aggregate, to the meeting discussion make up over half of the meeting participants. If AGC systems encourage larger numbers of peripherally involved people to join discussions, then these additional people are likely to be only listeners, or low volume contributors. Rather than developing AGC systems assuming equality of participation, designers should provide "power listening" features for this majority of participants.

#### 4.5.1.3 Information exchange

Information exchange was the dominant function of the meetings studied. Text-based electronic communication media can effectively support information exchange [Keisler et al., 1984], but AGC designers must provide additional capabilities to enhance this function, such as multimedia (image, speech, graphic) object handling abilities. An implication of high levels of information exchange is a requirement for subsequent indexing, searching and archiving of the information elements contributed to the group discussion. This capability must provide simple but powerful tools to access the vast amounts of data that are likely to be captured in these systems in the future.

#### 4.5.1.4 Visual aids

Handouts and whiteboard were used in a small but not insignificant number of the transactions observed. There are many ideas that are within the reach of today's technology that could be used to provide these shared workspaces, such as large format, high resolution graphic displays or integrated fax interfaces. However, if incorporating these capabilities, designers must avoid making the basic workstation so complex and expensive that the basic requirement of information exchange for the majority of usage is overpowered by the technology for a less frequent usage.

#### 4.5.1.5 Linkages

The majority of transaction linkages observed in the face-to-face meetings were to the immediately preceding transaction, and the structure of the discussion was essentially serially, rather than hierarchically, cross-linked. Therefore, complex linking features, which may slow down the rate of contributions by asking for linkage information, may be a hindrance rather than an aid to system use.

#### 4.5.1.6 Voting and decision support

Voting was seldom used in the observed meetings. It appeared decisions, when formally required, were reached instead by compromise and group consensus. While a large body of research has investigated group decision support systems [i.e., Gallupe et al. 1988], the data from the present study appears to indicate that specialized decision support functions may be of minor importance in the context of the larger requirements of group communication.

#### 4.5.1.7 Attaining asynchronous interactivity

A significant observation from this study was the very high number of relatively short transactions, and by implication, the large number of transactions that could be exchanged in the relatively short meeting time (i.e., an hour). AGC system design has attempted to exploit the asynchronous advantage of the communication (synchronous) medium, but the offsetting disadvantage is that a much lower number of transactions are possible over a much longer period of time (say several weeks). Designers need to address this shortcoming, and provide capability and encouragement for much more frequent sign-on and contribution. One area which deserves attention is the high time overhead required to get into the AGC system (turn on machine, network connection, host login, etc.) for what may be a small number of waiting comments. Continuous connection to network services (perhaps as a background task on a workstation) may deserve some investigation to solve this serious problem.

### 4.5.2 User interface design

The user interface is the link between the system capabilities and the user's ability to make use of them. Potential AGC users have characteristics which may span a broad spectrum, including computer literacy, typing skills, frequency of use, and motivation [McQueen & Sheffield, 1990]. AGC user interface designs may target particular populations of users or task models to achieve their goals. Beside the more general aspects of user interface design, the observations of this study may be helpful to the AGC user interface designer in the following areas.

#### 4.5.2.1 Large number of small transactions

Most transactions were short in duration (12 seconds) and low in the number of words (18). Where typed text is to be input by speakers, the input method (text grabber) must be simple. For example, word wrap should be an important requirement to relieve contributors from the worry of end of line spillovers. Another example might be an automatic spell checker/corrector. On the other hand, features such as block move or replace may be infrequently used, but if incorporated, may disadvantageously add to the cognitive load of the user of the text grabber.

#### 4.5.2.2 Typing versus talking

Digitized voice is becoming more widely used in voice mail systems, and should be considered for incorporation into AGC system design as soon as possible. Reasonable quality digitized speech requires data rates of a minimum of 1000 bytes per second, so there are some serious implications for storage of large amounts of data. A more usable form would be text derived from speech, but economical speech recognition devices, with large speaker independent vocabularies are not yet commercially available. However, the future widespread use of AGC systems will not likely occur until cheap, good speech recognition is readily available. Talking rates of 113 words per minute cannot be compared to hunt and peck typing rates of 10 words per minute. AGC designers need to begin working with speech storage and recognition technologies as soon as possible.

#### 4.5.2.3 Non-text objects

Users of AGC systems will demand the capability to input, store and retrieve non-text objects, such as hand written notes, drawings, charts, and other paper based items. The huge popularity of fax machines supports the need to be able to move easily between paper and electronic versions of documents. Video images (for example, a small "picturephone" image of a comment's contributor) are also going to be desirable. The user interface designer's task is to provide easy access to these objects without context switches. Some kind of windowing, multimedia workstation may be a common future AGC system access mechanism.

#### 4.5.2.4 Portability and access

Business participants in meetings are typically very mobile. Cellular telephones attest to the current desire of a wide range of business people to be constantly available for communication. Present AGC system design is based on a desktop based workstation connecting to a server through a network. Future systems must look beyond these restrictions, to provide a group communication tool that is totally portable.

## 4.6 Summary

This chapter has described the results of a field study which videotaped and analysed ten business meetings. The organization studied frequently uses business meetings as a group communication method, but the data and conclusions derived may not be fully generalizable to all business meetings. The data from the analysis has been used to highlight potential design priorities and user requirements which should be considered by designers of AGC systems. In particular, the important role that information exchange took in the observed meetings is of interest. As well, the high degree of interactivity of the meeting participants (short duration, large number of transactions) is something that will be difficult to replicate in an AGC system. Finally, the role that both dominant speakers, and low participation "listeners" perform in a business meeting is important to recognize.

## CHAPTER 5

### THE MOOT VOICE-INPUT AGC SYSTEM PROTOTYPE

#### 5.1 Introduction

Previous chapters have discussed a number of modes and tasks that occur in face-to-face meetings, of which information exchange now becomes of primary interest. The information exchange component of group interaction might be linked to the number and duration of contributions; therefore, if voice input made contribution easier and more extensive, then it is possible that the information exchange component would similarly be increased.

Voice input is viewed by the author as both innovative and applicable to asynchronous group communication, and in particular may assist the exchange of information by making contribution easier. While previous studies [Hiltz 1984] have shown that typing speed was not a barrier to the level of commitment to use of a text based conferencing system, a touch typist would certainly have an advantage in the ease of preparing keyboarded contributions. Voice input is seen both as a potential leveller of variation in contribution quantity, and as a strong parallel to the normal mode of voice contribution in face-to-face meetings.

This chapter describes the development of a voice input prototype of an asynchronous group communication system.

#### 5.2 Constraints

Development of a comprehensive, completely operational asynchronous group communication software system is a major undertaking, and well beyond the scope of this work. What has been developed is a prototype system.

Following common usage, a prototype is a software model of a proposed system, with only enough functionality to test and evaluate how users will interact with the system. This idea of a prototype can be expanded to include a working software system which might exhibit many of the characteristics of a professionally developed system, but would also have shortcomings that would preclude its use in a production environment.

The difference between a prototype interface (demonstrates how the system interacts with a user), a prototype system (works with real data, but only just), and a professionally developed production system lies primarily with the time to develop and the resources (programming and support) available. Development of a user interface prototype might involve 10 to 30 hours of work, using available tools. A prototype system, capable of working with real data, might require 100 to 500 hours of effort. A production system, fully specified tested and documented, is probably in the scale of six months to perhaps years of effort.

The resources available for this research have not permitted the development of a production system. However, it has been possible to go beyond a basic user interface prototype into the realm of a prototype system, through the availability of student programming resources (the equivalent of one student for approximately 3 months). This resource has been applied to the development of the prototype Moot system described later.

## **5.3 Models to Guide Prototype System Design**

### **5.3.1 Conceptual model**

The conceptual model for the prototype was defined to be an extension to the common form of group electronic mail. The conceptual model of a face-to-face group meeting was considered and discarded, primarily because of the desire to model asynchronous communication, and the significant conceptual distance between a highly interactive, synchronous, face-to-face meeting, and the lower interactivity of working asynchronously through a computer. Most of the subjects for the test were to be second year management students, who had completed a first year course in computer applications. During that course, the concept of electronic mail had been covered, even though they likely had little hands-on experience with it. Regardless of their experience with email, the concept of passing messages among group members as a means of group communication was likely to be an acceptable conceptual model for users of the system.

### **5.3.2 User model**

The target group for ultimate adoption of asynchronous group communication is business users. Therefore, the user model for the prototype system should reflect that target group. However, the availability of subjects from business to test the prototype system was likely to be below the sixty required for statistically significant results, so it was decided to use second year management students as the test subjects. A user

model of business people should recognize variations in motivation, experience, and computer literacy, and many of these variations were also present in the planned management student test subjects. While lacking business experience, the test subjects likely shared very similar sets of attitudes with the targeted business user group. Therefore, the user model for the target group (business people) and the test subject group (business students) were sufficiently similar.

To formulate a model of potential users of such an AGC system in a business organization, a survey [McQueen 1990] was undertaken among 50 professional staff. The user characteristic given below is common to a population of 50% or more of the population who responded to the survey.

The user model is detailed as follows.

**Job category:** professional; typically no subordinates

**Communication:** all forms of communication (written, telephone, face) comprise half of working hours

**Computer literacy:** greater than 500 hours computer experience lifetime

**Email experience:** typically not regularly used

The user model so constructed was considered when designing the user interface of the prototype system.

### **5.3.3 Task model**

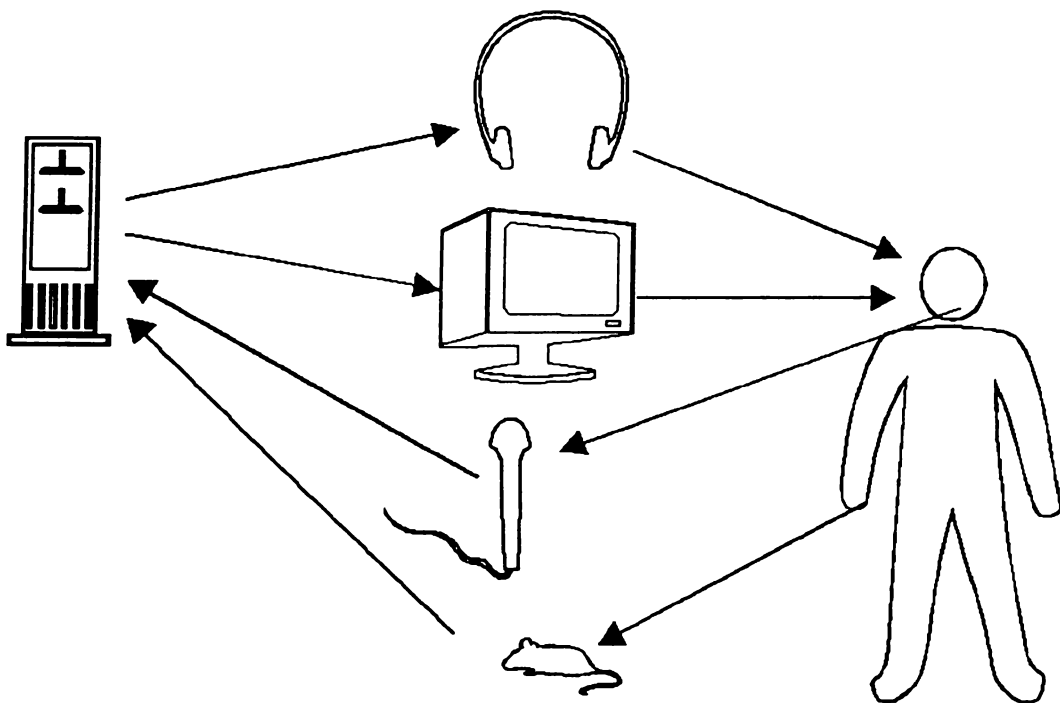
The following are the main tasks to be supported by the prototype system, from the perspective of the target users.

- a) **Information contribution.** Enable and encourage group discussion participants to contribute information facts they hold for the benefit of other group members.
- b) **Information receipt.** Enable other group members to read and receive contributions.
- c) **Feedback.** Enable feedback to be provided by other members on the relevance and usefulness of a member's contribution.
- d) **Previous contribution review.** Provide access to previous contributions on a second or subsequent occasion.

## 5.4 Features and Technology used for the Prototype

The prototype was named "Moot" (see Appendix 8 for a definition of the word). A graphic of the physical human computer interface components of Moot is given below. The subject receives data from the screen and earphones, and inputs data into the system through the mouse and microphone. No keyboard input is required.

**Figure 5.1 Moot Physical Human Computer Interface**



### 5.4.1 Voice input

The objective of developing and testing a prototype of a voice-input, asynchronous computer-assisted group communication system in this research is to gain some insight into the information exchange component of group communication, and the effect of the voice input user interface on this component.

The prototype development should not replicate existing text based AGC systems, of which a number are commercially available, by making only minor changes

(improvements?) to the user interface which may suit a narrow segment of the user spectrum. Rather, some significant technology advance should be incorporated.

The concept of ease of input (through speaking, rather than typing), coupled with speed of review (by reading text, rather than listening) is what may make AGC effective, and popular. This requires speech to text conversion. Speech recognition is a significant computer technology under development, that may radically affect how computer systems interface with users in the future. However, there are not presently available connected word, speaker independent speech recognition systems with sufficient vocabularies to support this kind of group communication.

For the purposes of this research, we wish to test the effect of voice in, text out capability on the effectiveness of a AGC system, rather than the actual mechanics of speech recognition. Therefore, we avoid the difficult problem of speech to text recognition, by using a manual (secretary) method to transcribe the voice files to text form.

The prototype will therefore allow participants to contribute voice messages, and be able to read the text equivalent of those messages on the screen. From the user's perspective, it should be transparent whether the voice messages are automatically "speech recognized" and converted to text by the computer, or whether a manual transcription process is taking place offline.

A speech interface board (Scott Instruments SIR20) was available to be incorporated into the prototype. This board has capabilities for discrete word, speaker dependent speech recognition vocabularies of 160 words. However, because of this small vocabulary, the speech recognition features of the board were of no practical use for this particular prototype, and the board was only used to digitize and replay speech, at 8,000 bytes per second.

#### **5.4.2 Graphical user interface**

The user interface of the prototype system is crucial to the successful use of the system by the subjects in an experimental setting. A windows and mouse based point and select system design was seen as desirable from several perspectives. From the view of the naive user, the highly intuitive direct manipulation windows interface would minimize learning time for test subjects, and minimize the effect of variations in the training experience for the subjects. For the experienced user, their previous computer experience (and likely comfort with command based systems) would have less effect on the usage of the prototype, thus clustering all subjects together more homogeneously.

From the perspective of the developer, windows offered an opportunity to utilize screen layout chaining tools which would reduce the prototype development effort, as well as using an interface which was rapidly becoming the one of choice for new commercial application software.

The mouse based select interface would also make possible an essentially keyboardless interface, where both output and input (both text and voice) could be selected by a mouse click.

### **5.4.3 Architecture for the application**

Purely hierarchical organizations for messages in conferencing systems may prove too inflexible for future asynchronous group communication systems. For example, it may be required to "attach" a word processor file, a spreadsheet, or a graphical image to a comment, much like a meeting speaker would distribute a handout or draw on the chalkboard. Linkage of comments across topic and conference boundaries, and perhaps even to other systems, may be desirable.

All of the possible items that could comprise a contribution, such as a speech segment, a block of text, or other blocks of digital data such as a digitized image, are collectively referred to here as objects. The relationships and linkages among objects, as well as the objects themselves, form the message database. An architecture for the message database must therefore be flexible enough to allow a range of objects to be linked to discussion contributions, but not so complex that readers lose track of an essentially serial and chronologically ordered set.

Hypermedia techniques may ultimately be of interest in organizing these objects. There have been some investigations [Jackson 1989] of hypermedia-type organizations for messaging systems that allow greater flexibility in linking related objects, but investigating a hypermedia database organization was beyond the scope of this research.

### **5.4.4 Data logging for subsequent analysis**

Because the prototype was to be used as an experimental testing vehicle, the need to automatically record data pertaining to usage was important. It was required to timestamp each contribution of a message (date, time, duration) as well as each review or reading of that message by any participant. An example of the readtimes log appears in the sample Moot log in Appendix 2.

### **5.4.5 Technology components not selected, and why**

Certain components which might be desirable for a functional AGC system were not incorporated in the working version of the prototype system to be used for the experiment, for the following reasons.

a) Distributed functionality.

Many present text-based AGC systems are designed around central service machines, where users use datacommunications facilities to connect terminals to a host machine. Future AGC systems may exploit existing LAN connectivity and split functions between the user workstation (contribution construction, review) and perhaps many network based servers, each supporting only a portion of the conferences and database of objects. While interesting, the time and programming effort required to develop an operational distributed prototype would have been significant, and would have diluted the focus on the voice input aspects of this work.

b) Automatic speech to text conversion.

The impact of automated speech input, text output (normally called speech recognition) asynchronous group communication is central to this research. Speech recognition can be categorized into speaker dependent, vs speaker independent, and connected word vs discrete word. Reasonably large vocabulary (2000+ word) speaker dependent, discrete word systems are now becoming available. However, commercially available products do not yet support large vocabulary, multi-speaker, connected word speech recognition. The point of this research, however, is not to investigate speech recognition per se, but rather the impact of voice-to-text capability on asynchronous group communication, and this can be done by simulating the automated conversion of speech to text by a behind-the-scenes secretarial transcription process. In effect, we bypass the present technology shortfall, and move forward to investigating the impact of speech recognition technology on AGC when it becomes available.

c) Hypertext style of linking comments across conferences.

This is likely an interesting area for future development efforts in AGCs, but has more to do with post contribution searching and retrieval of data, rather than the facilitation of information exchange at the time of contribution, the latter of which is the focus of this research.

d) Picture images to enhance verbal contributions.

The added value of visual, non-verbal communication components, such as body language, or still, slow or full motion video images of the speaker certainly has value in face-to-face meetings, and could be an important enhancement to AGC systems. The technology to capture these images is available and inexpensive, and the digitized

images can be linked and manipulated in much the same way as voice clips. Some work was done during the prototype development to leave the "hooks" for such enhancements to be added at a later time.

## **5.5 The Prototyping Environment**

The prototype was developed and run on a microcomputer with the following configuration.

**Hardware:** Mitac 386DX, 4 megabytes memory, 33 megahertz clock, 100 megabyte hard disk, Scott Instruments SIR20 voice recognition board, super VGA primary display, secondary Hercules monochrome adapter and display (for debugging), serial mouse, WD 8003 ethernet card.

**Software:** DOS 4.0, Windows 3.0, Microsoft C, Scott Instruments Voice board drivers, Novell Netware 2.15C.

An additional DOS machine was also used for code writing and testing.

## **5.6 Specification and Development of the Prototype**

Two students, Geoffrey Weatherall and Ian McDonald, took approximately two months to develop the prototype software in early 1991. A rapid prototyping approach to the system development was taken. A small number of pages of written requirements was developed by the author and discussed with the two students, along with the basic concepts of message and conference structure found in conferencing systems. CoSy, and News were used to illustrate features to include, and problems to avoid.

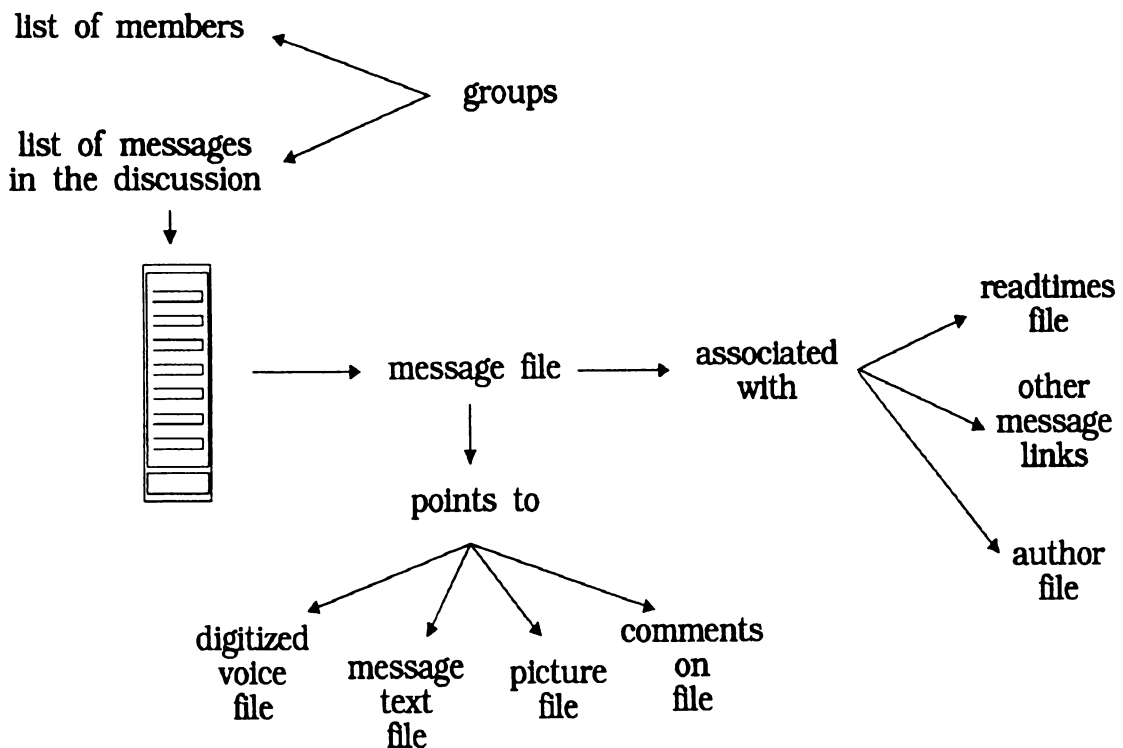
The two students then set about to write the system, with Geoffrey concentrating on the user interface (screens and menus), and Ian concentrating on the underlying file structure and manipulation of the voice files through the Scott board. Reviews and demonstration of the working parts were held frequently, and feedback provided to focus on key features and discard troublesome objectives that could compromise the completion of the project. The target date of completion by mid-February was achieved.

The file structure set up to service the object-based design of Moot was a key part of the project.

When a message was created, a sequential number was calculated, and a text file named `nnn.msg` was created (where `nnn` is the sequential number). This file contained author id, date and time information, forward and backward referenced message link pointers, and a list of object pointer files named `mmm.obt` associated with that message. Also associated with the `nnn.msg` file was a standard readtimes file called `nnntime.txt`.

