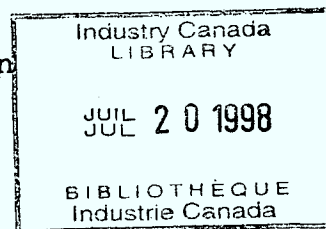


FINAL REPORT

December, 1976

DOC CONTRACT #0SU5-0072

Research into more efficient use of
standard television and telephone
channels in educational communication
systems.



SCIENTIFIC AUTHORITY

Mr. L. Durr
Department of Communications
16th Floor, Journal Tower North
300 Slater Street
Ottawa, Ontario
K1A 0C8

PREPARED BY

D.A. George & S.A. Paterson
Wired City Laboratory
Department of Systems Engineering & Computing Science
Carleton University
Ottawa, Ontario
K1S 5B6

EFFICIENT USE OF COMMUNICATION CHANNELS IN EDUCATION

PREAMBLE

This contract, for the 1975-76 year, was in support of work growing naturally from previous activities within the Wired City Laboratory. It was a joining together of two previous major thrusts - our researches into teleconferencing, and our work in educational communications. In particular, the contract provided resources for the experimental utilization of special apparatus for the storage of video images which had been acquired with support from DOC's Educational Technology Program.

The primary orientation of the work was towards more efficient use of television transmission channels, with work on telephone channels having a lower priority. During the period of the contract, activities supported by DOC contracts OST5-0059, 4130-05447-2807 and OZSU-36100-4-0873, were parallel to the aims of this project and considerable mutual reinforcement was possible.

By the end of the contract year, it had proven not to be possible to conduct a detailed evaluation study which was an important component of our overall objective. The nature of that study made it necessarily carried out over a regular academic term, but by the time preparations had been made, the current term was almost over. Consequently, this report does not contain the results of that study. An annex to the report will be available April 1st, 1977, and will present these findings.

91
C655
B463
1976
C.1

10040182

INTRODUCTION

This contract for research into more efficient use of standard television and telephone channels in educational communication systems had two main goals:

- "a) to design a system which would permit the transmission of several video signals of various activity levels over a single television channel. The benefits accruing from the suggested means of effective bandwidth utilization include the use of normal television technology, transmission channels and procedure to maintain full resolution of the received images;
- b) to design a system which would permit the multiplexing and transmission of audio, slow-scan television, facsimile, electronic blackboard, control and other signals on existing narrow band facilities."

As is usual for the researches conducted in the Wired City Laboratory, the design orientation was towards the interaction of the users and the technology, towards the design of the functional system. More conventional engineering design of the communications facilities themselves was to be minimized, with simulations used when possible. This did not mean that there was no engineering effort needed but simply that there was much less than would otherwise be expected.

The motivation for this study may simply be stated by a quotation from the contract:

" In order to support remote teaching it is necessary to provide good quality audio together with some form of visual communications."

This does not necessarily apply to all educational areas as much can be done through voice transmission alone (take, for example, the extensive telephone-based teaching system maintained by the University of Wisconsin-Extension). Nevertheless, much of the teaching that can

be carried out in such a system of educational communications would be enhanced by some form of graphical communications and there are many subjects, all of those in the pure and applied sciences, for example, in which graphical communications are a necessity.

A bewildering variety of terminal devices exist which may be used to provide graphic or visual communications, and each has its particular communications channel requirement. The Wisconsin system just mentioned provides graphical communications to some of its terminals with "scribble-phone" devices, and at the other end of the range of possibilities is Stanford University's Instructional Television Network which uses Instructional Television Fixed Service (ITFS) facilities to broadcast four instructional television channels in the San Francisco-Oakland Bay region of California. How to make a choice between the many alternatives which are available is a complex matter. Each case appears to be a matter for decision on the relevant particulars such as history, economics, availability of systems, geography, educational objectives, subject matters to be taught, and so on. No systematic methodology exists for the choice of the proper technologies and through the years there have been more failures than successes. But there have been successes, and notable successes. This is the context of the present work. The general problem is large and complex, and there is a growing, although unconsolidated, body of literature in the field. A single contract can provide but limited results and so it is necessary to identify a particular focus.

One important decision in the design of these educational communications systems is the selection of channel bandwidth. This is conventionally viewed as a binary decision, either a telephone channel (or two) or a television channel (or two), and the decision is usually a consequence of the practicalities of the situation. The work of this contract is specifically oriented towards showing that there are prospects for breaking away from this binary circumstance, that there is in fact a continuum of possibilities between voice and video.

A communications channel capable of supporting a single television channel can accommodate almost 1,000 telephone channels. This is a very wide range, and the present researches do not cover the full spectrum of possibilities which could be imagined, but rather concentrate mainly on the prospects for accommodating several video channels in a single conventional four megahertz television channel.

For the foreseeable future, there will still be a fundamental choice between narrow band (several telephone channels) or wide band (several video sources sharing a single television channel). But this work will establish, hopefully, much greater flexibility in choice and in approach than is currently available, although design decisions will continue to be difficult and governed by the circumstances of the application. Of these circumstances, the geometry of the situation is most important due to the balance of costs between terminals and transmission requirements. Television systems can utilize relatively inexpensive terminals but transmission cost is high. Telephone systems, on the other hand, have relatively inexpensive transmission costs but high visual terminal costs. Systems which allow the transmission of real time video can be quite readily used by teachers without a great deal of special training; telephone systems require the careful development of different teaching techniques. Even more intangible is the alleged advantage of video over audio in the basic human communication processes of teaching and learning.*

* Research in the Wired City Laboratory has demonstrated that video teleconferencing is not appreciably inferior to face to face conferencing, but is different. Weston and Kirsten¹(1973) have shown that audio teleconferencing is considerably inferior to other face to face or video teleconferencing, but Williams and Chapanis²(1976) argue that many results have been obtained to demonstrate little or no difference in critical elements of the teleconferencing process.

1 Weston and Kirsten (1973). Teleconferencing: A comparison of attitudes, uncertainty and interpersonal atmospheres in mediated and face to face group interaction.

2 Williams and Chapanis (1976). Paper presented at the Status of the Telephone in Education, May 26-28, 1976. A Review of Psychological Research Comparing Communications Media.

Effective and satisfying human communication requires interaction, and this implies the existence of some form of feedback channel allowing communication from the student to the teacher. The bandwidth of this feedback channel is generally expected to be less than that from teacher to student. Even in a classroom the students' time-shared a single channel from them to the lecturer while he monopolizes the channel from lecturer to students. In the Stanford television system, audio facilities are provided to allow remote students to speak with the teacher and in some instances even narrower band feedback channels in which the students press buttons to signal the teacher have been used.

In all, a large number of possible areas for detailed investigation were available. Not only is the mix of technologies important, but even more significant is the integration of those technologies into the overall educational process. Two decades of experience with educational technology in North America has surely demonstrated that if the technology is not acceptable to the teachers and students then failure is inevitable. It would seem that, to be viable, the technology must present some advantage to all participants.

Given such a broad and complex situation, it was necessary to select between the many particular directions which could be hypothesized. To effect rational choices, the various directions for work under this contract were evaluated under the following criteria:

- 1) Is the project consistent with the human and fiscal resources of the Laboratory?
- 2) Can the work be carried out primarily through simulation (which is the particular capability for which the Wired City Laboratory was created) or, if not, can the work be integrated into other ongoing projects or contract work?
- 3) Is it reasonable to expect results within the time span of the contract, and will these results have some lasting value?

With these criteria in mind, the particular research efforts of 1975-1976 will be discussed.

Broadband Communications

The contract noted that it was now possible to consider a frame-interleaving multiplex system as an effective solution to transmitting simultaneous images over the same television channel. The availability within the Laboratory of a specially designed single frame storage and processing unit, which will be described in greater detail later, made this work particularly appropriate. In suitable circumstances, the capability to share a single television channel between several video sources has prospect for providing very considerable economic advantages.

This apparatus allows the production of real time video images which are updated or refreshed only intermittently, so that two or more video signals may be interleaved into a single television channel. Normally, the image resulting from such a system would exhibit psychologically unacceptable flicker. It would, in effect, be so badly interfaced with the human user as to be unacceptable as a means of interpersonal communications. In our approach, the first image is repeated to the viewer during those times when the transmission system is being used for the other channels. The image appearing on the TV monitors is, as a result, conventional except that motion is not continuous but intermittent.

The resulting dynamic television images are quite different from those seen on the commercial television networks. They would almost certainly not be acceptable to the general television viewers in place of the present system. However, they might well be acceptable outside mass communications if the essential communications services which were being provided were sufficient for the purpose for which they were being provided. In teleconferencing or educational applications, if it can be demonstrated that adequate communication is being maintained, then the system would have practical potential.