The object pointer files, one or more of which was named in the `nnn.msg` file above, were text files which contained date and time information, and pointed to one target object file, and the type of object pointed to. These target files in turn could contain various data, such as a digitized voice file, a text file (for the transcribed message), a comments file (for comments attached by other readers in that group), a digitized picture file, and the readtimes file which was appended each time the message was read. Figure 5.2 below shows this structure.

**Figure 5.2 Moot Object Structure**



## 5.7 Preliminary Testing of the Prototype

As development of the prototype went on, there was a continuous cycle of review of what was operational (from both system and user perspectives), what problems in the

development environment were causing problems, and what short term targets were to be set for completion before the next review. This process seemed to work very well, ensuring that something would be complete and running by the end of the student programmer's availability, while maximizing the inclusion of key features within the constraints of available resources.

## 5.8 Moot from the User's Viewpoint

This section will describe Moot from the perspective of a user.

**Figure 5.3 The Moot System**



The Moot system is located in a private office. On entering, the user would see a microcomputer (screen and processor box) located on the desk in the office. Plugged

into the microcomputer is a headset, consisting of earphones and an attached microphone. A mouse, also attached to the computer, is on the desk. A keyboard is present, but has been placed out of the way, instead of its normal position in front of the screen.

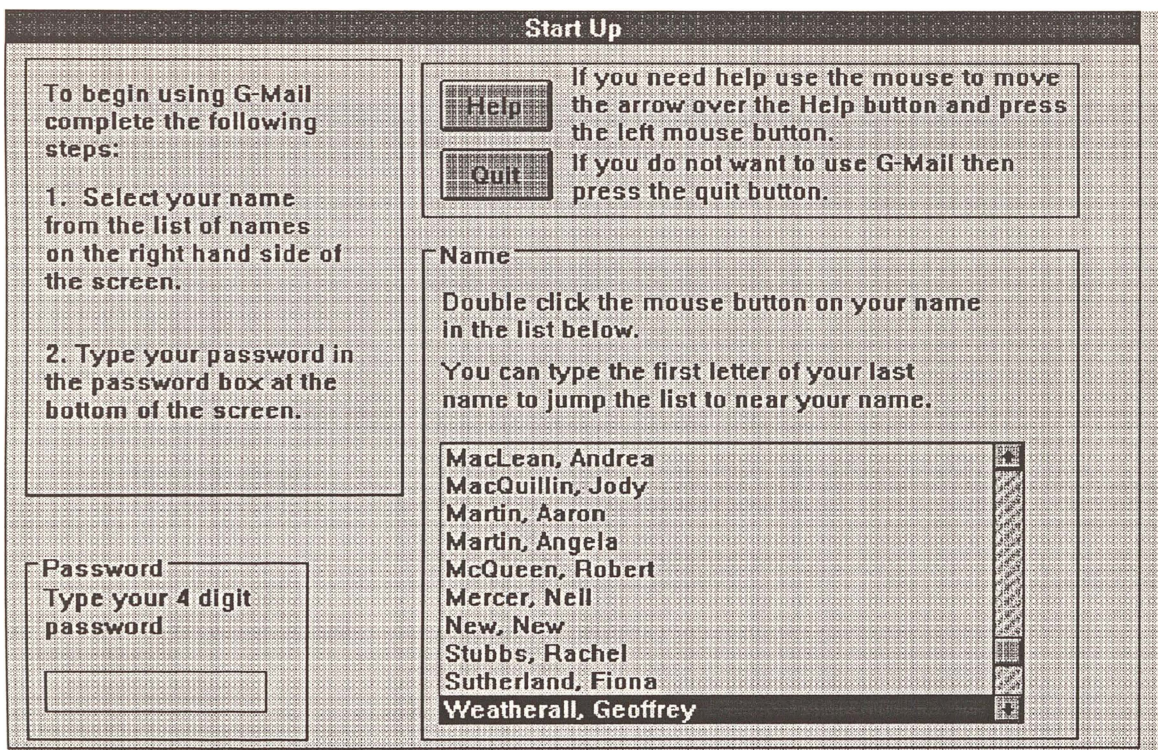
### 5.8.1 Strapping in

The user sits in the chair, and put on the headset.

### 5.8.2 Logging on

Using the mouse, the cursor arrow would be positioned over the Moot icon on the screen, and double clicked.

**Figure 5.4 Sign-on Screen**



There is a brief (< 5 second) wait while a screen and a moving bar says "finding users" is displayed, and then the sign-on screen (figure 5.4) is displayed. A window contains a list of all user names. The scroll bars would be used to position the highlight over their name, and the mouse clicked. Although a password box appears on the screen, no password was entered by the test subjects. The G-Mail name indicated on the screen was an early identifier for Moot.

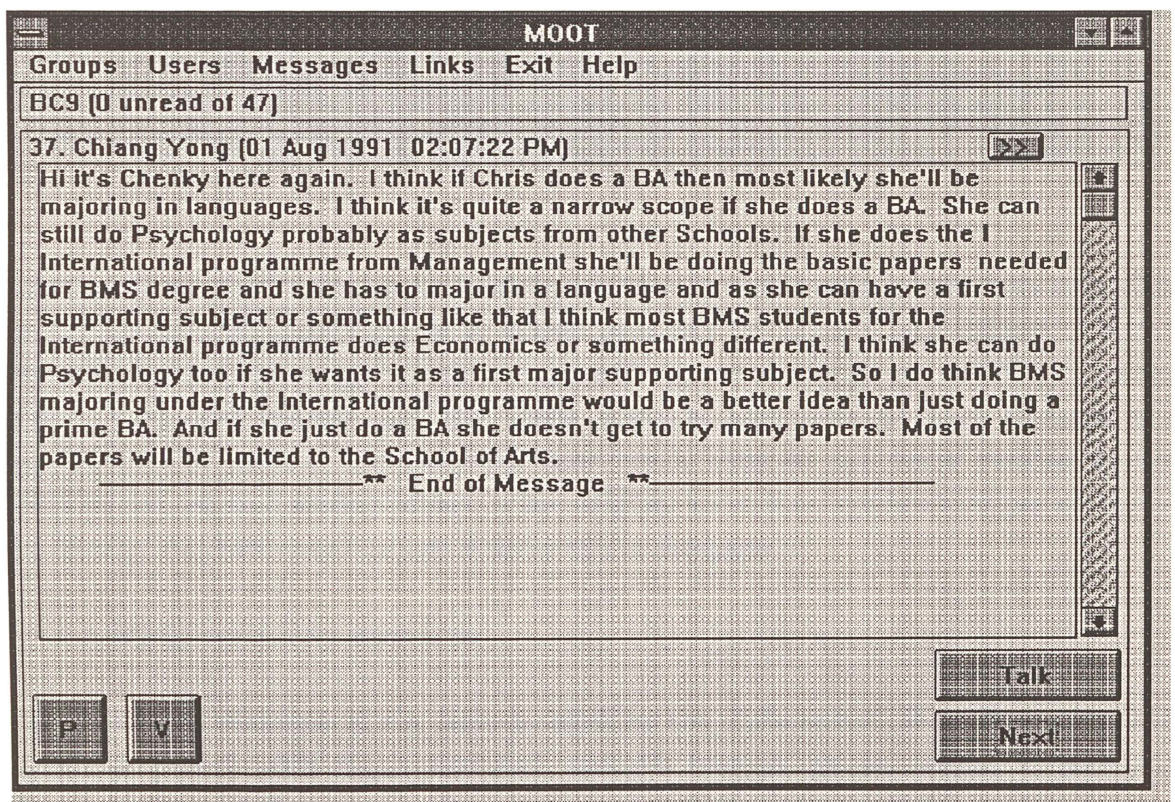
### 5.8.3 Automatically joining the discussion

The user is automatically connected to their group discussion (in the experiment, each subject was only a member of one discussion). The first unread message put in by other group members since that user's last sign-on is displayed on the screen. If the voice message as input has been transcribed, then the text of the message will appear in the box on the screen. If the transcription has not yet been completed, then the words "There is no text translation for this message yet" appears in the box.

At this point, the user can see the pull down menu buttons at the top of the screen, which hold the labels *Groups*, *Users*, *Messages*, *Links*, *Exit* and *Help*.

At the bottom of the screen, there are four buttons visible, labelled P, V, Next, and Talk, which will be discussed shortly.

**Figure 5.5 Main Screen**



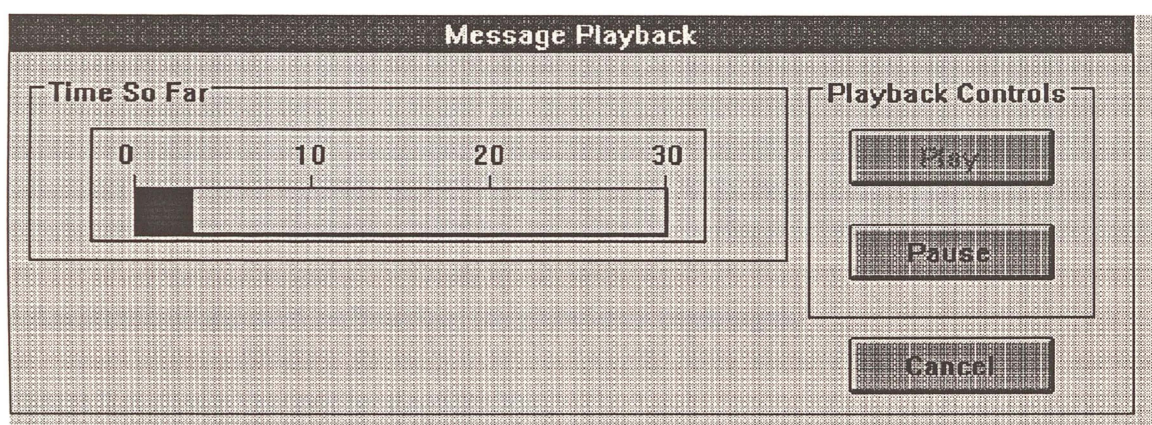
This screen contains the text that resulted from the conversion of the original voice input message.

### 5.8.4 Reading or listening to other's messages

The user can move from the present message displayed on the screen, either forward to see the next sequential message, or backward, to see again messages that had previously been viewed. The user can also listen to a replay of the original voice message presently displayed.

To see the text of the next sequential message in the discussion, the cursor arrow is moved over the *Next* button, and clicked.

**Figure 5.6 Voice Replay Controls**



To hear the original voice message connected to the text message currently displayed on the screen, the cursor arrow is moved over the "V" button, and clicked. A set of controls (figure 5.6) to regulate the replay will appear on the screen (with buttons for pause, play, and cancel) and the voice message will start to play through the headphones. A moving bar indicates how much time in the voice version of the message has elapsed during replay. If the original voice message is no longer available, the display will return to the text display of the message.

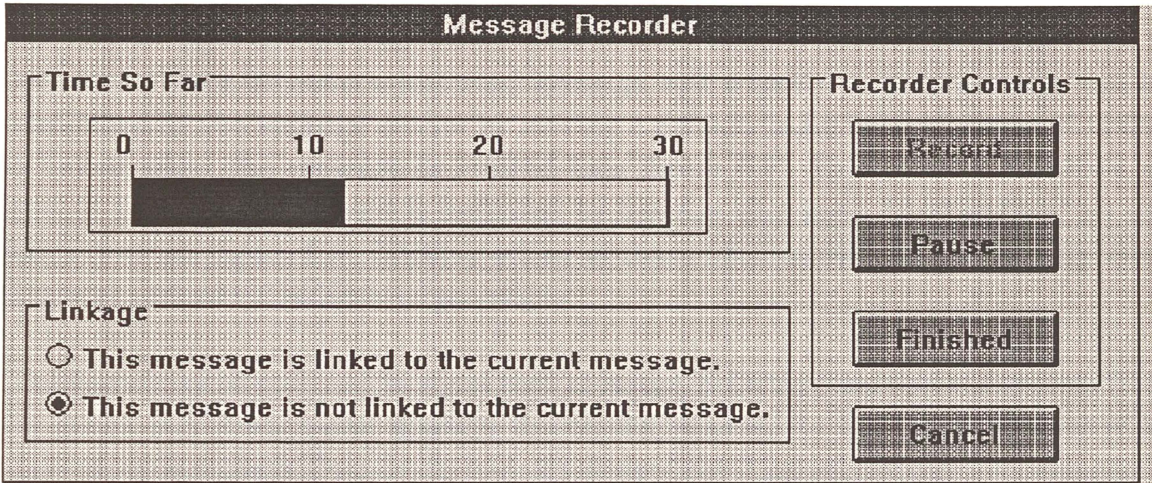
### 5.8.5 Adding your own message

The user can add a message at any time by clicking the *Talk* button at the bottom of the screen. A screen with "tape recorder" controls (record, pause, cancel, finished) is displayed (figure 5.7).

Clicking the *Record* button starts capture of microphone input. A moving bar showing that recording is in progress is displayed. No editing of the voice message is possible. A maximum message length of 180 seconds is permitted. The newly recorded message

may be played back if desired by pulling down the message directory, selecting the last message (the one just added), and clicking on the "V" button to hear it.

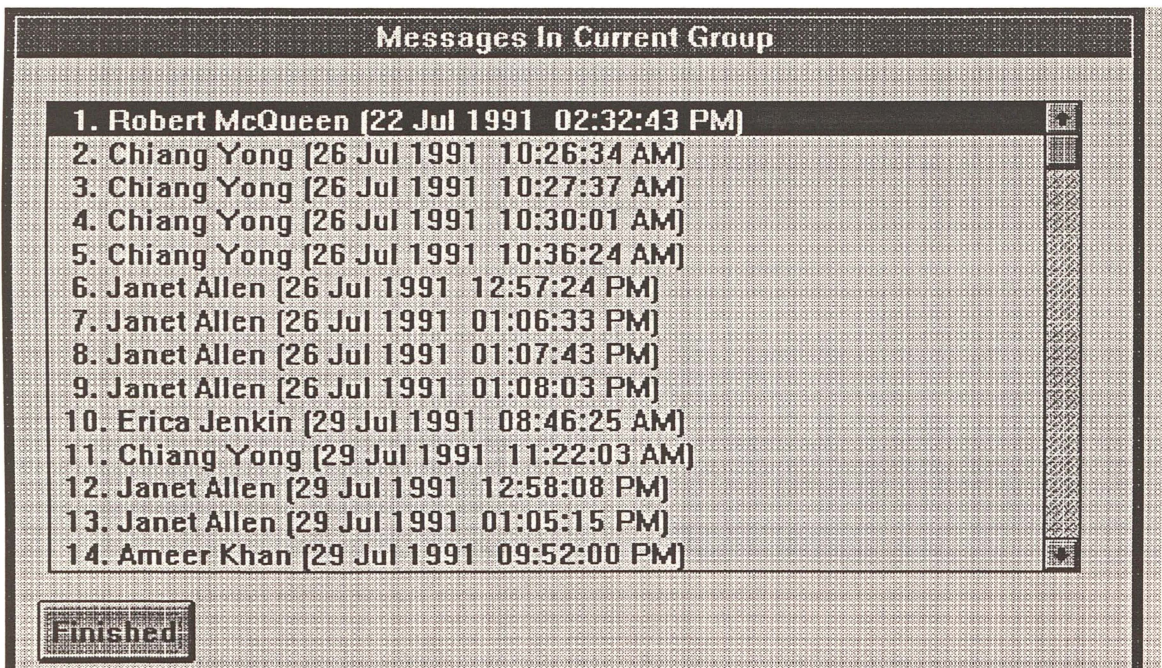
**Figure 5.7 Voice Recording Controls**



### 5.8.6 Reviewing and reflecting on previous messages

Figure 5.8 shows the group message list.

**Figure 5.8 Message List**



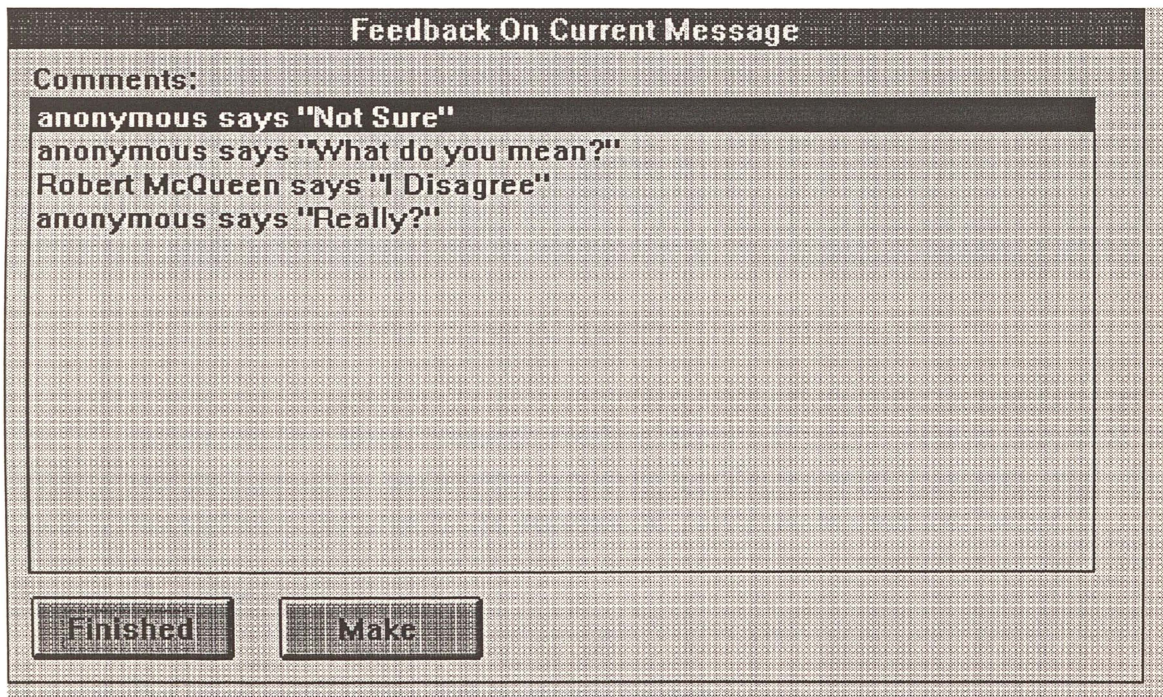
To see previous messages, the cursor is placed over the *Messages* pull down menu, and the *Directory* entry is selected. A list of all messages in the present group discussion is displayed, and the highlight can be scrolled and clicked to select one of the messages.

### 5.8.7 Other functions

Connection links between a just read message and a newly created message can be established by the message author by moving a default "radio button" from not linked to linked when the message is created (see figure 5.7). Existence of backward or forward links (if established) is indicated by buttons showing a "<<" or ">>" on the status line (see figure 5.5). Clicking either of these buttons will display the respective backward or forward referenced message.

Comments may be attached to a just read message. Selecting the *Comments* item from the *Links* pull down menu displays comments attached to the current message by other group members. Comments from a standard list (I agree!; rubbish!; sounds good!) may be selected and attached to the present message.

**Figure 5.9 Feedback From Other Participants**

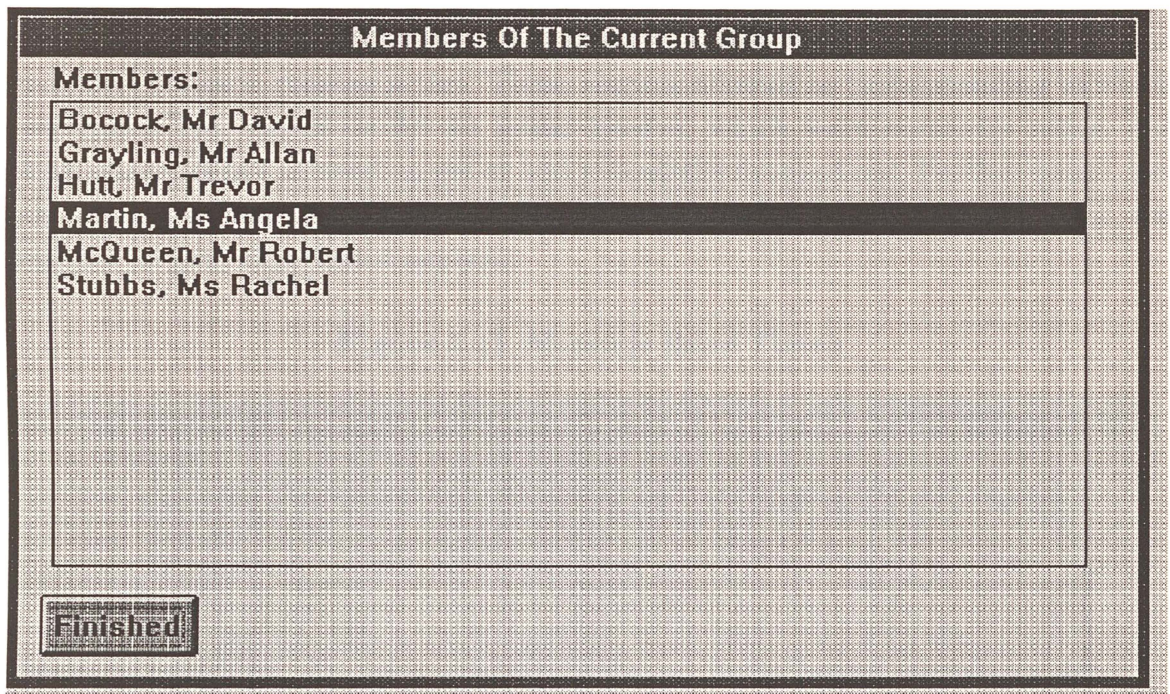


The *help* pull down menu was intended to contain context sensitive help information, but the data was not loaded in the prototype prior to running the experiment. Other

menu entries anticipating future feature enhancements which were not required for the basic operation of the prototype return a message "Sorry... this feature not implemented yet".

A list of the names of the members of the presently selected group can be displayed by pulling down the *members* menu and selecting the *member* bar. The display gives the full name of the member.

**Figure 5.10 Group Members List**



The "P" button on the main message reading screen (figure 5.5) was intended to display a still picture of the participant contributing the message. However, while the function was operable, pictures of the experiment participants were not loaded.

### 5.8.8 Signing off

To finish the Moot session, the *Exit* button is clicked.

## 5.9 Moot from the Experimenter's Viewpoint

### 5.9.1 Setting up users and groups

A utility program was available to key in the participant's names. The participant number (unseen by participants) was assigned as groups were created.

### 5.9.2 Monitoring subject usage

A report writing function was created to dump out the statistics collected. Time log records were appended to the message's readtimes file each time a participant read or listened to that message. The log record contained time stamps of start and end time (and date) for each reading action. These records allowed an understanding of which participants had signed on for an initial session, which were currently active, and which either hadn't showed up yet or had potentially dropped out. Further detail, like how long, and how many times each message was read by each participant was available for post-experiment analysis.

**Figure 5.11 Message Read Times**

When Current Message Has Been Read	
When Read:	
Rachel Stubbs for 56 seconds finishing	25 Jul 1991 01:49:20 PM
Trevor Hutt for 62 seconds finishing	26 Jul 1991 11:52:21 AM
Angela Martin for 17 seconds finishing	26 Jul 1991 03:56:56 PM
Trevor Hutt for 3 seconds finishing	27 Jul 1991 04:01:17 PM
Angela Martin for 32 seconds finishing	27 Jul 1991 04:28:26 PM
Angela Martin for 10 seconds finishing	28 Jul 1991 12:21:08 PM
Allan Grayling for 16 seconds finishing	28 Jul 1991 01:13:05 PM
Angela Martin for 6 seconds finishing	29 Jul 1991 04:23:39 PM
Allan Grayling for 21 seconds finishing	29 Jul 1991 11:02:33 PM
Allan Grayling for 2 seconds finishing	30 Jul 1991 11:01:10 AM
Angela Martin for 2 seconds finishing	30 Jul 1991 02:41:48 PM
Angela Martin for 1 seconds finishing	30 Jul 1991 02:43:26 PM
David Bocock for 11 seconds finishing	31 Jul 1991 10:50:26 AM
David Bocock for 2 seconds finishing	31 Jul 1991 10:57:36 AM

Finished

### 5.9.3 Transcribing the voice messages

A utility program was created to present the voice messages to a secretary for transcription. Controls similar to a dictation transcribing machine were provided to

pause, rewind 5 seconds, etc. Two transcription sessions a day were scheduled. However, during the first eight groups' use of the system, a backlog of voice messages developed because the transcription rate was not keeping up with the message creation rate.

This stretched into a three day delay between the time a voice message was entered and the time when the text transcription was available. During the final four groups' use of the system, the combination of an improved microphone arrangement (on the headset instead of on the desk) which provided more legible messages, and experience with the transcription process, resulted in less than 24 hour turnaround for message transcription. This meant that participants in these final four groups usually were able to see text transcriptions instead of having to listen to the original voice message.

#### **5.9.4 Managing the disk space**

The voice messages were digitized at the rate of 8,000 bytes per second. Compression was not used. This meant that a 3 minute voice message represented about 1.44 megabytes of data. As the transcription backlog mentioned above built up, the available disk capacity on the 100 megabyte disk was rapidly used up. Because the transcribed text equivalent of a 1.44 megabyte voice file was about 2400 bytes, text storage was far more efficient. Therefore, it was necessary to delete the voice messages as soon as they were transcribed to free up disk space for the next day's messages. The deletion of voice messages was a manual process, after a check was made to ensure that a corresponding text message existed.

#### **5.9.5 Assembling the transcripts**

The text objects associated with each voice message consisted of the following.

- a) the text transcription of the voice message
- b) the log of time stamps for each reading action
- c) the list of attached comments
- d) a list of connected objects

A utility program assembled the related text objects associated with each group, in the sequence that the voice messages were entered. An example of a segment of the transcript generated by the utility is given in Appendix 2.

## **5.10 Summary**

This chapter has described how the Moot prototype was created. A number of screen dumps and diagrams have been presented to show how the system would appear to a user. It is claimed that the development of this prototype system is innovative in using a voice input interface for asynchronous group communication, and further that it was highly successful in permitting the testing and comparison of voice input to text input media described in the chapter which follows.

## **CHAPTER 6**

### **AN EXPERIMENT TO COMPARE VOICE VERSUS TEXT INPUT AGC**

#### **6.1 Introduction**

This section describes the development and execution of an experiment to examine the usefulness of the voice input medium for asynchronous group communication. The experiment is constructed so that the voice input prototype can be compared to text input, as implemented on an existing computer conferencing system, with a face-to-face meeting as a control.

The results from the field study discussed in Chapter 4 indicated that information exchange was an important component of the business meetings observed. Therefore, the purpose of the experiment developed in this chapter is to evaluate the influence that the three media types (voice input, text input, and face-to-face) have on the ability of group members to exchange information amongst themselves. Other important group processes such as discussion, deliberation, consensus gathering, and decision making were not of primary interest in this study.

#### **6.2 Hypotheses**

To formalize the objectives and aid in subsequent analysis, the following research questions, and the hypotheses that they suggest, have been developed.

a) Research question 1: How is the number of words contributed by participants related to the medium of voice input compared to typed input?

H1a (null). The number of words contributed by a participant using the voice input medium will be no different than the number of words using typed input.

H1b. The number of words contributed by a participant using the voice input medium will be greater than the number of words using typed input.

b) Research question 2: For an information exchange task, will the number of facts disclosed by a participant to the group differ when voice input is compared to typed input?

H2a (null). The number of facts disclosed by a participant using the voice input medium will be no different than the number of facts disclosed using typed input.

H2b. The number of facts disclosed by a participant using the voice input medium will be greater than the number of facts disclosed using typed input.

c) Research question 3: Where a participant holds a large proportion of the facts held by all group members, how is the number of words contributed by that participant related to the medium of voice input compared to typed input?

H3a (null). The number of words contributed by a participant using the voice input medium will be no different than the number of words using typed input where a participant holds a large proportion of the facts held by all group members.

H3b. The number of words contributed by a participant using the voice input medium will be greater than the number of words using typed input where a participant holds a large proportion of the facts held by all group members.

d) Research question 4: Where a participant holds a large proportion of the facts held by all group members, how is the number of facts contributed by that participant related to the medium of voice input compared to typed input?

H4a (null). The number of facts disclosed by a participant using the voice input medium will be no different than the number of facts disclosed using typed input where a participant holds a large proportion of the facts held by all group members.

H4b. The number of facts disclosed by a participant using the voice input medium will be greater than the number of facts disclosed using typed input where a participant holds a large proportion of the facts held by all group members.

e) Research question 5: Where a participant holds a small proportion of the facts held by all group members, how is the number of words contributed by that participant related to the medium of voice input compared to typed input?

H5a (null). The number of words contributed by a participant using the voice input medium will be no different than the number of words using typed input where a participant holds a small proportion of the facts held by all group members.

H5b. The number of words contributed by a participant using the voice input medium will be greater than the number of words using typed input where a participant holds a small proportion of the facts held by all group members.

f) Research question 6: Where a participant holds a small proportion of the facts held by all group members, how is the number of facts contributed by that participant related to the medium of voice input compared to typed input?

H6a (null). The number of facts disclosed by a participant using the voice input medium will be no different than the number of facts disclosed using typed input where a participant holds a small proportion of the facts held by all group members.

H6b. The number of facts disclosed by a participant using the voice input medium will be greater than the number of facts disclosed using typed input where a participant holds a small proportion of the facts held by all group members.

### **6.3 Overview of the Experiment**

The objective of the experiment was to measure information exchange in a group discussion, using the new medium of voice input asynchronous group communication, and compare this with typed input AGC, and traditional face-to-face group meetings.

To provide a basis on which information exchange could be structured and observed, "information profiles" of three prospective university students were developed, and then the information subdivided into five parts for each profile. The task given to each experimental subject, and their group, was to formulate advice to this prospective student on which degree should be undertaken, and what institution should be attended.

Each individual group member held seemingly unconnected pieces of information, which formed parts of the whole body of information about the prospective student. Individuals did not know which of the pieces of information they held were shared by other group members.

The underlying need, as perceived by group members, was to exchange their information (whatever they saw as relevant to the discussion) with the others in the group, discuss the suggestions and opinions of what should be recommended to this prospective student, and finally agree on a consensus piece of advice for that student.

The discussions of group members would be recorded, and subsequently analyzed, with respect to this information exchange component. The actual advice offered was of no interest.

## **6.4 Factors Considered in the Experimental Design**

Once the basic design of the experiment was conceived, there were a number of detailed questions that had to be resolved. This section raises the factors about the experimental design that were considered at the outset.

On experimental subjects:

- should subjects be members of one, or more than one group?
- should the group size be small, or large, or mixed?
- how many test subjects would be required
- what would be the subject motivation for participating in the experiment?

How would the data be captured?

- observation with video tape?
- computer transaction logging?

What would be the measurement parameters?

- number of words exchanged?
- total group member time on problem?
- elapsed time?
- percent of all facts brought before group?
- percent of individual's facts contributed?
- "correctness" of solution?

After the observations were finished, what would be the expected analysis methods?

- coding of videotaped sessions
- statistical analysis

All of these questions could be resolved into "How to get key results without complicated interdependencies, and with a minimum number of experimental situations?" This then led to the following specific questions.

1. How many groups are needed (10?, 30?)
2. What should be the group size (5? 10?)
3. How many media to test (2? 3? 4?)
4. Can the tasks be made sufficiently similar?
5. Order of tasks - will that matter?
6. Order of media use - will that matter?
7. Should the same group use all media?
8. Should the same subjects be mixed into different groups?
9. Anonymity?
10. Motivation?
11. Subject payment terms: hourly, prize for best?
12. What type of students? soc sci? mgmt? compsci? (literacy)

And finally, an important complication factor. There was only one workstation of the voice input prototype operating. How should this be incorporated into the experimental design?

## **6.5 Development of the Experiment**

### **6.5.1 Experimental objective**

a). **Information exchange:** for each of the communication media (and particularly the voice input system compared to the keyboard input CoSy system), measure the portion of the available information facts presented by each individual to the rest of the group.

b). **Participation rates:** to see if the amount of participation in the discussion (number of words) is related to the number of information facts held by that speaker, and whether the medium used seems to enhance or inhibit participation by those holding key pieces of information.

## 6.5.2 Variables in the experiment

### 6.5.2.1 Independent Variables

#### a) Communication media

To hold the experiment size to a manageable level, the media to be used are the following:

1. face-to-face group meeting
2. voice input AGC
3. text based AGC

#### b) information exchange task

-3 tasks, rotated through each medium

#### c) group membership

-randomly assigned

#### d) sequence of tasks and media

- each group performs 3 tasks
- each group uses a different medium for each of their three tasks
- order of medium used is rotated
- order of tasks is rotated

### 6.5.2.2 Measurements

#### a) definitions:

**transaction:** segment of spoken or written communication begun and ended by a change in speaker in the sequential transcript of the discussion. Contiguous messages, contributed by one speaker during one session on Moot or CoSy without significant time gaps between , are considered to be combined into one transaction. A transaction may be of an information exchange type, or other type.

**information fact:** an individual piece of data, which may be either be unique (held by only one group member), or shared (held by two or more group members).

**information exchange:** the presentation to all members of the group of an information fact, through a communication medium to which all group members have access.

b) of primary interest:

1. Information facts presented to the group by participants
2. Number of words used by participants

Groupings:

- by medium used
- by participant
- by group totals

c) of secondary interest:

1. differences in participation and contribution rates by individual subjects across the three media
2. differences in dominant behaviour and passive behaviour shares across the three media.

d) to examine unintended interdependencies:

- differences among tasks
- order of usage of media
- order of tasks

### **6.5.3 Other observations to be collected**

a). Individual users usage: achievement of design goals for user interface

- observation of new users (videotape)
- keyboard logging
- post usage questionnaires

b). Testing of task model design:

- primarily information exchange
- support for dominant speakers
- support for ease of listening
- support for ease of contributing

#### 6.5.4 The experimental setup

**Subjects:** All 57 subjects were undergraduate students at the University of Waikato, typically in their second year of studies. About 45 of the subjects were enrolled in a second year Business Communication course in the School of Management Studies. The remainder came from a second year Microcomputer Applications in Business course. All were paid \$25 for their participation in the experiment.

**Group membership:** Each subject was randomly assigned to a group by the following method. An initial explanatory meeting was set for all those who were to take part. As the subjects came into the room for the meeting, they were assigned to a group (the first 5 to group one, the second five to group two, etc.).

**Number of groups:** The experiment was designed for 12 groups, with a nominal 5 members per group, as the minimum number of groups which might give statistically significant results on analysis of the data. This number was a compromise between 20 groups of 8 (not feasible due to equipment and finance restrictions), and 9 groups of 5, which would have matched the 3 x 3 blocked design, but perhaps produced results which would be hard to derive statistical significance.

**Group size:** While a group size of 8 to 10 would have been desirable, a compromise nominal size of 5 was set due to the restrictions on equipment and the funds available to pay the participants.

**Task set:** There were three separate information exchange scenarios (tasks). Each group undertook a different task scenario on each of the three media. The task names will be referred to by the name of the student characterized in the scenario; Andy, Betty and Chris. Each of the task sets consisted of two pages of background information on what was expected to be accomplished by the participants, and an unnumbered list of one to two line information facts. For a given group and task, there would be a different individual fact list prepared for each of the five group members. Some of the facts on each list would be unique (given only to one group member) and some would be shared (given to one or more other group members). While the content of the information facts was different for each of the three tasks, the number of unique and shared facts given to a particular subject was the same across the three tasks, allowing across-task (and across-media) comparisons to be made.

**Tasks on media:** the assignment of the three tasks to the three media was rotated. The following table shows the group number using each task on each media.

	<u>Andy</u>	<u>Betty</u>	<u>Chris</u>
Moot	1,4,7,10	2,5,8,11	3,6,9,12
CoSy	3,6,9,12	1,4,7,10	2,5,8,11
Face	2,5,8,11	3,6,9,12	1,4,7,10

Media order: the sequence in which the three media were used by each group was rotated.

<u>Media order</u>	<u>First</u>	<u>Second</u>	<u>Third</u>
Groups 1,2,3,4	Moot	CoSy	face
Groups 5,6,7,8	face	Moot	CoSy
Groups 9,10,11,12	CoSy	face	Moot

Task order: the order in which the tasks were undertaken was the final variable which was controlled. However, due to the effects of the preceding rotations desired, it was not possible to evenly distribute the order in which tasks were undertaken. However, the similarity of the tasks were such that the effect of task order was expected to be small.

<u>Task order</u>	<u>First</u>	<u>Second</u>	<u>Third</u>
Groups 1,4,5,8,9,12	Andy	Betty	Chris
Groups 2,6,10	Betty	Chris	Andy
Groups 3,7,11	Chris	Andy	Betty

Individuals do not know which pieces of information about the task subject are known to others (shared), or known to them alone (unique).

Subject task objective: The instructions given to the group were such that members were expected to perceive that the primary objective was not information exchange per se, but the attainment of a goal (i.e. recommendation of a course of study).

Distribution of facts: A total of 65 unique and shared facts, and opinions/biases were available overall to each group for each task. The distribution of facts to role was identical for all three tasks, although the individual facts were different for each task. While participation rates were not the central focus of this study, non-equal participation profiles were expected among the subjects. However, it was desired to study the relationship between participation rates and number of facts held. Therefore, subjects were provided with varying numbers of information facts, as in the following table. Some facts are common to all group members, some are shared by a subset of the group, and some are known by that member alone. In addition, each

participant had two personal biases and one adviser opinion supplied, unique to that role, which were intended to encourage the subject to actively participate.

info facts id #								
Role	Unique	Shared	ao	pb	u	s	tot	
1	1-20	41-50	1	2	23	10	33	has highest number of facts
2	21-35	41-50	1	2	18	10	28	
3	36-38	45-50	1	2	6	6	12	
4	39-40	45-50	1	2	5	6	10	
5	nil	45-50	1	2	3	6	9	has fewest number of facts

ao=advisers opinion, pb=personal biases, u=number of unique, s=number of shared, tot=total facts for this role

Media used: Moot was the name given to the voice input group communication system prototype described previously. For the first eight groups (1-7&12), voice input was captured by a desktop directional microphone and voice messages were output through a desktop 4 inch speaker. For the last four groups (8-11), a chin mike/headphone assembly was used to more accurately position the microphone to maximize speech quality and minimize background noise. Only one computer was available with Moot, so users had to book 15 minute slots to use the system. Most groups completed their Moot tasks within one week.

CoSy is a computer conferencing software system developed at the University of Guelph, and a copy is installed on the University of Waikato VAX cluster. Messages are typed in through VT220 terminals, of which a relatively large number are available on campus, so that no pre-booking of CoSy sessions was required. CoSy would normally be operated in an asynchronous manner (participants on at different times). For the first eight groups (1-7&12), this was the case, and they completed their CoSy-based task over an elapsed time of about a week. For the last four groups (8-11), it was arranged that all participants for a given group using CoSy were simultaneously logged on, (synchronous) but physically separated. These groups completed the CoSy-based task over an elapsed time of about an hour.

Face-to-face meetings were scheduled and held in a room equipped with an unobtrusive surveillance-type video camera and microphone. The duration of the meeting was recorded on videotape. Most of the face-to-face meetings were about 30 minutes in duration.

### **6.5.5 Materials used by the participants**

#### **a) The Andy, Betty and Chris tasks.**

It was desired to construct a set of tasks which would fulfil various goals. Since investigation of information exchange was the primary objective of the research, the tasks had to have information that could be exchanged among group members across the three media planned. The tasks, and the individual roles for each of the tasks, had to have a sufficient volume of facts so that it would not be a trivial effort to contribute all of them. The facts had to have a range of utility to the group discussion, so that some decision was made by each participant as to which facts were to be contributed.

All three tasks were similar, in that the group was presented with a number of facts about a prospective university student and asked to offer suggestions as to what course, degree and university would be most appropriate for that student. It was hoped that the discussion and agreement on the recommendation would be the primary focus of the group discussion, with information exchange of the available facts providing the supporting background information to the discussion. The complete set of facts for the Andy, Betty and Chris tasks are given in Appendix 1.

Five subsets of facts were developed for each task from the complete set, corresponding to the roles for group members 1 to 5, as described in the previous section. Member 1 had the most unique facts and member 5 had the fewest, for each of the three tasks.

#### **b) Introductory material**

With each subset of information facts provided to each group member, there were a few paragraphs of material instructing members what to do and how to complete. This was common for all subsets of all tasks, and is reproduced in Appendix 1.

#### **c) Group decision report**

Group member 5 for all tasks (who had the least number of facts) was given an additional role to write down and hand in the group decision/recommendation on a form provided (Appendix 4).

#### **d) Member timesheet**

All participants were given a log sheet on which to record the date, time and duration for each of their sessions on the three tasks/media (Appendix 5). This was intended to be used as a cross check against the automatic data captured by the Moot and CoSy systems. This sheet was handed in at the end of the third task, and was the trigger to send out the \$25 payment cheque.

#### e) Media instructions

Each member received a one page introduction to Moot, CoSy and face-to-face meetings (Appendix 3). In addition, a brief 10 page CoSy manual was also included with the materials provided to each participant.

#### f) Conference setups and initial message

The conferences in both Moot and CoSy were set up with just the intended participants as members. Each member would see only the comments relevant to their group discussion, although there were some (Moot) and many (CoSy) discussions in progress on each system with other subsets of the system's user population. In each of the group discussions (12 each on CoSy and Moot) an initial welcome message was provided to confirm that the group members had found their way to the right discussion.

### **6.5.6 Recruitment and training of participants**

To fully populate all 12 groups with five members per group, sixty participants were needed. Fifty seven began the experiment, and fifty six completed. It was originally hoped that all could be recruited from the population of one course in the Management Studies school, but this was not possible. Groups 1 to 9 were primarily students enrolled in a second year Management Studies course on Business communication, and groups 10 to 12 were drawn from a second year Computer Science course (Microcomputer Applications in Business) which contains primarily non-computer science majors.

Nine of the twelve groups started and ended with the full five members. Group 12 started and ended with four members. Group 1 started with five members and ended with four members. In this group, the only dropout of the experiment made only one contribution in the first task on Moot before withdrawing. Group 6 started and ended with 3 members.

Subjects attended a 35 minute introductory meeting prior to the start of their usage. As they entered the room for the meeting, they were assigned to a group and asked to record their name and phone number on a group sheet. As the face-to-face meeting segment would require them to meet at a common time, they were asked to consult their personal timetables and work out a mutually agreeable time. The formal part of the meeting consisted of a brief demonstration of the two electronic media, CoSy and Moot, that they would be using.

Group members were identified by a group number (1 to 12) and a member number in that group (1 to 5).

Individually assembled envelopes were handed out to each participant which contained the following:

- a) three sealed envelopes, each containing that participant's set of facts for the tasks Andy, Betty and Chris. Each envelope had a message on the outside with the task name, medium name, group and member numbers, and a message "do not open before March 18", or whatever the scheduled start date for the task might be. The envelope of the number 5 member of each group also contained a pink task completion sheet which that member was to complete and hand in at the end of each of the three tasks.
- b) A 10 page manual on the CoSy conferencing system
- c) A yellow log sheet to record time used in the experiment
- d) A card key to allow after hours and weekend building access to the Moot room and the Vax terminal rooms.

The use of CoSy on the Vax required participants to obtain a Vax account through an interactive procedure at a terminal, then wait a day until the account was set up, then log in to the Vax, and then log in to CoSy. Needless to say, there were a few difficulties getting some of the participants through this process, and they were encouraged to try to get this all sorted out in the week prior to their scheduled use of CoSy for the experiment. An on-line tutorial (about 10 to 15 minutes) was available on CoSy to explain the system's basic functions, and participants were asked to go through it before starting their CoSy task.

No training or self-study tutorial, other than the initial meeting's 10 minute demonstration, was given on Moot, as it was felt that the mouse based interface could be quickly picked up.

## **6.6 Operation of the Experiment**

### **6.6.1 Starting dates and duration**

The first group (number 12) began their first task on CoSy on March 8th, and completed it on March 13th, 1991. Their second task was face-to-face on March 14, and their third task was on Moot from March 17 through March 26th. Seven other groups (numbers 1 to 7) started their first tasks on March 18, and generally finished their third task by April 10th. The final four groups started their first task on July 17th, and generally finished their third task by July 31st.

For all groups, the task on Moot took about a week elapsed time (typically five sessions per participant, one per day), while the face-to-face session took about a half-hour on one day. For eight of the groups (1-7, 12), the CoSy sessions were spread over a week (typically one login session per day). For the remaining four groups (8-11), the CoSy sessions were mostly completed within one hour of simultaneous connection on one day.