To this end, a great deal of effort was expended to conceive of a series of tests of the communications effectiveness of these reduced

bandwidth video signals, to design and implement the tests, and to conduct experiments using these testing instruments.

It was also felt that these tests could have use in the evaluation of the digital processing system which was to be used in the Carleton-Stanford Curriculum Sharing Experiment which is being conducted as part of the Communications Technology Satellite Program. There were also possibilities for the combination of this rather simple but flexible form of bandwidth reduction with the much more complex but fixed methods being used in the curriculum sharing experiment.

Yet further opportunities existed in the future when it may be possible to combine the interleaving method with reduced horizontal and vertical resolution so as to produce yet further reduction in the bandwidth requirement. It is possible that there is an optimum combination of methods to give minimum bandwidth requirement for a given level of communications effectiveness.

In educational applications, much of the time is spent transmitting graphics and from an information theory point of view this is a most inefficient use of television bandwidth, although a TV set does have the great virtue of being an inexpensive graphics terminal. In the research into teleconferencing conducted in the Wired City Laboratory, one television channel is usually devoted to graphics while the other presents a view of the participant. In other systems, it is common to eliminate the view of the speaker when it was considered appropriate to concentrate on the transmission of graphics. The interleaving system has a very real potential for application here, and it was decided to develop the capability to interleave the graphic channel with the regular video channel so that, say, one in every 10 of the regular video frames is devoted to graphics. The video interpretation capabilities would then provide for the continuous display of the most recent graphic image and also mask the loss of one in ten of the regular images.

The resulting graphics channel would have its peculiarities and special techniques for its use would have to be developed. The develop-

ment of these techniques, the choice of the appropriate sampling interval, and the resulting interaction with the other video channel, is a matter of very great complexity in itself and so it was decided not to perform any detailed evaluation of such systems but rather to demonstrate only the feasibility of combining these two channels.

Narrowband Communications

While the orientation and direction of our work in the broadband area was dictated in large part by the particular facilities which we had available, the narrowband area was much more open. Fortunately, in the beginning part of the contract period, we were able to gain experience in a field trial in the use of narrowband communications in remote teaching through the "Tele-Prof Project" which was conducted for the Educational Technology Branch. The basic objective of that experiment was to investigate the possibilities for teaching in the French language at the Royal Military College in Kingston, Ontario by professors physically located at the College Militaire Royale in St. Jean, Quebec. This project highlighted the need for the carefully considered design of the technology to meet the particular requirements of the given educational situation.

At the same time, an engineering and economic view of available narrowband terminal devices illuminated the very rapid evolution of technology in this field, and the relatively high cost of many of the terminal devices. Electronic blackboards, to take but one example, were a reality insofar as a prototype system was then being tested for the Bell Telephone Laboratories by the extension services of the University of Illinois. New systems were perpetually "just around the corner" and it became clear that any work on the basic engineering design to permit the multiplexing of an arbitrary combination of these devices would be simply a waste of time in terms of its future applicability. For the foreseeable future, a more appropriate approach would be to multiplex those devices and systems which the application design process has determined was appropriate. In any event, the engineering required to multiplex these devices is relatively straightforward and

the real problem is the choice of the appropriate mix of systems and the development of methods for their utilization.

Communication requirements are particularly straightforward for fixed format graphics such as text. Hand drawn diagrams and script present more of a puzzle. To gain better understanding of this area, which is important in educational applications, a review of the literature pertaining to the transmission of free form graphic information was carried out. This literature is extensive but it was found that the process of coding of the information from its analogue form into appropriate communications signals and the inverse process of reconstructing the images, particularly in a television compatible format, had received relatively little attention. Yet this is of critical importance as is the usual analogue to digital conversion problem in one-dimensional signal processing. While the evaluative methods which had been developed within the Laboratory seemed appropriate for adaptation to these problems, it was decided not to proceed further with this avenue of investigation as the physical facilities required for the research were available only in a very limited sense.

In the end, it was decided to emphasize the simulation and evaluation of selected narrowband facilities as was noted and specified in the research contract. Not only were the essential physical facilities available but, as well, the results of the work would be relevant to the CTS experiment.

The role of feedback was also within the scope of the intended work and our efforts in this area emphasized the potential for feedback through touch-tone telephone pads. A feedback system was developed which can be used either in the classroom or with remote students who use standard telephone equipment. Two trials of this equipment were conducted during the contract period.

SYSTEMS FOR EDUCATIONAL COMMUNICATIONS AND DISPLAY

A vast variety of technologies for educational communications and display are available, ranging from television to the physical transportation of printed materials through the mail. During the term of this contract, three particular systems are studied:

- 1) a telephone line based system providing voice and remote graphics,
- 2) a television based display system for use in a lecture theatre or for communication with remote students, and
- 3) a very low bandwidth system allowing communications from student to lecturer by means of touch tone telephone pads.

These studies were not conducted in isolation of other Laboratory activities. The first item above included the field testing, and the associated evaluation of a prototype system operating between College Militaire Royale, St. Jean, Quebec and Royal Military College, Kingston, Ontario in May, 1975. This test was made possible financially through contract #02SU-36100-4-0873, and the lecture theatre system of item 2 was to find applications in the curriculum exchange program between Carleton and Stanford Universities. Preparations for that experiment were supported by DOC contracts OST5-0059 and 4130-05447-2807.

The RMC/CMR System

This is described in detail in "Tele-Prof Project: Assessment of a Remote Teaching Trial", September, 1975, submitted to the Educational Technology Program at DOC, and will only be reviewed here. The project centred around a week-long feasibility test of a possible remote teaching system between the military college in St. Jean and the one in Kingston. The communication link between the two locations consisted of the combination of a voice switching audio system, a slow-scan video unit, an alpha-numeric data storage/retrieval device and a facsimile unit. Three telephone lines were used for transmission. The system

was tested in two remote teaching conditions. Condition 1 was the combination of tele-teaching and face-to-face teaching where the lecturer addressed simultaneously a remote group and a present group; Condition 2 involved a remote group only. Evaluations were made both of technical feasibility and student behaviour and attitude.

Because of the limitations of the trial, extended conclusions cannot be drawn. However, the evaluators noted that Condition 1 remote students tended to demonstrate a lower level of participation in comparison with the other remote group. It was also observed that the teacher employed, alternatively, two teaching styles while lecturing in Condition 1: a traditional lecture delivery style and a mediated teaching style. The results of the attitude questionnaire administered to the students showed an overall slight trend toward increasing acceptance of the system after a week-long trial.

Considerable attention to our evaluations of the attitudes of teachers and students has been given previously in this paper, and so in this section we shall emphasize the communication facilities which were studied. A general overview of the trial is given in Table 1.

Three types of telephone interconnection were used with the equipment. This was to ascertain the need for private lines, a requirement which would determine the portability of the system. A conditioned line (Schedule 4, Type 4) was installed directly between the two classrooms to provide the necessary audio quality and service reliability felt to be necessary for remote teaching. The dial-up trunk, to which a Rapifax facsimile machine was connected, performed flawlessly for the data communications devices. However, variations in signal level and quality were often unacceptable for audio communications. On these occasions, the voice switching would not operate properly and the telephone had to be hung up and re-dialed until a satisfactory interconnection was obtained. A PBX tie-line between Kingston, Montreal and St. Jean was also used during the trial. The quality of this line was inferior to the private line (having considerable noise) and was subject to operator disconnection during the lecture.

TABLE 1

<u>DAY</u>	<u>EVENT</u>	<u>EQUIPMENT USED</u>	<u>LINE INTERCONNECTION</u>
Monday	Demonstration	Facsimile Unit Audio System Slow-Scan Video Alpha-Numeric Data Storage/Retrieval System	Dial-up Private (switched)
Tuesday	First Lecture	Facsimile Unit Audio System	Dial-up Private
Wednesday	Second Lecture	CVI and RCA Slow- Scan Video Audio System	Private Dial-up
Thursday	Third Lecture	Alpha-Numeric Data Storage/Retrieval System Audio System	Dial-up Private
Friday	Fourth Lecture	Facsimile Unit Audio System Slow-Scan Video Alpha-Numeric Data Storage/Retrieval System	Dial-up Dial-up Private PBX-EXT

Two audio conference systems were obtained for use in the trial: a Bell 50 A conference set, and an experimental BNR "Daisy" conference terminal. The 50 A set consists of a main unit with a built in microphone and speaker, and a provision for two remote microphones. There is a volume control for the speaker, and switching from transmit to receive is achieved by a voice-actuated switch. Only one of the three microphones is on at any time, and it is chosen by pressing the appropriate button on the unit. The BNR experimental conference terminal is a voice switched unit designed to pick up conversation anywhere in the room using a cluster of three dish microphones mounted on a pole about three feet above a base which houses four speakers.