### **6.6.2 Transcripts**

To analyse the presentation of information facts by the participants, a transcript of each use of each medium was required.

Moot required transcription of the recorded voice messages to text, which would then be available for other group members to read on the screen. Originally, it was hoped that transcriptions of the previous day's voice messages could be prepared in an hour or two the next morning, but unfortunately this process took considerably longer than expected, with the result that few messages of the Moot discussions for the first eight groups (1-7, 12) were converted by the end of each group's discussion week. The last four groups (8-11) were more fortunate to be able to have most voice input messages transcribed within 24 hours. A few voice input files were unable to be transcribed due to the rapid filling of the disk and one short period of microphone disconnection. However, all others were transcribed successfully, and were then printed out to form the transcript of each group's discussion on Moot.

CoSy transcripts were an automatic by-product of the typed-in messages, and it was a simple matter to dump out the transcripts of each group's discussion. All messages were successfully captured, with the exception of about five late added comments for group 6.

The audio portion of the face-to-face meeting sessions, recorded on videotape, were copied to cassette tapes and then transcribed by a typist to a word processor document. A second pass through the video tape allowed speaker identification to be added to the transcript.

Examples of a few pages of transcripts, for one group from each of their three tasks on the three media, are given in Appendix 2.

### **6.6.3 Technical problems**

It is unusual for any newly created piece of software or computer system to be installed and run perfectly, and absolute perfection was not to be found with this experiment. However, the equipment and the prototype voice input software did operate in a most satisfactory manner. No software dysfunctions occurred that had a significant effect on the operation of the prototype or on the participants using it. However, some minor problems occurred involving all three media, and they are described below.

#### **6.6.3.1 Moot technical problems**

##### **a) Recording time**

Group 12 were the first "real" users of the prototype Moot voice input AGC system. The key elements of the prototype, namely the recording and playback of voice messages, worked well from the start and through to the completion of the experiment. However, after group 12 had added their first few messages, it became obvious that the initial 30 second maximum voice message length was too short. This was extended quickly to 180 seconds (3 minutes), which proved to be adequate for the rest of the groups.

##### **b) Microphone**

The first eight groups used a desktop directional microphone for voice input. However, this picked up noise from the computer's fan and disk drive, and made listening to some of the soft-spoken participants a bit difficult. This was improved for the final four groups with the use of a microphone located on a headset. However, the microphone was inadvertently disconnected by a participant in the second set of four groups, and a few messages were "talked in" in some of the groups before the problem was discovered and corrected. When the participants involved connected subsequently, they repeated the earlier contribution.

#### c) Auto group connection

During the use of Moot by the first four groups, it was noticed that one of the twenty participants was putting his initial comments in the wrong conference. This was corrected immediately by instructing that participant in the correct joining procedure, and followed up by a software checking procedure on sign-on to restrict access to only the proper group.

#### d) Disk capacity

The computer available had a hard disk with about 80 megabytes of available disk. Because of the rate at which voice messages were recorded and the slow rate of transcription from voice to text, the disk rapidly filled during the first eight groups' use of Moot. Voice files which had been transcribed to text were deleted to free up disk space on a daily basis, and this was a process that resulted in several untranscribed messages being deleted. However, the messages that were lost were about a week old at the time, and most group members had listened to them in voice form prior to their deletion. The only loss was therefore to the final printed record.

#### e) Speed

As additional messages were added to the database by the initial set of eight groups, response time to join a group or add a message grew into the 20 to 30 second range, although most operations were not affected. This was easily corrected for the second set of four groups by reorganising the file directory hierarchy, which improved the response time for those functions to a few seconds.

### 6.6.3.2 CoSy technical problems

CoSy worked without problem during the experiment. However, after the completion of the CoSy task by group six, a few late comments were added by group members that were not captured on the session transcript file before a system cleanup initiated by others deleted them. It is likely that the lost comments, coming at the end of the discussion, did not have a high level of "information fact" content if similar to the patterns seen in all other discussions, and therefore would have had little impact on the outcome.

### 6.6.3.3 Face-to-face technical problems

The face-to-face sessions were recorded on videotape, with sound input from a wall mounted surface effect microphone. In general, the sound quality was sufficiently good quality to be able to extract the speaker identification and the information facts as they were contributed, but not high enough to be able to transcribe every word of every speaker. Participant mumbling and simultaneous talking were also problems. An

intermittent electrical buzzing was picked up by the recording circuits from computer equipment on the floor above the meeting room, and made transcription of some parts of the tapes a bit difficult.

#### **6.6.4 Administrative problems**

Up to 36 participants were actively using some of the facilities of Moot, CoSy, or the face-to-face meeting on any given day during the operation of the experiment. In retrospect, the effort that was put into task scheduling and setup prior to the use of the facilities paid dividends when those facilities were used. Both Moot and CoSy were operated in an unattended mode. The building containing the Moot prototype and CoSy terminals was open from 7am to 8pm, and late night and weekend access was possible with the use of the card key provided to participants.

##### **a) Moot administrative problems**

**Single machine:** Only one machine was available for Moot, so participants were required to schedule 15 minute slots. About half the slots available in any given day were used, although those at some popular times were in demand. In some cases, a participant would overflow their slot into the next, causing a bit of aggravation.

**Transcription:** The amount of time required by the secretary to transcribe a day's voice messages into text was underestimated, with the result that voice to text transcription fell behind during the first set of eight groups using Moot. This caused some loss of available time slots to Moot users, and unavailability of text transcriptions to next-day participants. It also indirectly caused the rapid growth in large voice files (1 megabyte for two minutes speech) and the pressure on disk capacity. These problems did not occur with the second set of four groups, as experience with the transcription process by the secretaries enabled them to keep up to date.

##### **b) CoSy administrative problems**

The security associated with the use of the campus VAX, on which the CoSy software runs, caused a few problems in getting IDs set up for participants. The ID system requires a student to be enrolled for a particular course to gain computer access; in some cases, late enrolments in the course from which experiment participants had been drawn had not yet been processed, blocking the issue of an ID. Once an ID is granted, it takes one to two days for the authorization to be processed so that access to CoSy is enabled. Several students in the first eight groups left the sign-up process to the scheduled start of the CoSy task, resulting in a sign-on a few days later in the discussion. In the last set of four groups where CoSy usage was simultaneous within a one hour period, a temporary ID was given to two students who turned up without the

ID assigned. However, almost all of the participants got through the signup process without incident, and went straight into the CoSy task.

#### c) Face-to-face administrative problems

Group four's face-to-face meeting was not recorded due to an operational error in starting the videotape recorder. All other eleven groups were recorded successfully.

### 6.6.5 Completion of the tasks

Participant drop-out was one problem that was anticipated, but did not occur to any significant extent. Fifty seven participants started the experiment, and fifty six completed. In retrospect, the payment incentive (\$25), and the interesting nature of the experiment likely kept almost all of the starting participants through to the finish.

## 6.7 Coding of the Transcripts

The primary output from each of the group discussions, using each of the three media, was a printed transcript of the contributions by all of the group members. The information facts that had been provided to each individual group member were compared to the facts presented by that group member in each of their contributions to the group discussion. The "facts" contributed by each group member in each group discussion were accumulated in four categories, corresponding to whether the facts were solely held by that person, or shared with one or more other group members.

The data from the transcripts for Moot and CoSy was entered into a spreadsheet in a preliminary step. 731 records were created, with each record corresponding to one transaction. Each transaction was usually equivalent to one contributed message by one speaker in the discussion, with the exception that multiple contiguous messages, by one speaker within a short contiguous time block were treated as one transaction.

The record contained the following nine fields:

- |           |  |
|-----------|--|
| 1. group  | group number; from 1 to 12                                       |
| 2. member | group member number; corresponding to role, from 1 to 5          |
| 3. medium | discussion medium; either CoSy or Moot                           |
| 4. task   | task name; either Andy, Betty or Chris                           |
| 5. sync   | mode of the discussion; either synchronous or asynchronous       |
| 6. seq    | performance sequence of this task/media by this group; 1, 2 or 3 |
| 7. trans  | transaction number for this group discussion                     |
| 8. word   | number of words spoken or typed in this transaction              |
| 9. fact   | number of facts presented during this transaction                |

A fact was counted if that member had that fact available on their sheet. Advisers opinions and personal biases, also given on the sheet, were also counted as facts. A fact was not counted if it was not available on the member's sheet (i.e., if it was a restated fact originally given by others). A fact was counted more than once if given more than once by that speaker, which resulted in greater than 100% contributions for some members.

The data records above were then accumulated into 114 new records, by group and member, which contained the following fields:

1. group            group number; from 1 to 12
2. member        group member number; corresponding to role, from 1 to 5
3. medium        discussion medium; either CoSy or Moot
4. task            task name; either Andy, Betty or Chris
5. sync            mode of the discussion; either synchronous or asynchronous
6. seq            performance sequence of this task/media by this group; 1 2 or 3
7. rolfact        total role facts available to this member for this task from sheet.

And the following accumulations, by this group member in this media/task discussion

8. trans        total transactions by this member
9. word        total words spoken or typed
10. fact        total facts presented

## 6.8 The Observed Data

This section gives a first look at the data observed in the experiment. The following section, 6.9, reports on statistical analysis of this data.

### 6.8.1 Means

The following table gives some basic means from the data. Under the sync column, sync indicates those cases where CoSy participants were connected simultaneously, but physically separated. Grp indicates the group number, grptran the total transactions for the group, grpfact the total facts disclosed for the group, and grpword the total words used by the group.

**Table 6.1 Means**

media	task	seq	sync	grp	grptran	grpfact	grpword
CoSy	betty	2	async	1	19	15	1216
CoSy	chris	2	async	2	23	25	2097
CoSy	andy	2	async	3	29	36	3675
CoSy	betty	2	async	4	18	11	1068
CoSy	chris	3	async	5	33	37	4671
CoSy	andy	3	async	6	8	25	430
CoSy	betty	3	async	7	31	34	1724
CoSy	chris	3	sync	8	118	53	2991
CoSy	andy	1	sync	9	36	34	3957
CoSy	betty	1	sync	10	77	28	2373
CoSy	chris	1	sync	11	72	43	1586
CoSy	andy	1	async	12	31	44	4514
TOTALS					495	385	30302
MEANS					41.3	32.1	2525
Moot	andy	1	async	1	16	19	3975
Moot	betty	1	async	2	22	28	4502
Moot	chris	1	async	3	21	47	3787
Moot	andy	1	async	4	21	36	5767
Moot	betty	2	async	5	19	24	2959
Moot	chris	2	async	6	16	42	2874
Moot	andy	2	async	7	15	23	1830
Moot	betty	2	async	8	24	51	4411
Moot	chris	3	async	9	24	34	7493
Moot	andy	3	async	10	32	37	3460
Moot	betty	3	async	11	16	63	3851
Moot	chris	3	async	12	10	40	3704
TOTALS					236	444	48613
MEANS					19.7	37	4051

Ten of the twelve groups had higher word counts with Moot than with CoSy. Eight of the twelve groups had higher or equal information fact counts with Moot than with CoSy. 15% more facts overall were contributed on Moot than with CoSy. 60% more words were given in Moot than with CoSy. The number of transactions used in Moot was only 47% of those used in CoSy.

### 6.8.2 Individual member comparison across media

The table below compares the transactions, facts and words used by each of the 57 experiment subjects in each of the CoSy and Moot media.

**Table 6.2 Member Comparison**

grp	memb	transact.		facts given		words used	
		CoSy	Moot	CoSy	Moot	CoSy	Moot
1	1	1	3	1	0	56	577
1	2	9	5	4	9	668	2176
1	3	0	1	0	1	0	42
1	4	8	4	8	7	362	703
1	5	1	3	2	2	130	477
2	1	5	4	6	3	748	1088
2	2	4	3	8	14	288	753
2	3	5	4	4	5	464	449
2	4	4	6	4	6	467	1417
2	5	5	5	3	0	721	795
3	1	6	5	17	26	991	702
3	2	5	5	2	8	661	948
3	3	5	2	6	0	569	456
3	4	4	5	5	7	636	581
3	5	9	4	6	6	818	1100
4	1	4	5	3	12	263	859
4	2	3	4	0	11	121	875
4	3	4	3	4	3	254	813
4	4	2	4	1	6	236	1172
4	5	4	5	3	4	194	2048
5	1	9	3	13	3	1366	374
5	2	5	1	8	3	357	94
5	3	6	4	6	6	1134	590
5	4	5	5	6	8	734	505
5	5	8	6	4	4	1080	1396
6	1	2	5	15	27	120	1134
6	2	3	6	5	6	105	883
6	5	3	5	5	9	205	857
7	1	2	0	14	0	153	0
7	2	5	4	11	10	402	522
7	3	7	4	3	4	443	484
7	4	10	4	3	7	551	230
7	5	7	3	3	2	175	594
8	1	29	5	22	27	767	751
8	2	25	4	14	9	644	880
8	3	22	6	5	9	471	864
8	4	11	5	7	4	359	680
8	5	31	4	5	2	750	1236
9	1	5	3	6	10	749	2540
9	2	5	4	4	7	294	1131
9	3	13	4	15	3	1674	668
9	4	2	8	4	8	560	1459
9	5	11	5	5	6	680	1695
10	1	19	8	12	27	627	1658
10	2	16	8	8	5	420	454
10	3	18	5	3	2	402	599
10	4	13	5	4	3	495	423
10	5	11	6	1	0	429	326
11	1	10	2	17	16	361	633
11	2	15	3	10	22	284	693
11	3	13	4	1	4	176	797
11	4	16	3	10	17	277	1037
11	5	18	4	5	4	488	691
12	1	7	2	25	20	1544	1284
12	2	7	3	8	11	1052	1798
12	3	9	2	6	8	921	195
12	5	8	3	5	1	997	427
MEANS		8.7	4.1	6.6	7.8	541	853

41 of the 57 participants (72%) had higher word counts on Moot than on CoSy. Mean words used was 58% higher on Moot than on CoSy. 29 subjects had higher fact counts on Moot than CoSy, 4 were the same, and 24 had higher counts on CoSy. Two participants (1-3 and 7-1) did not participate in CoSy and Moot respectively.

### 6.8.3 Role number comparison across media

This table compares the facts contributed in accumulations by role across the CoSy and Moot media.

**Table 6.3 Contributed Facts**

role	media	#of grps	tot trans	tot facts	role fact	%facts given
1	CoSy	12	99	151	30	42%
1	Moot	12	45	171	30	48%
2	CoSy	12	102	82	25	27%
2	Moot	12	50	115	25	38%
3	CoSy	11	102	53	9	53%
3	Moot	11	39	45	9	45%
4	CoSy	10	75	52	8	65%
4	Moot	10	49	73	8	91%
5	CoSy	12	116	47	6	65%
5	Moot	12	53	40	6	55%

For those roles holding the most task facts (1 & 2), Moot users presented a higher proportion of facts held than CoSy users. For the roles holding a smaller portion of the task facts (3,4 & 5) the results were mixed.

### 6.8.4 Volume of words by medium

This table compares the words used, accumulated by role, on the CoSy and Moot media. Total facts contributed by role is compared to the available facts for each role as a percentage.

**Table 6.4 Words by Role**

role	media	#of grps	tot words	tot facts	words/fact given
1	CoSy	12	7745	151	51
1	Moot	12	<u>11600</u>	171	68
			19345		
2	CoSy	12	5296	82	65
2	Moot	12	<u>11207</u>	115	97
			16503		
3	CoSy	11	6508	53	123
3	Moot	11	<u>5957</u>	45	132
			12465		
4	CoSy	10	4677	52	90
4	Moot	10	<u>8207</u>	73	112
			12884		
5	CoSy	12	6667	47	142
5	Moot	12	<u>11642</u>	40	291
			18309		

For 4 of the 5 task roles, the number of words used in Moot exceeded those in CoSy by a considerable margin. Roles 1 and 2 (most facts) and 5 (responsible for decision sheet preparation) had the highest number of words used. If the total words for both media by role are added together, roles 3 & 4 (fewer facts, no hand-in preparation) were significantly lower in the total number of words used.

### 6.8.5 Transactions

Moot was a single workstation which had to be scheduled with time slots. CoSy was accessible through any terminal on campus that had Vax connections. Therefore, access to CoSy was easiest, perhaps encouraging more frequent sign-ons than with Moot. Consequently, an analysis of the number of transactions across media would only reflect the setup conditions of the experiment, rather than characteristics of the medium used. The number of transactions on CoSy was about double that on Moot.

### 6.8.6 Effect of sequence of medium used

The data was accumulated to investigate whether the sequence (first, second or third) in which the medium was used (learning effect about the type of task) had any effect on the outcome. Note that a face-to-face medium was used in addition to the Moot and CoSy media, with the result that a given task would have been undertaken either first, second or third with respect to the other media.

**Table 6.5 Media Sequence**

media	task	seq	grp	grptran	grpfact	grpword
CoSy	andy	1	9	36	34	3957
CoSy	betty	1	10	77	28	2373
CoSy	chris	1	11	72	43	1586
CoSy	andy	1	12	31	44	4514
Moot	andy	1	1	16	19	3975
Moot	betty	1	2	22	28	4502
Moot	chris	1	3	21	47	3787
Moot	andy	1	4	21	36	5767
			TOTALS	296	279	30461
			MEANS	37	35	3807
CoSy	betty	2	1	19	15	1216
CoSy	chris	2	2	23	25	2097
CoSy	andy	2	3	29	36	3675
CoSy	betty	2	4	18	11	1068
Moot	betty	2	5	19	24	2959
Moot	chris	2	6	16	42	2874
Moot	andy	2	7	15	23	1830
Moot	betty	2	8	24	51	4411
			TOTALS	163	227	20130
			MEANS	21	29	2516
CoSy	chris	3	5	33	37	4671
CoSy	andy	3	6	8	25	430
CoSy	betty	3	7	31	34	1724
CoSy	chris	3	8	118	53	2991
Moot	chris	3	9	24	34	7493
Moot	andy	3	10	32	37	3460
Moot	betty	3	11	16	63	3851
Moot	chris	3	12	10	40	3704
			TOTALS	272	323	28324
			MEANS	34	40	3541

No trends seem to be apparent, either up or down, based on the effect of the sequence in which the task was performed, or the sequence in which the CoSy or Moot medium was used.

### 6.8.7 Effect of task undertaken

The data was accumulated by task (Andy, Betty, Chris), to determine whether the tasks had any influence on the observed data. The letters H, M and L indicate in the table below the highest, medium and lowest for the category.

**Table 6.6 Tasks**

media	task	#grps	grptran	grpfact	grpword
CoSy	andy	4	104	139	12576
-	andy -	avg/grp	26	35M	3144H
CoSy	betty	4	145	88	6381
-	betty -	avg/grp	36	22L	1595L
CoSy	chris	4	246	158	11345
-	chris -	avg/grp	62	40H	2836M
TOTALS			495	385	30302
COSY OVERALL MEANS			41	32	2525
Moot	andy	4	84	115	15032
-	andy -	avg/grp	21	29L	3758L
Moot	betty	4	81	166	15723
-	betty -	avg/grp	20	42H	3931M
Moot	chris	4	71	163	17858
-	chris -	avg/grp	18	41M	4465H
TOTALS			236	444	48613
MOOT OVERALL MEANS			19	37	4051

None of the tasks (andy, betty, chris) is either highest or lowest, in mean group facts or mean group words, on both Moot and CoSy.

### 6.8.8 Subject verbosity & participation

The following table compares relative verbosity between media for individual members. The word count by member, on both CoSy and Moot, was sorted, and arbitrarily divided into three categories of 19 members each, representing the lowest, middle, and highest word counts on each media. The data has been re-sorted by group and member number within those categories to facilitate location of group/member number.

Five of the nineteen members of the lowest word count category on CoSy (11, 13, 15, 52 & 71) were also members of the lowest word count category on Moot. Seven of the nineteen members of the middle category on CoSy (14, 82, 83, 84, 103, 111 & 115) were also members of the middle category on Moot. Ten of the nineteen members of the high word count category on CoSy (12, 21, 32, 35, 55, 85, 91, 95, 121 & 122) were also members of the high word count category on Moot.

**Table 6.7 Verbosity of Participants**

bottom third CoSy			middle third CoSy			top third CoSy		
grp/mem	CoSy	Moot	grp/mem	CoSy	Moot	grp/mem	CoSy	Moot
11	56	577	14	362	703	12	668	2176
13	0	42	23	464	449	21	748	1088
15	130	477	24	467	1417	25	721	795
22	288	753	33	569	456	31	991	702
41	263	859	34	636	581	32	661	948
42	121	875	72	402	522	35	818	1100
43	254	813	73	443	484	51	1366	374
44	236	1172	74	551	230	53	1134	590
45	194	2048	82	644	880	54	734	505
52	357	94	83	471	864	55	1080	1396
61	120	1134	84	359	680	81	767	751
62	105	883	94	560	1459	85	750	1236
65	205	857	101	627	1658	91	749	2540
71	153	0	102	420	454	93	1674	668
75	175	594	103	402	599	95	680	1695
92	294	1131	104	495	423	121	1544	1284
112	284	693	105	429	326	122	1052	1798
113	176	797	111	361	633	123	921	195
114	277	1037	115	488	691	125	997	427

bottom third Moot			middle third Moot			top third Moot		
grp/mem	CoSy	Moot	grp/mem	CoSy	Moot	grp/mem	CoSy	Moot
11	56	577	14	362	703	12	668	2176
13	0	42	22	288	753	21	748	1088
15	130	477	25	721	795	24	467	1417
23	464	449	31	991	702	32	661	948
33	569	456	41	263	859	35	818	1100
34	636	581	42	121	875	44	236	1172
51	1366	374	43	254	813	45	194	2048
52	357	94	65	205	857	55	1080	1396
53	1134	590	75	175	594	61	120	1134
54	734	505	81	767	751	62	105	883
71	153	0	82	644	880	85	750	1236
72	402	522	83	471	864	91	749	2540
73	443	484	84	359	680	92	294	1131
74	551	230	93	1674	668	94	560	1459
102	420	454	103	402	599	95	680	1695
104	495	423	111	361	633	101	627	1658
105	429	326	112	284	693	114	277	1037
123	921	195	113	176	797	121	1544	1284
125	997	427	115	488	691	122	1052	1798

### 6.8.8 Speaker Dominance

Section 4.3.7 discussed the dominance of the top one or two speakers in the business meetings observed. Table 6.8 below gives this analysis for the CoSy and Moot sessions observed.