In pre-trial testing, the quality and performance of the BNR unit was found to be far better for open group interaction than the 50 A set and thus the "Daisy" was used exclusively in the trial. Despite the fact that the "Daisy" appeared to be the best system for group interaction, it was still somewhat "unnatural". While the teacher was talking, he heard nothing from the remote end unless somebody spoke loudly enough to activate the voice switch. When he stopped talking, nothing was heard from the other end until someone there "captured" the audio system. If some level of audio output between the links of the system were maintained, it would help the instructor regulate the level of his voice, while reassuring him that the class is still there. On several awkward occasions during the trial, channels in both directions were "off" as both ends waited for a response from the other.

The results of the technical evaluation seem to indicate that both channels should be open or partially open at all times. Yet to have proper audio levels, too much acoustic feedback must be prevented either by wearing headphones or by costly acoustic treatment of the rooms involved. However, other results of the trial evaluation indicate that it may be preferable to isolate the teacher from any local class, in which case acoustic isolation would be easier and less costly.

The Rapifax facsimile machine operated without difficulty throughout the trial. When operating at high speed there was some distortion

of the characters of a "typed" page but the display remained readable. At low speed the transmission time was 50 seconds while at high speed it was 20 seconds. The facsimile unit is far from interactive since material received must be photocopied or placed under a camera to be seen by the entire group. This usually means that material must be sent by facsimile prior to the lecture, because of the distribution time involved.

The RCA and CVI slow-scan television system used in the trial demonstrated useful features, and both units performed as designed. The RCA system has a built in camera with a fixed lens, and is attractive as a video source because of the retention of the old image during the gradual unveiling of the new image maintained student interest. For the trial, the CVI transmitter was connected to an overhead camera pointing down at a desk top, and was equipped with a zoom lens, thus permitting greater format variation than the fixed system.

The alpha-numeric character generator, storage and retrieval system consisted of an Ann Arbor CRT computer terminal, with external sync option, and a Hecon data storage cassette unit. With this combination alpha-numeric characters were typed out in a page format and used in much the same manner as overhead transparencies. Each data cassette can hold the equivalent of over 100 full screens (16 x 32) of alpha-numeric characters. The terminal and cassette unit at the instructor's position and the terminal at the student end were connected, using acoustic couplers, at 300 baud. The output of the Ann Arbor character generator terminal is sync lockable to any standard television source and will superimpose the characters on the video signal.

A digital feedback system allowed students at the remote location to register any of the ten coded impressions (see Table 2) by pressing buttons on a touch-tone pad. Each button press generated a tone that was recorded on one audio channel of the video tape recording. These responses were decoded electronically to provide the trial evaluator with information about how the students experienced various aspects of the lecture.

TABLE 2

CODE D'IMPRESSIONS/CODED IMPRESSIONS

- 1) IMPOSSIBLE DE QUESTIONNER/IMPOSSIBLE TO ASK A QUESTION
- 2) TROP LENT/TOO SLOW
- 3) ENNUYEUX/BORING
- 4) TRES INTERESSANT/VERY INTERESTING
- 5) TROP VITE/TOO FAST
- 6) TROP COMPLIQUE/TOO COMPLICATED
- 7) JE N'ENTENDS PAS LE PROFESSEUR/I DID NOT HEAR THE PROFESSOR
- 8) JE N'ENTENDS PAS L'ETUDIANT/I DID NOT HEAR THE STUDENT
- 9) JE NE COMPREND PAS LE PROFESSEUR/I DID NOT UNDERSTAND THE PROFESSOR
- 10) JE NE COMPREND PAS L'ETUDIANT/I DID NOT UNDERSTAND THE STUDENT

Five categories were generated as relevant areas for comparison of this apparatus. The first is "Rigidity or inflexibility in use" which gives some indication of the extent to which the use of the various elements must be carefully planned ahead of time. A low rating implies a flexible adaptive system while a high rating implies that it is difficult to deviate from the scheduled operation. "Preparation time for effective use" represents the relative preparation or organization time that the various elements require if they are to be used to advantage in the remote teaching situation. A low rating suggests that little preparation is required in addition to typical lecture preparation, whereas a high rating implies considerable time is required to prepare or locate material especially for that mode of communication. "Delivery time between terminals" implies a comparison of the amount of time required to transmit information from the teacher end to the remote group of students. A low rating means relatively small transmission time (instantaneous or immediate) while a high rating implies a relatively long period of time (up to one minute) is required to transmit the information. The "Cost factor" is a relative dimension. A low rating is about \$1,000 to \$2,000; a medium rating about \$5,000; a high rating \$10,000 or more. Finally, "Operational complexity" implies the relative degree of complexity involved for the operation of the elements by the instructor while lecturing. A low rating means little effort required to operate the system but a high rating means some disruption to the flow of the lecture is likely in order to use the mode of communication.

Considering these five dimensions, an assessment of the technical elements is summarized in Table 3, and the recommendation which emerges from this assessment favours a good quality audio link, a combination of a writing tablet with video display and alpha-numeric data storage/retrieval, and the digital feedback system.

Of course, the use of the technical elements of the system is at least as important as those elements themselves, and was an important aspect of this study. Of the two conditions, student preference clearly favoured the circumstance when only the remote group was present over the situation when both a local and remote group were involved.

TABLE 3

ASSESSMENT OF TECHNICAL ELEMENTS

Technical Element	Rigidity or Inflexibility in Use	Preparation Time for Effective Use	Delivery Time Between Terminals	Cost Factor	Operational Complexity
Audio System	Low	Low	Low	Low	Low
Writing Tablet Plus Alpha-Numeric Data Storage/ Retrieval System	Low	Low	Low	High	Low
Writing Tablet with video display	Low	Low	Low	High	Low
Alpha-Numeric Data Storage/Retrieval System	Medium	Medium	Low	Medium	Medium
Facsimile Unit Plus Photocopying	High	Medium	High	High	High
Slow-Scan Video	High	Medium	High	High	High
Remote Control VTR	High	High	Low	Medium	Low
Digital Feedback System	Low	Low	Low	Low	Low

Yet a decision to reject the combination of tele-teaching and face-to-face lecture, in favour of a remote group only, cannot be taken, in spite of the negative results of the comparison. Further investigation should focus on the condition of having a local group artificially "remoted". It can be stated, however, that teaching has to be adapted to the communication link to ensure the acceptance of the system.

As with the selection of student users of remote teaching systems, instructors should be sought who, by their attitude, interest and motivation and ability, stand the best chance of conducting a successful course. Then with experience and practice, it is expected (as occurred with this trial) that a mediated teaching style will evolve. This is not to suggest that there is a single best method of mediated teaching, for there will be as many methods as there are teachers. It does suggest that some alteration of the traditional teaching styles will occur, emphasizing a deliberate effort to project through the communication system to remote participants.

The most unanimous reaction from the remote students to the various components of the link was with respect to the digital feedback system. Practically without exception, they recommended that this element be developed further so that students could register their reactions on a histogram display for the instructor to view. They saw that such a link would permit a type of communication that was more anonymous than raising a hand or speaking out loud but less ambiguous than smiles or frowns in the traditional classroom.

An Electronic Lecturer's Podium

Electronic display and communications apparatus has application for students present in the classroom and remote students. In both cases the role filled in the provision of a communications link between the students and a collection of educational support material or data. Either narrowband or broadband channels may be used, and most of the display material is sufficiently narrowband in nature that there is little difference apparent to the users. In some cases, the particular technology

used would reflect whether broadband or narrowband communications channels were being utilized. Delay is the most noticeable effect in an intrinsically narrowband system but even that cannot be taken to be the general rule.

In this particular situation display is provided through television monitors, and the system is sufficiently broadband that no problems are experienced with delay.

This teaching system has been evolved in the Wired City Laboratory and the Department of Systems Engineering and Computing Science over a number of years. During 1975-76 the major development of the system was the addition of a video disk system to its capabilities. That system too, had undergone a lengthy development. Developed by the Laboratory by the Ampex Corporation, it provides for virtually instantaneous access to up to 1,000 video frames for either retrieval or storage. A lecturer can access any frame by number, or in a pre-chosen sequence. Provision for computer control is also included. A better understanding of this video system may be obtained by reference to Appendix I.

Student reaction to this system (but without this video disk) has been discussed in previous reports (The Wired City Laboratory and Educational Communications Project: 1974-75, Carleton University, May, 1975), evaluation with questionnaires was continued throughout the 1975-1976 academic year. The primary purpose was to improve the previous data base, and to provide a baseline for a continuation of that study through the Carleton/Stanford Curriculum Sharing Experiment.