**Table 6.8 Dominant Speakers**

Group	Participants	---CoSy---		---Moot---	
		top 1	top 2	top 1	top 2
		words	words	words	words
		%	%	%	%
1	4	61.5	94.8	62.2	78.7
2	5	27.8	54.7	31.5	55.6
3	5	27.0	49.2	29.0	54.1
4	5	24.6	48.4	35.5	55.8
5	5	29.2	53.5	47.2	67.1
6	3	47.7	75.6	39.5	70.2
7	4	35.1	63.3	32.5	61.0
8	5	25.6	50.7	28.0	48.0
9	5	42.3	61.2	33.9	56.5
10	5	26.4	47.3	47.9	65.2
11	5	30.8	53.5	26.9	47.6
12	4	34.2	57.5	48.5	83.2
	Mean	34.4	59.1	38.6	61.9

This profile of the most dominant, and two most dominant speakers in both CoSy and Moot seems to be similar to that observed in the face-to-face videotaped business meetings and discussed in Chapter 4.

## 6.9 Analysis of the Observed Data

This analysis refers to the hypotheses developed in section 6.2. The test results from the experiment are related samples: each participant used both the voice input and typed input media for similar tasks.

### 6.9.1 Analysis of variance - preliminary

An analysis of variance was carried out to take account of the complete structure of the experimental results. In particular, there were several minor factors which, if not controlled, could have contributed to errors in the interpretation of the results obtained. The experimental design was intended to minimize the influence of these factors, and was discussed more fully in section 6.5.4. The ANOVA analysis was carried out using Genstat 5, and the output from this analysis is given in Appendix 7. In light of the results from this analysis, which indicates that these minor factors were not important, we will proceed first to discuss simpler tests on the main variables of interest, and conclude with a discussion of the ANOVA results on all factors.

The dependent variables of interest in the experiment were words used and information facts disclosed by each participant. The primary independent variable of interest was media used. An independent variable of secondary interest was role,

which had high fact and low fact dimensions. The independent variables incorporated in the experimental design, together with other potential sources of variation, were:

- a) Medium used: Moot (voice input), CoSy (typed input) and face-to-face. Only Moot and CoSy data were analysed.
- b) Role: each role (1 to 5) had a different number of facts available.
- c) Sequence of media used. Each medium (CoSy, Moot, face) was rotated through first, second and third use.
- d) Task. Three tasks (Andy, Betty and Chris) were rotated through all situations. The tasks contained the same number of facts per role, and the situations were similar.
- e) Groups: 12 groups were used. The dynamics of each group's discussion might have an effect.
- f) Residual: Individual member differences.

It was anticipated that the experimental design would minimize the effect of independent variables c through f.

### **6.9.2 Overall - words used and facts disclosed**

To examine the influence of media (Moot versus CoSy) on words used and facts presented by individual participant, table 6.9 below was extracted from the test data.

Data rows where the participant had not participated in either CoSy (1-3) or Moot (7-1) were eliminated. A difference of the facts presented by each participant in Moot minus the facts presented in CoSy, and a difference of the words used by each participant in Moot minus words in CoSy were calculated.

As each participant was assigned one of five roles, with a range of available facts for each of the roles, this comparison would indicate what effect the media (Moot versus CoSy) had on their ability to present facts, for their particular situation.

Fifty-five participants had non-zero contributions to both Moot and CoSy. There were different roles within each group, and these roles had a range of 9 to 33 facts available for disclosure (some shared and some unique). It was expected that there would be variations in participation and fact disclosure because of this construction. However, by calculating the difference of words used (and facts disclosed) by each of the individual participants, of Moot minus CoSy, this role variation can be minimized.

Table 6.9 lists the data, and provides the basis on which the statistical validity of the hypotheses may be tested. A difference was calculated for each of the participants listed in this table for the number of facts disclosed in Moot minus the number

disclosed in CoSy. A second difference was calculated for the number of words used in Moot minus the number used in CoSy. A two tailed t test is used.

**Table 6.9 Participant Words and Facts**

grp	memb	CoSy facts	Moot facts	ratio M:C	diff M-C	CoSy words	Moot words	ratio M:C	diff M-C
1	1	1	0	0.00	-1	56	577	10.30	521
1	2	4	9	2.25	5	668	2176	3.26	1508
1	4	8	7	0.88	-1	362	703	1.94	341
1	5	2	2	1.00	0	130	477	3.67	347
2	1	6	3	0.50	-3	748	1088	1.45	340
2	2	8	14	1.75	6	288	753	2.61	465
2	3	4	5	1.25	1	464	449	0.97	-15
2	4	4	6	1.50	2	467	1417	3.03	950
2	5	3	0	0.00	-3	721	795	1.10	74
3	1	17	26	1.53	9	991	702	0.71	-289
3	2	2	8	4.00	6	661	948	1.43	287
3	3	6	0	0.00	-6	569	456	0.80	-113
3	4	5	7	1.40	2	636	581	0.91	-55
3	5	6	6	1.00	0	818	1100	1.34	282
4	1	3	12	4.00	9	263	859	3.27	596
4	2	0	11		11	121	875	7.23	754
4	3	4	3	0.75	-1	254	813	3.20	559
4	4	1	6	6.00	5	236	1172	4.97	936
4	5	3	4	1.33	1	194	2048	10.56	1854
5	1	13	3	0.23	-10	1366	374	0.27	-992
5	2	8	3	0.38	-5	357	94	0.26	-263
5	3	6	6	1.00	0	1134	590	0.52	-544
5	4	6	8	1.33	2	734	505	0.69	-229
5	5	4	4	1.00	0	1080	1396	1.29	316
6	1	15	27	1.80	12	120	1134	9.45	1014
6	2	5	6	1.20	1	105	883	8.41	778
6	5	5	9	1.80	4	205	857	4.18	652
7	2	11	10	0.91	-1	402	522	1.30	120
7	3	3	4	1.33	1	443	484	1.09	41
7	4	3	7	2.33	4	551	230	0.42	-321
7	5	3	2	0.67	-1	175	594	3.39	419
8	1	22	27	1.23	5	767	751	0.98	-16
8	2	14	9	0.64	-5	644	880	1.37	236
8	3	5	9	1.80	4	471	864	1.83	393
8	4	7	4	0.57	-3	359	680	1.89	321
8	5	5	2	0.40	-3	750	1236	1.65	486
9	1	6	10	1.67	4	749	2540	3.39	1791
9	2	4	7	1.75	3	294	1131	3.85	837
9	3	15	3	0.20	-12	1674	668	0.40	-1006
9	4	4	8	2.00	4	560	1459	2.61	899
9	5	5	6	1.20	1	680	1695	2.49	1015
10	1	12	27	2.25	15	627	1658	2.64	1031
10	2	8	5	0.63	-3	420	454	1.08	34
10	3	3	2	0.67	-1	402	599	1.49	197
10	4	4	3	0.75	-1	495	423	0.85	-72
10	5	1	0	0.00	-1	429	326	0.76	-103
11	1	17	16	0.94	-1	361	633	1.75	272
11	2	10	22	2.20	12	284	693	2.44	409
11	3	1	4	4.00	3	176	797	4.53	621
11	4	10	17	1.70	7	277	1037	3.74	760
11	5	5	4	0.80	-1	488	691	1.42	203
12	1	25	20	0.80	-5	1544	1284	0.83	-260
12	2	8	11	1.38	3	1052	1798	1.71	746
12	3	6	8	1.33	2	921	195	0.21	-726
12	5	5	1	0.20	-4	997	427	0.43	-570
	sum	371	443	72.22	72.00	30740	48571	138.40	17831
	count	55	55	52	55	55	55	55	55
	mean	6.745	8.055	1.389	1.309	559	883	2.516	324
	std	5.202	7.026	1.113	5.138	357	501	2.445	589
	var	27.062	49.361	1.240	26.395	127383	250993	5.980	346470
	max	25	27	6.0	15	1674	2540	10.56	1854
	min	0	0	0.0	-12	56	94	0.21	-1006
	t test				1.872				4.047

From the data in table 6.9, the overall means of facts and words were calculated, by role and media. These are presented in table 6.10.

**Table 6.10 Overall Means - Words and Facts**

<u>role</u>	----facts----		----words----		--role means--	
	<u>cosy</u>	<u>moot</u>	<u>cosy</u>	<u>moot</u>	<u>facts</u>	<u>words</u>
1	12.5	15.5	690	1055	14.0	872
2	6.8	9.6	441	934	8.2	688
3	5.3	4.4	651	592	4.9	621
4	5.2	7.3	468	821	6.3	644
5	3.9	3.3	556	970	3.6	763
Media means	6.8	8.1	559	883	7.4	721
high fact(1&2)	9.5	12.4	560	992		
low fact(3&4)	5.3	5.9	559	706		

Table 6.11 provides a different view of the data in table 6.9, by calculating means for facts and words by group.

**Table 6.11 Means by Group for All Participants**

grp	n	cosy facts	moot facts	ratio M:C	diff M-C	cosy words	moot words	ratio M:C	diff M-C
1	4	3.75	4.50	1.20	0.75	304	983	3.23	679
2	5	5.00	5.60	1.12	0.60	538	900	1.67	362
3	5	7.20	9.40	1.31	2.20	735	757	1.03	22
4	5	2.20	7.20	3.27	5.00	214	1153	5.39	939
5	5	7.40	4.80	0.65	-2.60	934	592	0.63	-342
6	3	8.33	14.00	1.68	5.67	143	958	6.70	815
7	4	5.00	5.75	1.15	0.75	393	458	1.17	65
8	5	10.60	10.20	0.96	-0.40	598	882	1.47	284
9	5	6.80	6.80	1.00	0.00	791	1499	1.90	708
10	5	5.60	7.40	1.32	1.80	475	692	1.46	217
11	5	8.60	12.60	1.47	4.00	317	770	2.43	453
12	4	11.00	10.00	0.91	-1.00	1129	926	0.82	-203
sum		81.48	98.25	16.04	16.77	6571	10570	27.90	3999
count		12	12	12	12	12	12	12	12
mean		6.790	8.188	1.336	1.398	548	881	2.325	333
std		2.526	2.934	0.639	2.366	289	258	1.816	388
var		6.38	8.61	0.41	5.60	83417	66708	3.30	150205
max		11.0	14.0	3.27	5.67	1129	1499	6.70	939
min		2.2	4.5	0.65	-2.60	143	458	0.63	-342
t test					1.959				2.852

a) All participants - words used.

From table 6.9, the mean of the difference of words used in Moot minus CoSy was 324, for a sample of 55, with a standard deviation of 589. The t test value is calculated to be 4.047, and for a two tailed test  $p < .001$ . An analysis of the data in table 6.10 provides

similar results ( $t=2.852$ ,  $v=11$ ,  $p<.02$ ). Therefore, the null hypothesis (1a) is rejected, and the alternative hypothesis (1b) accepted for the whole set of participants.

We conclude that the voice input medium has increased the words used by participants in this information exchange task over the typed input medium. The mean of the ratios of Moot words to CoSy words is 2.516, indicating that a 151% increase in words used in Moot over CoSy was observed.

#### b) All participants - facts disclosed

From table 6.9, the differences of facts disclosed by each participant were calculated in a similar manner, for voice input minus typed input. The mean of the differences of facts disclosed in Moot minus CoSy was 1.309, for a sample of 55, with a standard deviation of 5.138. The t test is calculated to be 1.872 ( $p < .1$ ). An analysis of the data in table 6.11 provides similar results ( $t=1.959$ ,  $v=11$ ,  $p<.1$ ). Therefore, the null hypothesis (2a) is rejected, and the alternative hypothesis (2b) accepted for the whole set of participants.

We conclude that the voice input medium has increased the facts disclosed by participants in this information exchange task over the typed input medium. The mean of the ratios of Moot facts to CoSy facts is 1.389, indicating that a 38% increase in the information facts disclosed in Moot over CoSy was observed.

### **6.9.3 High fact participants - words used and facts disclosed**

Roles 1 and 2 in each group were given the highest number of unique and shared facts available (23 and 18 unique, 10 and 10 shared respectively) out of the group total of 65. Hypotheses 3 and 4 can be tested with this subset of the data, to determine if the characteristics of facts disclosed and words used is related to this factor. The combination of these two roles (instead of individual analysis by role) seems to be justified on the basis that the facts available to each role were about equal, and these roles in turn had about three times the facts available in the low fact roles 3 & 4.

**Table 6.12 High Fact Participants**

grp	mem	CoSy facts	Moot facts	ratio M:C	diff M-C	CoSy words	Moot words	ratio M:C	diff M-C
1	1	1	0	0.00	-1	56	577	10.30	521
2	1	6	3	0.50	-3	748	1088	1.45	340
3	1	17	26	1.53	9	991	702	0.71	-289
4	1	3	12	4.00	9	263	859	3.27	596
5	1	13	3	0.23	-10	1366	374	0.27	-992
6	1	15	27	1.80	12	120	1134	9.45	1014
8	1	22	27	1.23	5	767	751	0.98	-16
9	1	6	10	1.67	4	749	2540	3.39	1791
10	1	12	27	2.25	15	627	1658	2.64	1031
11	1	17	16	0.94	-1	361	633	1.75	272
12	1	25	20	0.80	-5	1544	1284	0.83	-260
1	2	4	9	2.25	5	668	2176	3.26	1508
2	2	8	14	1.75	6	288	753	2.61	465
3	2	2	8	4.00	6	661	948	1.43	287
4	2	0	11		11	121	875	7.23	754
5	2	8	3	0.38	-5	357	94	0.26	-263
6	2	5	6	1.20	1	105	883	8.41	778
7	2	11	10	0.91	-1	402	522	1.30	120
8	2	14	9	0.64	-5	644	880	1.37	236
9	2	4	7	1.75	3	294	1131	3.85	837
10	2	8	5	0.63	-3	420	454	1.08	34
11	2	10	22	2.20	12	284	693	2.44	409
12	2	8	11	1.38	3	1052	1798	1.71	746
sum		219	286	32.02	67	12888	22807	70.01	9919
count		23	23	23	23	23	23	23	23
mean		9.522	12.435	1.392	2.913	560	992	3.044	431
std		6.446	8.319	1.049	6.440	389	566	2.874	600
var		41.554	69.202	1.100	41.471	151083	320501	8.258	360178
max		25	27	4.0	15	1544	2540	10.30	1791
min		0	0	0.0	-10	56	94	0.26	-992
t test					2.122				3.370

**Table 6.13 Means by group for High Fact Participants**

grp	n	cosy facts	moot facts	ratio M:C	diff M-C	cosy words	moot words	ratio M:C	diff M-C
1	2	2.50	4.50	1.80	2.00	362	1377	3.80	1015
2	2	7.00	8.50	1.21	1.50	518	921	1.78	403
3	2	9.50	17.00	1.79	7.50	826	825	1.00	-1
4	2	1.50	11.50	7.67	10.00	192	867	4.52	675
5	2	10.50	3.00	0.29	-7.50	862	234	0.27	-628
6	2	10.00	16.50	1.65	6.50	113	1009	8.93	896
7	1	11.00	10.00	0.91	-1.00	402	522	1.30	120
8	2	18.00	18.00	1.00	0.00	706	816	1.16	110
9	2	5.00	8.50	1.70	3.50	522	1836	3.52	1314
10	2	10.00	16.00	1.60	6.00	524	1056	2.02	532
11	2	13.50	19.00	1.41	5.50	323	663	2.05	340
12	2	16.50	15.50	0.94	-1.00	1298	1541	1.19	243
sum		115.0	148.0	21.96	33.00	6648	11667	31.52	5019
count		12	12	12	12	12	12	12	12
mean		9.583	12.333	1.830	2.750	554	972	2.627	418
std		4.834	5.189	1.813	4.571	315	423	2.256	496
var		23.37	26.93	3.29	20.90	98964	178742	5.09	246419
max		18.0	19.0	7.67	10.0	1298	1836	8.93	1314
min		1.5	3.0	0.29	-7.5	113	234	0.27	-628
t test					1.995				2.794

**a) Words used for high fact participants**

From table 6.12, the mean of the difference of words used in Moot - CoSy was 431, for a sample of 23, with a standard deviation of 600. The t test value is calculated to be 3.370 ( $p < .01$ ). An analysis of the data in table 6.13 provides similar results ( $t=2.794$ ,

$v=11$ ,  $p<.02$ ). Therefore, the null hypothesis (3a) is rejected, and the alternative hypothesis (3b) accepted for participants with high fact roles.

We conclude that the voice input medium has increased the words used by high fact participants in this information exchange task compared to the typed input medium. The mean of the ratios of Moot words to CoSy words is 3.044, indicating that a 204% increase in words used in Moot over CoSy was observed for high fact participants.

#### **b) Facts disclosed for high fact participants**

From table 6.12, the differences of facts disclosed by each participant was calculated in a similar manner, for voice input minus typed input. The mean of the difference of facts disclosed in Moot - CoSy was 2.913, for a sample of 23, with a standard deviation of 6.440. The t test is calculated to be 2.122 ( $p < .05$ ). An analysis of the data in table 6.13 provides similar results ( $t=1.995$ ,  $v=11$ ,  $p<.1$ ). Therefore, the null hypothesis (4a) is rejected, and the alternative hypothesis (4b) accepted for participants with high fact roles.

We conclude that the voice input medium has increased the facts disclosed by high fact participants in this information exchange task compared to the typed input medium. The mean of the ratios of Moot facts to CoSy facts is 1.392, indicating that a 39% increase in the information facts disclosed in Moot over CoSy was observed.

#### **6.9.4 Low fact participants - words used and facts disclosed**

Roles 3 and 4 in each group were given a low number of unique and shared facts available (6 and 5 unique, 6 and 6 shared respectively) out of the group total of 65. Hypotheses 5 and 6 can be tested with this subset of the data, to determine if the characteristics of facts disclosed and words used is related to this factor.

**Table 6.14 Low Fact Participants**

grpmemb	CoSy facts	Moot facts	ratio M:C	diff M-C	CoSy words	Moot words	ratio M:C	diff M-C	
2	3	4	5	1.25	1	464	449	0.97	-15
3	3	6	0	0.00	-6	569	456	0.80	-113
4	3	4	3	0.75	-1	254	813	3.20	559
5	3	6	6	1.00	0	1134	590	0.52	-544
7	3	3	4	1.33	1	443	484	1.09	41
8	3	5	9	1.80	4	471	864	1.83	393
9	3	15	3	0.20	-12	1674	668	0.40	-1006
10	3	3	2	0.67	-1	402	599	1.49	197
11	3	1	4	4.00	3	176	797	4.53	621
12	3	6	8	1.33	2	921	195	0.21	-726
1	4	8	7	0.88	-1	362	703	1.94	341
2	4	4	6	1.50	2	467	1417	3.03	950
3	4	5	7	1.40	2	636	581	0.91	-55
4	4	1	6	6.00	5	236	1172	4.97	936
5	4	6	8	1.33	2	734	505	0.69	-229
7	4	3	7	2.33	4	551	230	0.42	-321
8	4	7	4	0.57	-3	359	680	1.89	321
9	4	4	8	2.00	4	560	1459	2.61	899
10	4	4	3	0.75	-1	495	423	0.85	-72
11	4	10	17	1.70	7	277	1037	3.74	760
sum	105	117	30.8	12	11185	14122	36.11	2937	
count	20	20	20	20	20	20	20	20	
mean	5.250	5.850	1.540	0.600	559	706	1.805	147	
std	3.080	3.439	1.322	4.091	340	337	1.390	541	
var	9.488	11.828	1.748	16.740	115571	113631	1.932	292861	
max	15	17	6.0	7	1674	1459	4.97	950	
min	1	0	0.0	-12	176	195	0.21	-1006	
t test				0.639				1.183	

**Table 6.15 Means by Group for Low Fact Participants**

grp	n	cosy facts	moot facts	ratio M:C	diff M-C	cosy words	moot words	ratio M:C	diff M-C
1	1	8.00	7.00	0.88	-1.00	362	703	1.94	341
2	2	4.00	5.50	1.38	1.50	466	933	2.00	467
3	2	5.50	3.50	0.64	-2.00	603	519	0.86	-84
4	2	2.50	4.50	1.80	2.00	245	993	4.05	748
5	2	6.00	7.00	1.17	1.00	934	548	0.59	-386
7	1	3.00	5.50	1.83	2.50	497	357	0.72	-140
8	2	6.00	6.50	1.08	0.50	415	772	1.86	357
9	2	9.50	5.50	0.58	-4.00	1117	1064	0.95	-53
10	2	3.50	2.50	0.71	-1.00	449	511	1.14	62
11	2	5.50	10.50	1.91	5.00	227	917	4.04	690
12	1	6.00	8.00	1.33	2.00	921	195	0.21	-726
sum	59.5	66.0	13.31	6.5	6236	7512	18.37	1276	
count	11	11	11	11	11	11	11	11	
mean	5.409	6.000	1.210	0.591	567	683	1.670	116	
std	2.009	2.089	0.464	2.353	282	267	1.249	433	
var	4.04	4.36	0.22	5.54	79749	71451	1.56	187163	
max	9.5	10.5	1.91	5.0	1117	1064	4.05	748	
min	2.5	2.5	0.58	-4.0	227	195	0.21	-726	
t test				0.794				0.848	

a) Words used for low fact participants

From table 6.14, the mean of the difference of words used in Moot - CoSy was 147, for a sample of 20, with a standard deviation of 541. The t test value is calculated to be 1.183 ( $p > .1$ ). Therefore, the null hypothesis (5a) is not rejected for participants with low fact roles, and no conclusion is reached on words used by low fact participants.

#### b) Facts disclosed for low fact participants

From table 6.14, the differences of facts disclosed by each participant was calculated in a similar manner, for voice input minus typed input. The mean of the difference of facts disclosed in Moot - CoSy was .600, for a sample of 20, with a standard deviation of 4.091. The t test is calculated to be .639 ( $p > .1$ ). Therefore, the null hypothesis (6a) is not rejected for participants with low fact roles, and no conclusion is reached on facts contributed by low fact participants.

### 6.9.5 Analysis of variance - other factors

The above discussion has ascribed the differences in the two measured variables, words and facts, primarily to the media used (voice input versus text input), and to the relative number of facts held by the participant's role (high fact versus low fact). Some of these differences could be ascribed to the sequence of the use of the media, or to the differences between the tasks Andy, Betty and Chris.

To properly take these into account, and to simultaneously evaluate the effect of task and sequence, an ANOVA was carried out as discussed in section 6.9.1. The output from this analysis is contained in Appendix 7. The ANOVA analysis estimated missing values, which result in some slight differences from the means calculated in the foregoing sections to the means tabulated in the ANOVA analysis.

These more sophisticated analyses in no case gave results differing significantly from the simple analyses presented above.

### 6.9.6 Other data

Other data items were recorded during the experiment, but have not been analysed further.

The number of transactions for each participant was recorded, and could have been treated as a dependent variable. On Moot, pre-booking of slots for the single voice input workstation was necessary, although there were about twice as many slots available throughout the day as were actually used. This implies that there were likely to be a larger number of sessions initiated by the participants on the freely available CoSy terminals rather than on the booked access Moot workstation. Therefore, analysis of transaction count data would reveal little about the inherent characteristics of the two systems to actually encourage or discourage more frequent transactions.

The characteristic of synchronous or non-synchronous interaction was an independent variable that was also recorded for the CoSy sessions. It has been discussed earlier that there was a non-trivial sign-up procedure for CoSy, which involved obtaining a VAX ID and then access to the CoSy system. The first eight groups undertook their CoSy discussions over a timespan of approximately five to seven days. To avoid distortions of late sign-ons, where a participant was not able to join a CoSy discussion until it was perhaps two or three days underway, the last four groups' CoSy sessions were run synchronously. All members were simultaneously logged in to CoSy for approximately an hour, although they were not physically proximate. These sessions tended to generate somewhat higher transaction counts, due perhaps to the immediate feedback and reaction to a contribution that was likely to occur. While interesting, the experiment was not constructed in a way to be able to draw conclusions from this data dimension, so no further analysis on this aspect has been done.

The Moot and CoSy media were considered to be directly comparable; both were computer based, and both operated in an essentially asynchronous manner. A face-to-face session using a third task was also undertaken by all groups. Transcripts were created from the recordings of the face-to-face sessions, but it became apparent that word counts and possibly information fact disclosures might be difficult to accurately record. Contributing to this were low quality of sound from some participants (almost whispers in some cases) and frequent occurrences of several people taking at once, which made accurate and complete verbatim transcription of the recordings virtually impossible. It was therefore decided to proceed no further with analysis of this incomplete data.

## **6.10 Anecdotal Comments**

### **6.10.1 Videotape observation of Moot usage**

A camera was set up to observe and record participants using the Moot prototype, with the intention that difficulties in the user interface experienced by early users could be quickly identified and corrected, if possible. Alternately, additional instructions could be posted to help others avoid getting into the same difficulties. However, none of the sessions recorded showed any substantial difficulties. All participants using Moot seemed to pick up the basic operations very quickly, and seemed quite comfortable in using the mouse and voice input/output facilities.

### 6.10.2 Comments sheet

After subjects had completed their three tasks, they were paid \$25. When the cheque was sent out, a sheet with a number of feedback questions was also included, and subjects were asked to anonymously fill out and return the sheet. As it was not intended to use these responses in a formal way, no quantitative analysis has been done. However, the following informal information was extracted from the returned comments sheets.

23 sheets were returned, out of the 56 participants who completed the experiment.

The first question asked was whether they had any trouble getting on to either CoSy or Moot. 13 reported no trouble at all. The remaining 10 comments could be characterized as "I had a bit of trouble getting started with CoSy (or Moot), but after I got going everything was OK".

The second question asked whether CoSy and Moot operated correctly once they got on the system. 13 reported that both operated without problems, while the remaining 10 comments reported some problems that they generally felt were of a minor nature.

The third, and perhaps most interesting question, asked whether they preferred CoSy or Moot, and why. 9 indicated they preferred Moot, and 13 preferred CoSy. One answered that CoSy was the best medium, but Moot was more interesting. All 23 replies to this question are given in appendix 6.

Those that preferred Moot (voice input) in their answer mentioned the following:

I am a poor typist - voice was easier to put in  
I didn't have to cut down what I wanted to say because of effort of typing  
there was extra info in listening to other's voice tones  
having both voice and text aided understanding

Those that preferred CoSy (text input) mentioned the following reasons:

time to think, edit  
can proofread what is to go in before it goes

The final question asked whether there were "Any other suggestions?".

One person replied that "I don't know whether it is necessary to translate Moot into text - verbal communication was O.K. Moot's distinct advantage is its simplicity". Another said "I really enjoyed participating in the experiment and I learnt a lot from it".

And perhaps a final comment from one of the participants that puts a somewhat chilling perspective on the whole search for effective computer mediated communication: "The most effective method seemed to be face-to-face, as it was very effective and more personal i.e. you weren't just talking to a machine. On CoSy & Moot you can't tell who you are talking to as its a machine".

### 6.10.3 When information is disclosed

No formal analysis was done on when the information facts were disclosed during the discussion (i.e., number of transactions from start). An informal inspection of the transcripts shows the expected bulge of fact disclosure early in the group discussion, and relatively few facts being disclosed during the last quarter. However, it is surprising how late in the discussion some facts are disclosed, when the meeting supposedly has shifted from information exchange to consensus gathering / decision making. Further investigation into this area with an experiment tailored to measure patterns for different media might be interesting.

### 6.10.4 Storage comparisons - voice and text

Speech compression was not used on the voice files created, although good compression techniques are available. However, it is worthwhile to compare the disk storage required for an uncompressed voice file with that of the text file which results from transcription. Table 6.16 below shows a comparison for seven messages selected from the experiment.

**Table 6.16 Storage comparisons - voice and text**

<u>Sample</u>	<u>Words</u>	<u>Duration seconds</u>	<u>Voice size (b)</u>	<u>Text size (b)</u>	<u>Ratio</u>	<u>Words / second</u>
1	472	180	1434880	2407	596:1	2.6
2	438	172	1379840	2207	625:1	2.5
3	410	161	1285632	2091	614:1	2.5
4	415	151	1206272	2071	583:1	2.7
5	270	117	932608	1370	680:1	2.3
6	259	108	864000	1319	655:1	2.4
7	114	45	363008	579	626:1	2.5
Sample means					620:1	2.5

The increase in storage space required to maintain voice files (620 times the text equivalent) is important when considering disk requirements for voice message based systems. It is also important to note the effective input speeds for voice input of 150 words per minute ( $2.5 * 60$ ), which is well above normal typing rates for all potential users.

### **6.10.5 Speaker dominance**

In section 4.3.7, the dominance of the top one and two participants in the videotaped business meetings was presented. The dominance patterns observed for the CoSy and Moot tasks presented in section 6.8.8 seems to indicate that much the same types of behaviour have occurred in the asynchronous group communication discussions observed. Therefore, it is possible to conclude that the requirements for dominant speaker support (through ease of input), and for listener support (through ease of reading and review) will be important in the design of future AGC systems.

Investigation of the effect of AGC media on dominance would be of interest for further study where this factor could be controlled. For example, whether the same participant was likely to be dominant in both face-to-face and AGC media would be of interest, as well as whether there was a significant shift in dominance patterns across media. However, from the informal observations here, it would appear that neither the typed input (CoSy) or voice input (Moot) media had any large effect on the dominance patterns observed in the videotaped business meetings.

### **6.10.6 Contribution length**

The characteristics of the videotaped meetings discussed in section 4.4.3 included the observation of mostly short duration transactions (mean of 12 seconds, 18 words per transaction).

The number, and mean duration of the CoSy and Moot transactions observed was likely to be strongly influenced by the availability and frequency of use of the workstation in each case, as much as by inherent differences between the two media. While formal comparisons are probably not completely appropriate, an informal look at what was observed is of interest.

Moot transactions had an average length of 205 words, while CoSy transactions had an average length of 63 words. This indicates quite a different basis of usage, from the highly interactive, short duration comments observed in the face-to-face business meetings, to the much longer, more infrequent sessions on the AGC systems.

### **6.10.7 Quality of decisions reached**

Measurement of decision quality was not one of the objectives of the experiment, and no analysis was done on the recommendations handed in by each group on which course/university their task subject should pursue. The group opinion form, prepared and handed in by each group on completion of each of their tasks (Appendix 4), did seem to be helpful to the groups as a focus for the discussion. However, there was a wide variety of degree, major and university advice offered by the groups to the three hypothetical students Andy, Betty and Chris. For example, for task Betty, law was suggested four times, social science twice, but others suggested a wide range including arts, veterinary medicine, management, education and physical education.

## **6.11 Summary**

This chapter has discussed the design and execution of an experiment to evaluate the impact of voice input on information exchange for asynchronous group communication.

The experiment was set up to compare the information exchange component of a group discussion when three media were used: face-to-face, typed input computer conferencing and the voice input Moot prototype. From the hypotheses postulated and accepted, it has been found that voice input substantially increases the number of words contributed and moderately increases the number of information facts disclosed, for both the whole test population and for those having a high percentage of facts available.

Participants seemed to adapt easily to the concept and operation of the Moot voice input prototype. While the majority indicated preference for the typed input CoSy media, a substantial 40% indicated they preferred this new form of voice input group communication (as characterized and no doubt restricted by the Moot prototype) over the established typed input form of computer conferencing. High speeds (150 words per minute) for voice input were observed. Message storage capacity is greatly reduced (620:1) when voice messages are converted to text.

## **CHAPTER 7**

### **DISCUSSION, IMPLICATIONS AND CONCLUSIONS**

#### **7.1 The Foundation for the Work**

This research has investigated the usefulness of voice input in computer supported asynchronous group communication, within the context of the needs of a business meeting.

In chapter 2, it was found that the use of computer support for interpersonal communication in general is the objective of several types of systems. Those that address the needs of asynchronous communication are primarily textual (email and computer conferencing), although voice mail is increasingly becoming available. Computer support for group communication has a number of dimensions, from textual based (computer conferencing) to real time support for decision making and distance collaboration. A potential niche for combining the aspects of voice input technology and asynchronous group communication is seen to exist.

The discussion of business meetings in chapter 3 examined a large number of ways of categorising the activities and participants. Many of the activities in these meetings are unlikely to be enhanced or effectively supported by the available computer technologies of today, and in fact it may be undesirable to do so. Alternatively, there are several of these activities where enough potential exists to justify further investigation. Decision making, for one, is a business meeting activity that has attracted a large degree of research interest in the development of group decision support systems. Information exchange is also seen as an important business meeting process, especially in the early stages of a meeting.

To examine the potential for technology support of business meeting functions, the field study described in chapter 4 was undertaken. This study confirmed that information exchange was a very important part of the group business meetings videotaped and analysed. It was concluded from the study that support for both dominant speakers (ease to contribute) and low-participation listeners (ease and convenience to read/listen) would be important considerations of any potential group communication system.

The construction of the Moot prototype system discussed in chapter 5 was undertaken to provide a test environment where some of these findings and suspicions could be analytically tested.

## 7.2 Outcomes

One clear outcome of the study was that **voice input to asynchronous group communication is feasible**, and usable for its intended purpose. However, the present shortcomings in available speech recognition, which are outside the scope of this research, may seriously limit its applicability to group communication systems in the short term.

The second clear outcome is that **voice input capability results in a large increase in the number of words contributed to a discussion**, above that of keyboard input systems, for the systems tested, and is strongly supported by the results obtained. Further work may be required to determine whether this apparently desirable effect for computer support of group communication is in fact of value.

The third outcome is that **the number of facts disclosed by participants is moderately increased when a voice input capability is incorporated**, based on the test environment, and is moderately supported by the results obtained. This effect is seen for all participants in the test, and for those with a high proportion of the facts available for information exchange. This outcome was not proved for the subcategory of participants with low facts available.

The fourth outcome is that the prototype, using voice input and a direct manipulation mouse driven user interface, was successful for this type of application, and that **"keyboardless" user interfaces for this type of application seem to have merit, and should be further investigated and developed.**

## 7.3 Implications

### 7.3.1 Information exchange.

Information exchange has been identified as an important component of business meetings, and this research has shown that this function can be supported as or more effectively by voice input asynchronous group communication than by existing typed input methods.

But what are the qualitative and quantitative measures of success for the process of information exchange? Some of the measures that could be defined and experimentally determined for information exchange are:

- convenience
- efficiency
- intrusion into other work patterns
- information gained versus effort expended
- more communication in same time
- more communication in more time
- same communication in less time
- quality of information received vs other channels
- non-productive or social use

Information exchange is an important group meeting component. These results suggest that further work is justified to construct systems and techniques which may exploit the apparent advantages of voice input as a medium for information exchange through AGC.

### **7.3.2 Asynchronous group communication**

The benefits and shortcomings of computer mediated asynchronous group communication compared to face-to-face communication have been discussed earlier. However, the question raised by the results of this research is whether this new technique of inputting information into a group discussions will be the significant breakthrough to overcome present preference to "doing it in the flesh".

Will there be the expectation that AGC can undertake all tasks usually associated with a face-to-face meeting, such as brainstorming, decision making, and particularly socializing, as successfully as it appears that the information exchange task might be performed? And if these expectations cannot be satisfied, will a good performance in the information exchange area alone be sufficient to sustain interest?

Perhaps we can find a compromise solution in using particular media for the tasks best suited: for example, using voice input AGC for a first phase of fact gathering (over a few weeks, from diverse geographical locations), followed by a second phase face-to-face gathering where decisions are made and social relationships are established or confirmed, followed in turn by a third phase typed input follow-up and cleanup. No one medium may be sufficient, or suitable, for all of these phases.

### 7.3.3 Keyboardless computer systems

The mouse-icon style of user interface continues to grow in popularity, from its birth at Xerox PARC, through its successful introduction with the Macintosh, and the rapid acceptance of the Windows 3 product from Microsoft. Most applications, however, still require some movement between mouse and keyboard. The development and testing of the Moot prototype has shown that potential exists for completely keyboardless applications supporting interpersonal communication. Eyes do not have to be shifted from keyboard to screen continually. Hands don't have to be shifted from keyboard to mouse and back. Voice input allows gaze to be continually on the screen, hand continually on the mouse, and voice input used to input the "data".

The demonstration in this research that voice input can be effectively used in user interfaces may provide incentives for further investigation of keyboardless applications.

### 7.3.4 Speech recognition

This research was intended to look beyond the present limitations of speech recognition, to investigate whether an *application* using speech recognition could be successfully developed and applied, before the necessary speech recognition technology was available to support it.

It has been shown that large vocabulary, connected word speech recognition (perhaps with speaker independence thrown in!) could provide advantages over present typed input. Therefore, this may provide incentive for speech recognition technology developers to investigate potential products for this use.

Present speech recognition technologies are based mainly on real time segmentation of speech into small intervals (typically 100 milliseconds), pattern matching those segments into phonemes or other basic building blocks, and then assembling those phonemes into words and sentences. Output from the speech recognition process is typically provided instantly.

Consider the implications of voice input AGC on speech recognition requirements. Output is not needed instantly; in fact, it may be acceptable to have delays of hours or even days between when a voice message was input, and when the text translation is required. This then implies that the speech recognition itself need no longer be necessarily be done in real time, allowing other techniques to be applied to the task. To start, many more iterations can be applied to whatever phoneme pattern matching algorithm is used, to converge on potentially better solutions. A new approach to non-

real time speech recognition might now be able to use phonemes, both before and after the one presently being decoded, to narrow the choices available. Multiple passes over a sentence or phrase of connected speech might start with only a few phonemes or words being recognized in the first few iterations, but converge on the correct translation after perhaps millions of iterations.

Perhaps connected word, large vocabulary speech recognition is within reach for voice input AGC applications, where more time, and computing cycles over time, are available.

## **7.4 Future Directions**

This research has focussed on the comparison of two types of asynchronous group communication media (Moot and CoSy). Face-to-face synchronous communication was included in the experiment as a third part of each cycle, but was not formally compared. There now exists a basis on which to more equally compare synchronous and asynchronous media, by setting up a task to be performed using multiple voice input workstations in both synchronous (all group members on at same time, but physically separate) and asynchronous (group members on at different times) modes.

There also appears to now exist a way of comparing synchronous, face-to-face meetings with synchronous physically separated voice input meetings, raising the possibility of investigating some interesting issues on the value of visual contact. Some turn sharing control and recording hardware would need to be developed for the face-to-face sessions.

Further work could be undertaken on some of the following issues:

- develop measures of success for AGC communication.

- investigate the information exchange mechanisms used by groups, and how these can be implemented in AGC.

- how AGC can be used as a complementary (not replacement) form of group communication to face-to-face meetings.

Further development of the technology used in this research could involve enhancement of the prototype Moot system. Some areas of improvement that could be addressed include:

use of an inexpensive voice digitization board

moving or still video image of the speaker on the screen

compression techniques with a bigger disk to allow voice files to remain longer

editing of the voice files by speaker

instantaneous transcription, to simulate real-time conversion to text

incorporating features for mobile (cellphone) access

And finally, it is hoped that work can be initiated by others to investigate the feasibility of non-real-time speech recognition for large vocabulary, connected word speech.

## **7.5 Conclusions**

### **7.5.1 AGC and information exchange**

The fit of asynchronous group communication to the information exchange component of group communication seems to be appropriate, and the experimental results show that this function can be performed adequately on either of the asynchronous group communication media tested. Other components of business meetings (decision making, socialising) may not be as well served by AGC. Further testing is required to quantify how well AGC performs the information exchange task, and these other business meeting tasks, when compared to a face-to-face meeting.

### **7.5.2 Voice input and AGC**

The use of voice input for AGC systems in general seems to be worthy of further investigation, and development of more advanced operational systems based on the prototype Moot design would seem to be feasible. The fit of voice input to the particular information exchange task on AGC also seems to have merit. While there

are present speech recognition shortcomings, this research has demonstrated that there is potential in this area.

### **7.5.3 Limitations of this research**

The conclusions drawn about word and fact differences between a voice input system, and a text input system for asynchronous group communication are based on two specific software systems, namely the Moot prototype and the CoSy computer conferencing system. Caution should be used in generalizing these results to encompass generic voice input or generic text input systems, without further study to confirm the results, using perhaps different software systems and different testing environments.

### **7.5.4 Real systems**

This study has developed and tested a voice input asynchronous group communication system prototype that simulates the availability of connected word, large vocabulary speech recognition to convert the voice messages into text. How feasible, and how soon will such technology be available? Some suggestions have been given that the nature of asynchronous group communication may lead to a non-real-time method of achieving this goal. In the meantime, perhaps some work on "real" systems can begin on voice message based systems, although the problem of less efficient reading times, and significant large requirements for storage may cause acceptance and operational difficulties.

Perhaps the next step is to continue with the idea of voice to text conversion through a human transcriber, with a local area network based system where the transcription activities could take place on an intermittent basis. Inexpensive voice digitization boards with compression are now available that would make this approach feasible for a larger, on-going trial.

A major attraction of present voice messaging systems is that they can be accessed from any telephone. Future AGC systems taking advantage of voice input might consider:

- interfaces to permit remote telephone access
- voice synthesis of system output
- use of the touch tone keypad for command or password entry

This research has demonstrated the feasibility of a "keyboardless" human-computer interface incorporating voice input. The combination of a mouse and voice seems

natural, intuitive, and easy. User eye contact is at one place (on the screen, not the screen + keyboard). However, further work is necessary to work around the drawback of users having to put on a headset to use this type of system.

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## **APPENDIX 1 The Andy, Betty and Chris Tasks**

There were 15 individually constructed task sheets. There were five roles within each of the three tasks. Each task sheet had some common introductory material (below), and a set of facts. The numbers that appear in the following exhibit are reference numbers, which will relate which facts were shared, and which were unique across roles. The numbers were not printed on the sheets given to participants.

Common material:

The following introduction was provided on each task sheet (adjusted for task name where appropriate).

---

You are a member of a group of people who have been asked to advise a prospective first year university student as to what courses to take. Each of the members of the group may have similar, or different perspectives and information on the student's background and interests.

Through discussion and sharing of the information held by your group members, the group is to determine a recommendation for what would be the best course plan for this student which is acceptable to all its members. It is important that the recommendation made by the group is the best one possible, taking account of all the information available to all group members.

The communication medium you have been assigned to use is to be the only means of communication among your group members. Please do not discuss the task outside of the test environment with anyone, especially your group members or others taking part in the study.

To help you get into your role as an adviser, you have been provided with some "ready-made" personal biases about your own attitudes and feelings; you can choose to adopt these or develop modified versions, if these are not in character for you. You have also been provided with some information about the student. Other group members may have the same, different, or conflicting information. Feel free to extrapolate on the facts provided you, so long as these embellishments don't drastically alter the best path for the student.

Questions for the group to discuss:

1. What university should Andy enrol at?
2. What degree/school should Andy enrol in?
3. What should be the subject major?
4. What career is Andy likely to enjoy?
5. What career is Andy likely to be good at?

The information about the student has been provided by a third party who is not available to resolve discrepancies or missing information. Do the best you can with what is available. You need to decide which of the pieces of information is relevant to the various phases of the discussion, and bring them out when most appropriate. Avoid dumping lists of unconnected facts into the discussion at one time.

At the end of your discussion, your group's chairperson will be required to write out the group's recommendation, supported by three to four sentences of justification, along with an indication of the agreement of the individual members of the group with the recommendation.

## A1 Task Andy

Facts about the student:

Name: Andy Osborne

- 1 Andy was born in 1970
- 2 Andy worked for three years after leaving school
- 3 Andy's family emigrated from the U.K. when he was three
- 4 Andy attended East Tamaki High School in Auckland
- 5 Andy's father thought Andy got involved with the "wrong crowd" while he was at East Tamaki High.
- 6 Andy's 6th form mark: english C1
- 7 Andy's 6th form mark: math C1
- 8 Andy's 6th form mark: biology B1
- 9 Andy's 6th form mark: history A2
- 10 Andy won a merit for diligence in 5th form history
- 11 Andy's 5th form mark: english B1
- 12 Andy's 5th form mark: math A1
- 13 Andy's 5th form mark: biology B1
- 14 Andy's 5th form mark: economics A1
- 15 Andy's 5th form mark: history B2
- 16 Andy had numerous detentions, and was suspended from school twice for uniform violations
- 17 Andy started 7th form in 1987, but left in April of that year.
- 18 Andy would not be considered a heavy reader
- 19 Andy has an older sister and three younger brothers
- 20 Andy enjoys card games (bridge) and chess
- 41 Andy's mother wouldn't allow a television in their house until he was fourteen years old.
- 42 Andy is quite good at fixing electrical appliances and stereos for his friends
- 43 Andy will be boarding with a retired couple in town while he is at university
- 44 Andy's father owns a small motor reconditioning shop
- 45 Andy has never used a computer, except for a bit at the last company he worked for.
- 46 Andy likes art and painting, but doesn't consider his own talent very good
- 47 Andy thinks his father is very bright, but could have gotten a lot further if he had been able to stay in school longer
- 48 Andy's mother was heartbroken when he left school in 7th form
- 49 Andy was always pretty quick with numbers, but the math subjects he had in school seemed too theoretical for his taste
- 50 Andy is a bit concerned he'll be the "old man" in most of his university classes

Advisers opinions about courses:

1. computing and management graduates generally have little difficulty getting jobs, although they tend to be in the larger centres.