Reaction by the lecturers have continued to be favourable. The approach taken by the Laboratory has been one with a very "low profile" in that the equipment was available in the lecture theatre, the professor may use it if he wishes, but no effort was made to promote its use. A lecturer requiring assistance or wishing to expand his use of the system must approach the Laboratory. On the other hand, no formalities are involved; neither permission or budget is needed.

The continuing and growing interest by staff in the system is taken to be a significant and positive assessment of the potential for display and communications technology in education. Although no formal study has been made (that would be a major undertaking in its own right) at least one lecturer is firmly convinced that with this technological assistance he is able to cover twice the material and with increased comprehension by the students. That is not just because the apparatus is there; he makes good use of the system and that it turns demands better preparation of the course material than in usual circumstances.

Appendix II provides a description of this electronic teaching support system.

Touch-Tone Feedback

The literature, as well as previous work in the Wired City Laboratory* provides ample evidence of the importance of feedback from the students to the lecturer. Such systems are intrinsically narrow band and are generally provided by voice channels in distance teaching systems. Even in the classroom the capability to "talk back" to the lecturer finds limited use, and could well be supplemented by other means such as the touch-tone telephone pad feedback system. Whether used just in the classroom or also for remote students, such systems offer the advantages of essentially simultaneous feedback from the whole class, of anonymity, and of immediacy. The main price paid is that of a limited vocabulary.

A complete apparatus of this type would assemble the data from the students, record it, and display and analysis to the lecturer. Resources and time did not allow for this, so only a portion of the system was implemented. A selected group of students were given touch-tone telephone pads with each button suitably identified with a statement:

* see the "Wired City Laboratory and Educational Communications Project: 1974-1975".

- 1) good point
- 2) irrelevant point
- 3) statement is confusing
- 4) statement is clearly understood
- 5) I am enjoying the experiment
- 6) I am not enjoying the experiment
- 7) I feel priveleged
- 8) I feel disadvantaged
- 9) lecture delivery is too fast
- 10) lecture delivery is too slow
- 11) experiencing technical problems
- 12) unable to ask questions
- 13) interesting
- 14) boring
- 15) too complicated
- 16) too simplistic

Each time a student pushed a button the corresponding tone was recorded in the audio channel of a video tape recording of the lecture. It would then be possible to relate the statements made with the lecture content and style of the moment.

One section of an introductory psychology course was offered in an experimental mode in which the lecturer's podium just described, was made available to the lecturer. Most of the students were located in the lecture theatre, but a small class of about 20 was separated and viewed the proceedings on monitors in a small classroom. A few others were located in the teleconferencing nodes of the Wired City Laboratory. Some students in each location had touch-tone pads, and the objective was to gain experience with this feedback system and to determine whether the feedback would be dependent on the student's location.

No real time presentation to the lecturer could be provided and so he could obtain direct feedback only by watching the taped lecture later.

A number of difficulties became immediately apparent, and the worst of these related to the intrusion of the measurement process. With such a large section of statements, the students found difficulty in responding through the touch-tone system while maintaining concentration on the lecture. One or the other tended to be sacrificed.

As a result, a simpler 1 to 9 scale was set up on which the student could indicate his general degree of satisfaction with the process in which he was involved - with the lecturer, the course material, and the technology. This was an improvement, but serious difficulties still existed.

The foremost of these was the highly labour intensive nature of the data reduction and its interpretation in terms of the ongoing lecture process. As well, little use was made of the special electronic lecturing aids by the lecturer in presenting his material. Sometimes during the course, the students' attitudes were rather negative and this too compounded the situation.

Although it was found that a much more elaborate study would be needed to extract valid data on the relevant educational factors, the experience gained aided our intuitive understanding of the impacts of technology in education and of the experimental difficulties likely to be experienced.

This was furthered in early 1976 by an opportunity to conduct a similar demonstration with the general public. During the evenings of January 12-15, the Wired City Laboratory conducted demonstration of interactive television in conjunction with TV Ontario which was christened "televote". It was an experiment in audience participation in which television viewers were invited to telephone a vote on issues posed during the program. The experiment was unique in that the telephone calls were answered by a computer rather than by an operator.