Advisers personal biases:

1. women generally do well in "people" subjects
2. management students generally get good jobs

## A2 Task Andy

Facts about the student:

Name: Andy Osborne

- 21 Andy got into a bit of trouble when he was 19, and spent a few months in jail.
- 22 Andy had little trouble finding part-time or summer jobs while in school
- 23 Andy's uncle is a university lecturer in England
- 24 Andy watched a lot of telly when he was on the dole
- 25 Andy had the highest score recorded on "frogger" last year
- 26 Andy's mother got all her children started on music lessons when they were young, but none of them lasted more than a couple of years at it.
- 27 Andy thinks a white collar job, with a flash car, would be a big improvement over the labouring jobs he's had to date
- 28 Andy lost his license for drink driving in 1989.
- 29 Andy's mother started nursing training at her local Polytech back in England, but quit when she got pregnant with his older sister
- 30 Andy's favourite music is punk and reggae
- 31 Andy was co-captain of his school first XV, and played centre
- 32 Andy was granted admission to university as an adult student
- 33 Andy is very easy going, and gets on well with most people.
- 34 East Tamaki High School had 1630 students when Andy attended.
- 35 Andy worked after school for a milk vendor from form 3 to form 5
- 41 Andy's mother wouldn't allow a television in their house until he was fourteen years old.
- 42 Andy is quite good at fixing electrical appliances and stereos for his friends
- 43 Andy will be boarding with a retired couple in town while he is at university
- 44 Andy's father owns a small motor reconditioning shop
- 45 Andy has never used a computer, except for a bit at the last company he worked for.
- 46 Andy likes art and painting, but doesn't consider his own talent very good
- 47 Andy thinks his father is very bright, but could have gotten a lot further if he had been able to stay in school longer
- 48 Andy's mother was heartbroken when he left school in 7th form
- 49 Andy was always pretty quick with numbers, but the math subjects he had in school seemed too theoretical for his taste
- 50 Andy is a bit concerned he'll be the "old man" in most of his university classes

Advisers opinions about courses:

- 2. the better science graduates would be well advised to stay on and do a masters degree.

Advisers personal biases:

- 3. too many people take management who are not suited for it
- 4. a good liberal education is better in the long run than "training" courses, such as computing.

### A3 Task Andy

Facts about the student:

Name: Andy Osborne

- 36 Andy originally enrolled to take History for a B.A., but now he is not so sure the first few weeks of classes
- 37 Andy had a hard look at where he was heading after he got out of jail, and decided to try to make something of himself
- 38 Andy's older sister is a lawyer
- 45 Andy has never used a computer, except for a bit at the last company he worked for.
- 46 Andy likes art and painting, but doesn't consider his own talent very good
- 47 Andy thinks his father is very bright, but could have gotten a lot further if he had been able to stay in school longer
- 48 Andy's mother was heartbroken when he left school in 7th form
- 49 Andy was always pretty quick with numbers, but the math subjects he had in school seemed too theoretical for his taste
- 50 Andy is a bit concerned he'll be the "old man" in most of his university classes

Advisers opinions about courses:

- 3. social science subjects, particularly sociology, provide a good sound base for an extremely wide variety of careers.

Advisers personal biases:

- 5. students taking "tough" courses should have had top grades in school
- 6. You work in the sociology department, and would like to recruit good students

### A4 Task Andy

Facts about the student:

Name: Andy Osborne

- 39 Andy used to have long talks with his history teacher after school
- 40 Andy reads a lot, and particularly likes historical novels
- 45 Andy has never used a computer, except for a bit at the last company he worked for.
- 46 Andy likes art and painting, but doesn't consider his own talent very good
- 47 Andy thinks his father is very bright, but could have gotten a lot further if he had been able to stay in school longer
- 48 Andy's mother was heartbroken when he left school in 7th form
- 49 Andy was always pretty quick with numbers, but the math subjects he had in school seemed too theoretical for his taste
- 50 Andy is a bit concerned he'll be the "old man" in most of his university classes

Advisers opinions about courses:

- 4. management courses convey practical and useful knowledge, not abstract and irrelevant theory.

Advisers personal biases:

- 7. four year degrees are better than three year.
- 8. country students generally don't like big city careers

**A5 Task Andy****Facts about the student:**

**Name: Andy Osborne**

**48 Andy's mother was heartbroken when he left school in 7th form**

**49 Andy was always pretty quick with numbers, but the math subjects he had in school seemed too theoretical for his taste**

**50 Andy is a bit concerned he'll be the "old man" in most of his university classes**

**Advisers opinions about courses:**

**5. management and science have enrolment restrictions-only the better students will get accepted.**

**Advisers personal biases:**

**9. people should select practical courses where there is some hope of getting a decent job.**

**10 many people are not really suited to management**

**B1 Task Betty**

Facts about the student:

Name: Betty Russell

- 1 Betty was born in 1973
- 2 Betty has never had a summer job, except for baby sitting and a bit of fruit picking
- 3 Betty is a fourth generation Kiwi
- 4 Betty attended Hamilton Girl's High
- 5 Betty's father is very proud of his daughter, although his expectations have put a lot of pressure on her sometimes
- 6 Betty's 7th form mark:            english            58
- 7 Betty's 7th form mark:            math                61
- 8 Betty's 7th form mark:            biology            63
- 9 Betty's 7th form mark:            economics        72
- 10 Betty's 7th form mark:           history            74
- 11 Betty's 5th form mark:           english            B1
- 12 Betty's 5th form mark:           math                A1
- 13 Betty's 5th form mark:           biology            A1
- 14 Betty's 5th form mark:           economics                    A1
- 15 Betty's 5th form mark:           history            A2
- 16 Betty's 5th form mark:           home economics        B1
- 17 Betty won a merit for achievement in 5th form math
- 18 Betty reads a variety of books, from fiction to biography
- 19 Betty is an only child
- 20 Betty and her mother both enjoy a variety of craft activities
- 41 A chance to travel would be an important consideration of any future career chosen
- 42 Betty got involved in the last election campaign for the labour party, and enjoyed the experience even though the candidate lost
- 43 Betty will be living at home if she goes to university in Hamilton
- 44 Betty's father has quite a responsible job with the Ministry of Agriculture
- 45 Betty's history teacher at school suggested she apply for the new law school at Waikato
- 46 Betty joined a tramping club a year ago, and has been on eight outings
- 47 Betty has never had a major argument with her parents - they are very good at "talking things out"
- 48 Betty always seem to pick up the math and science subjects much more quickly than her other classmates, but still didn't really care for them all that much
- 49 Betty has lived in Hamilton all her life, and in the same house for the last 14 years
- 50 Betty is a Gemini

Advisers opinions about courses:

1. the better science graduates would be well advised to stay on and do a masters degree.

Advisers personal biases:

1. many people are not comfortable with computers
2. a good liberal education is better in the long run than "training" courses, such as computing.

**B2 Task Betty**

Facts about the student:

Name: Betty Russell

- 21 Betty has travelled with her family to Australia and Los Angeles on holiday
- 22 Betty has had her own car since she got her unrestricted license
- 23 Betty's uncle is a doctor in Dunedin
- 24 Betty enjoys some television programs, but watching too much is frowned on in her house
- 25 Betty has given serious thought to teaching as a career, but wonders if she has the right personality for it
- 26 Betty has taken piano lessons since she was five, and is well regarded in music competitions
- 27 Betty is wild about horses, and rides two to three nights a week at her aunt's farm just outside town
- 28 Betty was quite interested in Auckland University, possibly applying for medicine, but didn't like the city all that much
- 29 Betty's was the runner up in a public speaking competition in fifth form
- 30 Betty's favourite music is Bach and Eric Clapton, not necessarily in that order
- 31 Betty has always been somewhat self-conscious about not being very good at sports
- 32 Betty won the prize for 7th form biology in her school
- 33 Betty has one very good close friend, but is not a member of any of the school cliques
- 34 Hamilton Girls High has a strong academic tradition
- 35 A surprising number of Betty's girlfriends are going to take management studies in university
- 41 A chance to travel would be an important consideration of any future career chosen
- 42 Betty got involved in the last election campaign for the labour party, and enjoyed the experience even though the candidate lost
- 43 Betty will be living at home if she goes to university in Hamilton
- 44 Betty's father has quite a responsible job with the Ministry of Agriculture
- 45 Betty's history teacher at school suggested she apply for the new law school at Waikato
- 46 Betty joined a tramping club a year ago, and has been on eight outings
- 47 Betty has never had a major argument with her parents - they are very good at "talking things out"
- 48 Betty always seem to pick up the math and science subjects much more quickly than her other classmates, but still didn't really care for them all that much
- 49 Betty has lived in Hamilton all her life, and in the same house for the last 14 years
- 50 Betty is a Gemini

Advisers opinions about courses:

2. social science subjects, particularly sociology, provide a good sound base for an extremely wide variety of careers.

Advisers personal biases:

3. students taking "tough" courses should have had top grades in school
4. the sociology department needs more good students

**B3 Task Betty**

**Facts about the student:**

**Name: Betty Russell**

- 36 A career as a veterinarian, either specialising on house pets or horses, is something Betty has considered
- 37 Betty is intrigued by computers, and has become quite proficient with the word processor on her father's home computer
- 38 It has always been assumed by Betty's parents that she will go to university
- 45 Betty's history teacher at school suggested she apply for the new law school at Waikato
- 46 Betty joined a tramping club a year ago, and has been on eight outings
- 47 Betty has never had a major argument with her parents - they are very good at "talking things out"
- 48 Betty always seem to pick up the math and science subjects much more quickly than her other classmates, but still didn't really care for them all that much
- 49 Betty has lived in Hamilton all her life, and in the same house for the last 14 years
- 50 Betty is a Gemini

**Advisers opinions about courses:**

3. management courses convey practical and useful knowledge, not abstract and irrelevant theory.

**Advisers personal biases:**

5. four year degrees are better than three year.
6. country students generally don't like big city careers

**B4 Task Betty**

**Facts about the student:**

**Name: Betty Russell**

- 39 Betty is a little apprehensive about the social life at university, as she hasn't had much dating experience and still feels uncomfortable around boys
- 40 Betty handles pressure situations quite coolly
- 45 Betty's history teacher at school suggested she apply for the new law school at Waikato
- 46 Betty joined a tramping club a year ago, and has been on eight outings
- 47 Betty has never had a major argument with her parents - they are very good at "talking things out"
- 48 Betty always seem to pick up the math and science subjects much more quickly than her other classmates, but still didn't really care for them all that much
- 49 Betty has lived in Hamilton all her life, and in the same house for the last 14 years
- 50 Betty is a Gemini

**Advisers opinions about courses:**

4. management and science have enrolment restrictions-only the better students will get accepted.

**Advisers personal biases:**

7. people should select practical courses where there is some hope of getting a decent job.
8. many people are not comfortable with computers

**B5 Task Betty****Facts about the student:**

**Name: Betty Russell**

**48 Betty always seem to pick up the math and science subjects much more quickly than her other classmates, but still didn't really care for them all that much**

**49 Betty has lived in Hamilton all her life, and in the same house for the last 14 years**

**50 Betty is a Gemini**

**Advisers opinions about courses:**

**5. computing and management graduates generally have little difficulty getting jobs, although they tend to be in the larger centres.**

**Advisers personal biases:**

**9. women generally do well in "people" subjects**

**10. management students generally get good jobs**

**C1 Task Chris**

**Facts about the student:**

**Name: Chris Andrews**

- 1 Chris was born in 1972
- 2 Chris' younger sister wants to be a nurse
- 3 Chris is presently from Kaipaki
- 4 Chris didn't like biology in school
- 5 Chris' mother is considered "very sharp" on business matters
- 6 Chris' 7th form mark: english           78
- 7 Chris' 7th form mark:           math           62
- 8 Chris' 7th form mark:           biology       66
- 9 Chris' 7th form mark:           economics   65
- 10 Chris' 7th form mark:          history       71
- 11 Chris' 5th form mark: english           B1
- 12 Chris' 5th form mark:          math           A1
- 13 Chris' 5th form mark:          biology       B1
- 14 Chris' 5th form mark:          economics   A1
- 15 Chris' 5th form mark:          history       B2
- 16 Chris' 5th form mark:          french        C1
- 17 Chris obtained a B bursary from 7th form
- 18 Chris took 7th form economics by correspondence
- 19 Chris was off school for two weeks early in the 7th form year
- 20 Chris knows how to use a computer
- 41 Chris' mother does accounts for their farm
- 42 An acquaintance, John, from Kaipaki High will be taking soc sci (sociology) this year
- 43 Chris will be living in student residence halls
- 44 Chris' father does part time trucking
- 45 Chris wants travel as part of career if possible
- 46 Chris thinks psychology might be interesting
- 47 Chris' father thinks job prospects after degree are important
- 48 Chris' mother believes that studying an enjoyable subject is important
- 49 Chris moved to Kaipaki half way thru 5th form
- 50 Chris is ambivalent about using computers

**Advisers opinions about courses:**

1. management and science have enrolment restrictions-only the better students will get accepted.

**Advisers personal biases:**

1. people should select practical courses where there is some hope of getting a decent job.
2. many people have trouble dealing with computers

**C2 Task Chris****Facts about the student:****Name: Chris Andrews**

- 21 Chris had a terrific english teacher in 7th
- 22 Chris was one of two people who wrote bursary biology in 7th form
- 23 Chris' aunt is a teacher
- 24 Chris' mother puts in a lot of time in partnership with her father on the family farm
- 25 Chris' favourite books are historical novels
- 26 Chris' mother does bookkeeping for several other farms and local small businesses
- 27 Kaipaki High School had only a few teachers, so not all subjects in 7th form were offered
- 28 Chris' father is a sheep farmer
- 29 An acquaintance from Kaipaki High, John, will be flatting
- 30 Chris organised youth group at church
- 31 Chris' mother taught Chris a bit about bookkeeping
- 31 Chris is not very good at sports, but tries most
- 32 Chris makes friends easily
- 33 some consider Chris a bit of a loner
- 34 Kaipaki High School draws primarily rural students
- 35 Chris got the best mark in school in 7th form in bursary biology
- 41 Chris' mother does accounts for their farm
- 42 An acquaintance, John, from Kaipaki High will be taking soc sci (sociology) this year
- 43 Chris will be living in student residence halls
- 44 Chris' father does part time trucking
- 45 Chris wants travel as part of career if possible
- 46 Chris thinks psychology might be interesting
- 47 Chris' father thinks job prospects after degree are important
- 48 Chris' mother believes that studying an enjoyable subject is important
- 49 Chris moved to Kaipaki half way thru 5th form
- 50 Chris is ambivalent about using computers

**Advisers opinions about courses:**

- 2. computing and management graduates generally have little difficulty getting jobs, although they tend to be in the larger centres.

**Advisers personal biases:**

- 3. women generally do well in "people" subjects
- 4. management students generally get good jobs

**C3 Task Chris****Facts about the student:****Name: Chris Andrews**

- 36 Chris really admires her mother
- 37 Chris dropped french after 5th form because teacher not good
- 38 Chris' older brother is a farm cadet
- 45 Chris wants travel as part of career if possible
- 46 Chris thinks psychology might be interesting
- 47 Chris' father thinks job prospects after degree are important
- 48 Chris' mother believes that studying an enjoyable subject is important
- 49 Chris moved to Kaipaki half way thru 5th form
- 50 Chris is ambivalent about using computers

**Advisers opinions about courses:**

- 3. the better science graduates would be well advised to stay on and do a masters degree.

**Advisers personal biases:**

- 5. too many people take management who are not suited for it
- 6. a good liberal education is better in the long run than "training" courses, such as computing.

**C4 Task Chris****Facts about the student:****Name: Chris Andrews**

- 39 Chris is female
- 40 Chris learned to water ski last year
- 45 Chris wants travel as part of career if possible
- 46 Chris thinks psychology might be interesting
- 47 Chris' father thinks job prospects after degree are important
- 48 Chris' mother believes that studying an enjoyable subject is important
- 49 Chris moved to Kaipaki half way thru 5th form
- 50 Chris is ambivalent about using computers

**Advisers opinions about courses:**

- 4. social science subjects, particularly sociology, provide a good sound base for an extremely wide variety of careers.

**Advisers personal biases:**

- 7. students taking "tough" courses should have had top grades in school
- 8. You work in the sociology department, and would like to recruit good students

**C5 Task Chris**

**Facts about the student:**

**Name: Chris Andrews**

**48 Chris' mother believes that studying an enjoyable subject is important**

**49 Chris moved to Kaipaki half way thru 5th form**

**50 Chris is ambivalent about using computers**

**Advisers opinions about courses:**

- 5. management courses convey practical and useful knowledge, not abstract and irrelevant theory.**

**Advisers personal biases:**

- 9. Four year degrees are better than three year.**
- 10. Country students generally don't like big city careers**

## APPENDIX 2 CoSy, Moot and face transcript extracts

CoSy extract - group 2 messages 10 to 13

=====  
bc2/general #10, dey, 605 chars, 27-Mar-91 10:42

-----  
TITLE: CHRIS'S LIFE

Giddy guys, Rick here.

Hey, did you guys get my last message? I left one yesterday (Tuesday) but when I had a brief look back thru the messages this morning I couldn't find it so I guess it's f

loating around the computer somewhere.

Anyway down to business - As I expected I've got stuff all info on Chris but I'll chuck it in here a

nyway:

Chris's mum thinks Chris should do something that she enjoys

She lives in Kaipaki - we probably should find out where this is

She's ambivalent (that beautiful word again Steve) about computers

And that's it - heaps eh!

From dey ( DEY, R O )

=====  
bc2/general #11, dey, 898 chars, 27-Mar-91 10:44

-----  
TITLE: MORE STUFF

O.K I think I know what happened to that first message now cos it just happened

to the last one ,except this time I managed to find it and sort it out

Well I think I'll just make a few comments on what I've heard from you guys while using my personal 'opinions' and 'biases'.

I think we can rule out a science degree unless Liz turns up with any vastly contrasting information. We cant really look at where she is going until we sort out what she is doing. We can probably pass on computers as a direct course but as she knows how to use them perhaps she could look towards something which uses them as an aid. Her better subjects would suggest a soc.sci.-ish course but maybe she should angle towards management.

That's enough waffle for now

See ya later

P.S. What did ya think of the Technical Control Test? No need for faulty coordination

ciao...Rick

From dey ( DEY, R O )

=====  
bc2/general #12, djhanson, 663 chars, 27-Mar-91 12:02

-----  
TITLE: CHRIS ANDREWS

Hi, its Deborah here again. I haven't got much more to add except to comment about what Rick had to say. I feel that not everyone is suited to a career in management and from what we have to go on (which does not seem like much) I think that it may be an option to abandon that

idea.

It will be my last time on the Cosy part of this experiment tomorrow because of Easter so it might be a good idea to round up our ideas and come to a conclusion.

I feel that Chris should definately take up Social Sciences either in economics or history. Perhaps even psychology. What do you guys reckon?

I will get in touch tommorrow. See you then.

=====  
bc2/general #13, sschollum, 881 chars, 27-Mar-91 12:29  
-----

TITLE: Chris Andrews

Hey its me Steve here yet again. I'm not really into it at the moment but here goes any way:

I found out what that word meant but it doesn't really matter cause she ain't gonna be doing no computers course anyhow.

It looks like she would be best doing a soc-sci degree and majoring in psychology; or as a second option a B.A. major in either english or history. My personal bias is that people should select practical courses where there is some hope of getting a decent job. Psychology could be a practical course, especially if she takes economics as her second major and does something like industrial psychology/human resource management which is a big thing these days. that will do for a wee while. I might come up again later.

The T.C. test was pretty goood.

P.S. Where the heck is Liz??

From sschollum ( SCHOLLUM, S B )







face-to face meeting transcript extract - group 2

22

I've also got that he likes a practical sort of thing that he's fixed appliances doesn't like theoretical sort of stuff so maybe a practical sort of degree would be good for him.

24

Yeah I kind of think something like that because something like ... he wasn't you know very good at it at school it sort of sounds that he ..... try hard, but if he tries hard he could you know do something with science and maths and he could get a job at the end of it even with his criminal record.

Yeah I'd say so.

He sounds pretty on to it really. .... with just his numbers

.....

Yeah

21

I mean he .... A1 for Maths ..... School C.....

Yeah.

24

I've got here he had long talks with the History teacher and .....

.....

23

Bit a contradiction isn't it.

No I've got that he he originally enrolled for in a BA

Yeah a BA in History but he's having second thoughts now.

I don't think ..... thing.

21

I think I mean it would be alright for him ..... some computers or electronics or something like that its probably too much theory.

Can you do electronics at this Varsity?

Don't know.

24

What about a Science and Technology?

Yeah.

Yeah.

21

It also says here ....my personal bias reckons that Management students generally get good jobs and sort of wants to suggest that maybe do something like Management.

In a BSc Tech you do some Management papers.

24

Yeah you do.

21

That might be alright.

24

So it wouldn't do any good to take Management in full because usually you've got to have a good record.

Yeah.

24

Especially in accounting and stuff like that.

22

It doesn't really say where he lives. Does anyone know where he lives?

24

No but I've got as a personal bias that country students generally don't like big cities .....

.....

24

Well I'm a bit I mean I'm a country student.

22

Well I've got lost license for drink driving.

They can't .....

24

He's he's boarding with a retired couple, is that what someone's got?

Yeah, Yeah. Maybe it's away from the country ... gives you .... prisons.

24

I think what we should concentrate on is finding some subjects or .... he could do and then worry about all the other stuff cause if it you don't .....

..... Waikato.

Why.

Well we basically know that .....

24

We don't know where .....

.....

Work out what career

Ok I agree

Career and degree first

24

Was it gonna be where I don't know much about a Science and Technology degree. I don't know whether

23

Pretty good like you do Management papers in that six and you you know can do maths

You can do .....

### **APPENDIX 3 Participant introductory material**

The experiment in which you will be participating will be examining group communication, and the effect of electronic group communication tools on the exchange of information.

Most business group communication is done today in face-to-face meetings, although there is much interest in how computers can assist this process. Two computer based tools will be used by you in this experiment.

You will be assigned to a group of five people, and given a task to accomplish by the end of each of the three weeks.

On two of these three weeks, you will be asked to use a computer based group communication tool to discuss the task. The two tools are CoSy, a text-based computer conferencing system, and MOOT, a voice input conferencing system. Each group member will need to sign into MOOT or CoSy at least five times prior to the group meeting that week; a once-a-day 10 minute sign-on will be the normal case. On one of these weeks, you will meet in a face-to-face meeting.

**Payment:** if ALL of your group members use the computer based tools, and attend the face-to-face meeting as requested over the three week period, then EACH of the members of the group will be paid a \$25 honorarium.

**Introduction and group assignment:** A meeting will be held on Wednesday, March 13 at 1:10 pm in room G1.15 (G Block) to assign you to experiment groups, and give you the materials you will need. One of the important functions of this meeting will be assignment of the scheduled meeting time for your experiment group's face-to-face meeting. Please bring your lecture timetable to the meeting. Those who intend participating in the experiment, but cannot make this meeting, should leave a message BEFORE that Wednesday on the door of Bob McQueen, G1.24, or with the Computer Science secretary (x4021).

The experiment will start on March 18.

CoSy runs on the campus VAX computer, so any of the VAX terminals in G block basement or elsewhere on campus may be used, without pre-booking, by just walking in and signing on.

MOOT, however, uses some special voice input technology, and unfortunately, there is only one operational workstation which can be used, located in GB.15 (near the basement entrance door). There will be about 20 people a day using MOOT for 10 to 15 minute sessions, so prebooking will be necessary. A sign-up sheet for each of the days of that week will be available, so it is suggested you book your whole week's slots at once, based on your timetable spares. MOOT will be available from 8am to 10pm each weekday and on the weekend, and so there should be a reasonable number of slots to choose from. A few slots through the day will be reserved for "walk-in" use.

The two tasks involving the use of CoSy or MOOT will start on the Monday of each week, will involve daily sign-ons to the electronic tool (minimum 5). The task with only a face-to-face meeting will be conducted solely in the scheduled meeting.

Please do not open your task envelopes before the date indicated. Please do not discuss the tasks with any of your group members outside of the medium scheduled for the experiment, or with other group members in the class.

## Introduction to MOOT

**Location:** G Block basement, room GB.15

MOOT is a prototype of a "next generation" electronic group communication tool. It is intended to be a medium of communication among group members who wish to exchange information, although there is only one person connected to the system at any time.

MOOT allows you to speak your messages into the system, instead of having to type them. The voice messages are then converted to text messages, and you can read the messages of others from your group on the screen.

Because there is only one MOOT workstation in operation, participants in the experiment will have to book time slots on the workstation. Each person should book at least one slot per day for the week they are using MOOT. The workstation is located in G Block basement, room GB.14, and will be available from 8am to 10 pm each day. A booking sheet will be posted on the door, and participants are welcome to book, or walk-in for any additional sessions they wish beyond the minimum one per day.

### How to operate it:

The MOOT design is completely mouse driven, and the keyboard is normally set out of your way. Using the mouse, move the cursor over the place on the screen desired, and selects the action desired by "clicking" the left mouse button. More detailed instructions will be available beside the MOOT workstation in GB.14.

**Getting started:** Move over the MOOT icon, and click. A list of names will appear; if your name isn't visible, click on the down arrow on the right side of the name box to see more names below. Move the cursor over your name and click. Please don't read other people's messages - it mucks up the pointers.

**Reading messages:** All messages put in by your group members are available. The next unread message for you will be displayed on the screen. To see the next one after that, click on the "next" button at the bottom of the screen.

**Re-reading messages:** Pull down the messages menu at the top, and click on "directory". Click on the old message you wish to re-read.

**"Text not available" messages:** recently added voice messages are only converted to text once per day. You can hear the voice message by clicking the "V" button at the bottom left.

The voice recording of the original message will be retained as long as storage space permits. Click on the "V" button to hear it.

**Adding your own message:** Click on the "talk" button at the bottom right of the screen. Use the "record" and "finished" buttons that appear to start and stop.

**Finishing with the session:** click on the "exit" item in the menu on the top line.

You are welcome (encouraged!) to try out MOOT in advance of your scheduled start - however, because time slots are limited, please don't "book" a time slot until your scheduled week on Moot arrives.

## Introduction to CoSy

Location: any campus VAX terminal

CoSy is a computer conferencing system, which is designed to support group communication through the exchange of text messages organised in a "conference" of messages. Members of a group are not usually connected simultaneously.

CoSy runs on the campus VAX, and can be accessed through any of the campus VAX terminals (G basement and other locations), so that booking of specific terminal times is not required. Participants are expected to sign on to CoSy at least once per day during the week when their CoSy task is being run, but are welcome to sign on more frequently if desired.

### How to Operate CoSy:

1. Type "c virtue"
2. At the Username prompt, type your assigned VMS username.
3. At the Password prompt, type your password.
4. Type "xeq cosy"
5. Follow the instructions in the learn tutorial (it takes about 10 minutes) to find out about the basic functions of CoSy.
6. To join your group conference, type the letter j plus its name, which will be a combo of the letters bc and its number - no spaces: for example, "j bc4" or "j bc10".

The next message, put in by other members of your group, that you have not yet seen will be displayed.

To see the next message: press the return key.

To reread an old message: type its number

To go back and re-read all messages: type "skip to 1"

To add your own message after reading somebody else's message: type "say" and follow the instructions.

To sign off, type "bye", then "log".

You can send private mail messages to other members of your group - type "mail" and "to xxxx" where xxxx is the recipient's username.

More information on CoSy commands is in the short manual supplied.

You are welcome (encouraged!) to sign on to CoSy in advance of your scheduled group discussion and do the tutorial, so that you will be ready to begin on the main work of your group discussion at the scheduled time.

## Introduction to Face-to-Face meetings

Location: G Block basement, room GB.16

No "how-to" is really necessary - all of you have attended many group meetings before, and know how they work.

To compare the interaction processes of the face-to-face meeting with the other group communication forms you will be using, the meeting will be videotaped.

Please speak clearly, and loudly, so that the words picked up by the microphone will be able to be understood later during analysis. Identify your group number, task name, and the date as you start so it will be captured on the videotape.

Please start your face-to-face meetings at the scheduled time, as there are likely others scheduled to use the room right after you. Start on time, even though all your group members may not have arrived.

Your face-to-face meetings should be around 1/2 hour in duration, and may finish early if you think you've got the task completed.

The videotape machine in your meeting room is voice activated, so it should start running as soon as somebody enters the room. However, please check that it is recording by looking for the letters "rec" in red on the panel. If a tape has been ejected, please put it in the "recorded" box, and take a new tape from the "blank" box, and insert it into the recorder. It should start recording automatically. Please report any apparent malfunctions.

## **APPENDIX 4 Group reporting form**

### **GROUP OPINION FORM**

**Date handed in:**

**Task name:**

**Group number:**

**Chairperson submitting opinion:**

**Other group members:**

**What should the student enrol in?**

**What points were most important in arriving at this decision?**

**Did all members of the group agree? If not, who and why?**

## APPENDIX 5 Individual time log

### Personal Log Sheet

Instructions: take this log sheet with you to each of the sessions of the experiment. It is very important to fill in the start and stop times, and the date for each session. Record only those times you are actually working on the assigned task - don't record time spent on learning about the system, experimenting, or doing tutorials. Hand this sheet in after your last session to the Department of Computer Science, 1st floor, G Block. If you and your other group members have each attended the scheduled group sessions, and each completed a minimum 5 sessions on both MOOT and CoSy, then a \$25 honorarium will be prepared and mailed to each of you.

Group number: 1 2 3 4

Name:

Local Address:

Local telephone:

#### Week of March 18, MOOT session log (5 minimum):

1. Date:	Time on:	Time off:
2. Date:	Time on:	Time off:
3. Date:	Time on:	Time off:
4. Date:	Time on:	Time off:
5. Date:	Time on:	Time off:
6. Date:	Time on:	Time off:
7. Date:	Time on:	Time off:
8. Date:	Time on:	Time off:
9. Date:	Time on:	Time off:

#### Week of March 25, CoSy session log (5 minimum):

1. Date:	Time on:	Time off:
2. Date:	Time on:	Time off:
3. Date:	Time on:	Time off:
4. Date:	Time on:	Time off:
5. Date:	Time on:	Time off:
6. Date:	Time on:	Time off:
7. Date:	Time on:	Time off:
8. Date:	Time on:	Time off:
9. Date:	Time on:	Time off:

Week of April 1:

Face-to-face only meeting date:

Time you arrived:

Time Finished:

## APPENDIX 6 Participant comments

Answers to the post-test question "Which did you prefer, CoSy or Moot? Why?"

a) Answers from those preferring Moot:

Moot, there is the option of either voice or keyboard, and voice is often an easier mode of communication.

I prefer Moot, because the ideas flowed one after another, and it was easier to think the issues through when you don't have to worry about typing what you think in to the computer.

I preferred Moot because it allowed really quick interactions especially if, like me, you happen to be a slow typist. The drawback to Moot is getting used to talking to yourself!!!

Moot was a much more comfortable mode of communication & for our group, proved to be both easier to use and more conducive to making decisions.

Moot. Hearing the voices of other conference members seemed to convey more in their messages.

I preferred Moot as it had both voice and text which made understanding what people were saying easier.

Moot, because I haven't got very good keyboard skills, and it came more naturally, (and) it was easier to discuss and get all my points down. It was faster.

Moot because with CoSy you have to type in all the ideas and I tended to summarize quite a bit so I wouldn't have to type as much. With Moot, I could express myself without taking any shortcuts and it was fun trying it.

I preferred Moot in that input was extremely easy. I cannot type well, so I was a lot more comfortable speaking into a microphone. CoSy was good in that you could refer back to messages easily, and at a glance you could find the messages you were looking for.

b) Answers from those preferring CoSy:

I prefer CoSy because I often find it hard to get across what I mean and on CoSy I could "proofread" messages before I put them on so that they read the way I wanted them to. I found that a lot was "lost" in the Moot transcriptions - they just didn't read the right way.

CoSy. I had time to think about what I wanted to say. There was no hesitation in my reply.

CoSy. I could take time to gather one's thoughts & type in, & also have time to read carefully the info. In Moot, you have a time limit thus have to rush. Though, one good thing about Moot is that you can "send" & "extract" messages quickly.

Cosy. I guess its easier for the individual to write than to speak and be heard. Also, if you've made a mistake in typing in CoSy, you can go back and correct it but not necessarily in Moot.

CoSy - more time to analyse what other group members had to contribute and time to prepare your own feedback to comments.

CoSy. Editing possible.

CoSy - decision made a lot quicker as we were all there, had some fun by arguing through the keyboard. Moot; had time to think & plan verbal suggestions & replies. Very slow process.

I think both of them are difficult ways of communication. but I prefer CoSy because you can put down your message how you want it to be rather than talking aloud and getting the "ahs and ums" in the background.

CoSy. Communication was easier as the person only needed to type in his/her suggestions while Moot took a longer time to complete task as some members don't log on Moot till very much later.

CoSy. Sentences were more articulate to read than spoken sentences. It was easier to make comments directly related to one sentence/idea. I was already familiar with it.

CoSy - can be quicker as I found the Moot rambled a little due to the time lag of info.

CoSy, it was easier to correct mistakes, as well it was not so disjointed, it followed a reasonable flow.

CoSy, because replies were instant and everyone was working simultaneously.

c) A bit of both.....

CoSy was the best medium but Moot was more interesting.

## APPENDIX 7 ANOVA Results

This appendix contains the results from an analysis of variance using Genstat 5. The first section contains the command file, the second section the data file, and the third section the output.

Command file:

```

job 'MOOT2: first analysis of conference system data'
open 'moot2.out'; file=out; ch=3; width=80
outp [indent=5] 3
unit [120]
fact [level=2; label=!t(cosy,moot)] medium
fact [lev=3] seq
fact [level=3; label=!t(andy,betty,chriss)] task
fact [lev=12] grp
fact [lev=5] role
open 'moot2'; ch=2;
read [ch=2] medium,seq,task,grp,role,facts,words;\
      frep=lab,*,lab,*,*,*,*
close ch=2
fact [label=!t(high,low,chair)] mem role
calc mem role=newlevel(role; !(1,1,2,2,3))
block grp/task
treat medium*mem role
for dy=facts,words
      anov [fprob=y] dy
endfor
stop

```

Data file (arranged in two columns):

cosy 2 betty	1	1	1	56	moot 1 andy	1	1	0	577
cosy 2 betty	1	2	4	668	moot 1 andy	1	2	9	2176
cosy 2 betty	1	3	*	*	moot 1 andy	1	3	1	42
cosy 2 betty	1	4	8	362	moot 1 andy	1	4	7	703
cosy 2 betty	1	5	2	130	moot 1 andy	1	5	2	477
cosy 2 chris	2	1	6	748	moot 1 betty	2	1	3	1088
cosy 2 chris	2	2	8	288	moot 1 betty	2	2	14	753
cosy 2 chris	2	3	4	464	moot 1 betty	2	3	5	449
cosy 2 chris	2	4	4	467	moot 1 betty	2	4	6	1417
cosy 2 chris	2	5	3	721	moot 1 betty	2	5	0	795
cosy 2 andy	3	1	17	991	moot 1 chris	3	1	26	702
cosy 2 andy	3	2	2	661	moot 1 chris	3	2	8	948
cosy 2 andy	3	3	6	569	moot 1 chris	3	3	0	456
cosy 2 andy	3	4	5	636	moot 1 chris	3	4	7	581
cosy 2 andy	3	5	6	818	moot 1 chris	3	5	6	1100
cosy 2 betty	4	1	3	263	moot 1 andy	4	1	12	859
cosy 2 betty	4	2	0	121	moot 1 andy	4	2	11	875
cosy 2 betty	4	3	4	254	moot 1 andy	4	3	3	813
cosy 2 betty	4	4	1	236	moot 1 andy	4	4	6	1172
cosy 2 betty	4	5	3	194	moot 1 andy	4	5	4	2048
cosy 3 chris	5	1	13	1366	moot 2 betty	5	1	3	374
cosy 3 chris	5	2	8	357	moot 2 betty	5	2	3	94
cosy 3 chris	5	3	6	1134	moot 2 betty	5	3	6	590
cosy 3 chris	5	4	6	734	moot 2 betty	5	4	8	505
cosy 3 chris	5	5	4	1080	moot 2 betty	5	5	4	1396
cosy 3 andy	6	1	15	120	moot 2 chris	6	1	27	1134
cosy 3 andy	6	2	5	105	moot 2 chris	6	2	6	883
cosy 3 andy	6	3	*	*	moot 2 chris	6	3	*	*
cosy 3 andy	6	4	*	*	moot 2 chris	6	4	*	*
cosy 3 andy	6	5	5	205	moot 2 chris	6	5	9	857
cosy 3 betty	7	1	14	153	moot 2 andy	7	1	*	*
cosy 3 betty	7	2	11	402	moot 2 andy	7	2	10	522
cosy 3 betty	7	3	3	443	moot 2 andy	7	3	4	484
cosy 3 betty	7	4	3	551	moot 2 andy	7	4	7	230
cosy 3 betty	7	5	3	175	moot 2 andy	7	5	2	594
cosy 3 chris	8	1	22	767	moot 2 betty	8	1	27	751
cosy 3 chris	8	2	14	644	moot 2 betty	8	2	9	880
cosy 3 chris	8	3	5	471	moot 2 betty	8	3	9	864
cosy 3 chris	8	4	7	359	moot 2 betty	8	4	4	680
cosy 3 chris	8	5	5	750	moot 2 betty	8	5	2	1236
cosy 1 andy	9	1	6	749	moot 3 chris	9	1	10	2540
cosy 1 andy	9	2	4	294	moot 3 chris	9	2	7	1131
cosy 1 andy	9	3	15	1674	moot 3 chris	9	3	3	668
cosy 1 andy	9	4	4	560	moot 3 chris	9	4	8	1459
cosy 1 andy	9	5	5	680	moot 3 chris	9	5	6	1695
cosy 1 betty	10	1	12	627	moot 3 andy	10	1	27	1658
cosy 1 betty	10	2	8	420	moot 3 andy	10	2	5	454
cosy 1 betty	10	3	3	402	moot 3 andy	10	3	2	599
cosy 1 betty	10	4	4	495	moot 3 andy	10	4	3	423
cosy 1 betty	10	5	1	429	moot 3 andy	10	5	0	326
cosy 1 chris	11	1	17	361	moot 3 betty	11	1	16	633
cosy 1 chris	11	2	10	284	moot 3 betty	11	2	22	693
cosy 1 chris	11	3	1	176	moot 3 betty	11	3	4	797
cosy 1 chris	11	4	10	277	moot 3 betty	11	4	17	1037
cosy 1 chris	11	5	5	488	moot 3 betty	11	5	4	691
cosy 1 andy	12	1	25	1544	moot 3 chris	12	1	20	1284
cosy 1 andy	12	2	8	1052	moot 3 chris	12	2	11	1798
cosy 1 andy	12	3	6	921	moot 3 chris	12	3	8	195
cosy 1 andy	12	4	*	*	moot 3 chris	12	4	*	*
cosy 1 andy	12	5	5	997	moot 3 chris	12	5	1	427

\* indicates missing value

Output file:

\*\*\*\*\* Analysis of variance \*\*\*\*\*

Variate: facts

Source of variation	d.f.(m.v.)	s.s.	m.s.	v.r.	F pr.
grp stratum	11	634.96	57.72	3.80	
grp.task stratum					
medium	1	48.54	48.54	3.19	0.101
Residual	11	167.17	15.20	0.53	
grp.task.*Units* stratum					
mem_role	2	1113.72	556.86	19.51	<.001
medium.mem_role	2	46.88	23.44	0.82	0.443
Residual	84(8)	2397.60	28.54		
Total	111(8)	4334.92			

\* MESSAGE: the following units have large residuals.

grp 3	task chris	*units* 1	12.29	s.e. 4.47
grp 8	task betty	*units* 1	12.49	s.e. 4.47
grp 10	task andy	*units* 1	15.29	s.e. 4.47
grp 12	task andy	*units* 1	11.46	s.e. 4.47

\*\*\*\*\* Tables of means \*\*\*\*\*

Variate: facts

Grand mean 7.43

medium	cosy	moot		
	6.80	8.07		
mem_role	high	low	chair	
	11.04	5.73	3.63	
rep.	48	48	24	
medium mem_role	high	low	chair	
cosy	9.71	5.33	3.92	
rep.	24	24	12	
moot	12.38	6.13	3.33	
rep.	24	24	12	

\*\*\* Standard errors of differences of means \*\*\*

Table	medium	mem_role	medium mem_role	
rep.	60	unequal	unequal	
s.e.d.		1.542X	2.077	min.rep
	0.712	1.336	1.767	max-min
		1.091	1.391	max.rep
Except when comparing means with the same level(s) of				
medium			2.181	min.rep
			1.889	max-min
			1.542	max.rep

(No comparisons in categories where s.e.d. marked with an X)  
(Not adjusted for missing values)

\*\*\*\*\* Missing values \*\*\*\*\*

Variate: facts

Unit	estimate
3	1.92
28	5.90
29	5.90
59	9.17
88	10.74
89	10.74
91	11.14
119	7.57

Max. no. iterations 4

## \*\*\*\*\* Analysis of variance \*\*\*\*\*

Variate: words

Source of variation	d.f.(m.v.)	s.s.	m.s.	v.r.	F pr.
grp stratum	11	4847718.	440702.	1.20	
grp.task stratum					
medium	1	2903369.	2903369.	7.90	0.017
Residual	11	4041492.	367408.	2.49	
grp.task.*Units* stratum					
mem_role	2	696089.	348045.	2.36	0.101
medium.mem_role	2	599616.	299808.	2.03	0.137
Residual	84(8)	12387447.	147470.		
Total	111(8)	24470874.			

\* MESSAGE: the following units have large residuals.

grp 9           447.   s.e. 201.

grp 1	task andy	*units* 2	1259.	s.e. 321.
grp 9	task andy	*units* 3	889.	s.e. 321.
grp 9	task chris	*units* 1	920.	s.e. 321.
grp 10	task andy	*units* 1	844.	s.e. 321.

## \*\*\*\*\* Tables of means \*\*\*\*\*

Variate: words

Grand mean 698.

medium	cosy	moot		
	543.	854.		
mem_role	high	low	chair	
	760.	605.	763.	
rep.	48	48	24	
medium mem_role	high	low	chair	
cosy	543.	536.	556.	
rep.	24	24	12	
moot	976.	674.	970.	
rep.	24	24	12	

## \*\*\* Standard errors of differences of means \*\*\*

Table	medium	mem_role	medium mem_role	
rep.	60	unequal	unequal	
s.e.d.		110.9X	178.6	min.rep
	110.7	96.0	160.5	max-min
		78.4	140.1	max.rep
Except when comparing means with the same level(s) of				
medium			156.8	min.rep
			135.8	max-min
			110.9	max.rep

(No comparisons in categories where s.e.d. marked with an X)  
(Not adjusted for missing values)

## \*\*\*\*\* Missing values \*\*\*\*\*

Variate: words

Unit	estimate
3	296.
28	133.
29	133.
59	1120.
88	658.
89	658.
91	610.
119	701.

Max. no. iterations 5

## **APPENDIX 8 About the word moot....**

Moot is the name applied to the voice input prototype in this research.

The following is from the Oxford English Dictionary, Second Edition, Clarendon Press, Oxford, 1989.

**Moot (mu:t)**

**a) Noun:**

- 1. Meeting, encounter**
- 2. An assembly of people**
- 3. Litigation; an action at law; a plea; accusation**
- 4. Argument; discussion; disputation; talking**
- 5. The discussion of a hypothetical case by students at the Inns of Court for practice**

**b) adjective:**

- 1. That can be argued; debatable; not decided; doubtful**

**c) verb:**

- 1. To speak, to converse; to say, to utter**
- 2. To argue, to plead, to discuss, dispute; to argue a point**
- 3. To raise or bring forward (a point, question, subject, etc.) for discussion**

**Other meanings include a tool for shaping wooden pins, and a tree stump.**