The experiment was conducted in cooperation with the Ontario Educational Communications Authority (OECA) series entitled "Workers,

Bosses, Government". Hosted by Ms. Judy Lamarsh, the series consisted of a number of films on related labour problems followed by discussions by panels of representatives from labour, management and Government. A prime objective of the series was to invoke audience participation, so viewers were invited to phone in and contribute to the panel discussions. In addition, viewers could discuss the issues with off-air personnel by telephone and obtain additional information compiled by OECA on the topic. Remote discussion groups were also organized at Humber College in Toronto, Confederation College in Thunder Bay and Carleton University in Ottawa.

With short notice and no supplementary funding, a proper telephone voting experiment could not be set up. However, it was decided to go ahead with a very limited demonstration if for no other reason than to test the public reaction.

The experiment was organized with a telephone number in Ottawa and another in Toronto. Automatic answering devices were placed on these lines so that when a viewer called a number, and it was not busy, it would ring once and then be answered. The caller heard a tone and had ten seconds to enter his vote. If the caller did not hang up within the ten seconds he would hear a second tone and be disconnected. This feature was incorporated to prevent possible blocking of other callers.

The Toronto calls were coupled to the Wired City Laboratory system through a long distance telephone line which was kept open during the voting periods. The Laboratory had only "Touch-Tone" decoders available, so calls were restricted to those viewers who had Touch-Tone service. The digits were decoded and fed into a computer which tabulated the results of the vote.

In spite of the limitations, the results are quite interesting. The response indicated that viewers are interested in participating in interactive television programming services. Over a thousand votes were registered during the four evenings, in a total of about three hours of voting time, in spite of the fact that only a single call at a time could be handled in each city.

It is estimated that there were an additional 100 to 200 calls answered for which no vote was registered because either the caller did not have a Touch Tone telephone or did not know what to do. Unfortunately no record of those calls was made and they are not included in the total presented here, but they did block a considerable percentage of polling time.

It must be emphasized that the true public response to this service was not measured because of the technical limitations. The system was physically limited to a maximum of five or six calls per minute for each of the two telephone lines. It is suspected that the majority of callers tried to get through within the first ten minutes after each "televote" question was announced, and if they did not get through, they probably gave up. Certainly, the system worked to capacity in that the first ten minutes or so on both lines on all four days before calls tapered off. That problem can be eased, or solved, simply by employing more lines. One further suspected problem was ballot stuffing. There is no simple way to stop people from making multiple calls, but the effects could be minimized by limiting polling time. Thus a caller would be physically limited in number of calls in that time.

Probably this type of system should not be used for voting because of the constraints on the Bell Telephone System itself. If too many people were to call at one time, it would overload the system, blocking the regular telephone services for which it is statistically designed. Thus, the system as described here should be put to applications where the demand would be better distributed and peaks minimized. Such applications would be information retrieval or viewer programming preference polling.

It is hoped that this simple demonstration will lead the way to more sophisticated experiments in interactive television using the public telephone system as a narrowband feedback device. While there are many current limitations compared to the envisaged "wired city" of the future, the present system is certainly ready for more innovative uses. Also, development of services based on today's technology should provide meaningful insight into how future communications systems and home terminals should be developed and implemented.

All-in-all, the potential for narrowband communications in education is very considerable and perhaps even essential in order to overcome the passivity normally associated with TV. The conventional lack of opportunity for participation and interaction is held by many to be a most serious impediment to "teaching at a distance". Perhaps in the future this will no longer be true.

REDUCTION OF VIDEO BANDWIDTH

A major portion of the work conducted under this contract was devoted to the reduction of the bandwidth required for the transmission of television signals in teleconferencing and educational applications. There is a long history of attempts to transmit television pictures using less bandwidth than the standard 6 MHz television channel. In some cases a completely different system was designed, as was the case with Bell's Picturephone (R), in which the picture and resolution is reduced to a minimum. With this, and some additional "corner cutting", a bandwidth of 1 MHz was achieved. Thus it was possible to transmit a live video picture through a twisted pair telephone cable. In other cases, still television pictures have been transmitted over conventional telephone lines at a rate of one every 30 or 60 seconds according to the resolution desired.

However, none of the reduced bandwidth systems have found wide application due primarily to their high cost. In addition, they transmit television pictures of less resolution than full bandwidth television, which in itself has marginal resolution for many applications.

The approach taken in this study has been to assume that a full television channel is available and that a technically standard television signal is transmitted. This constraint was imposed because the number of installed television channels is growing rapidly and becoming increasingly available. Using a standard signal also ensures compatibility in terminal equipment and in transmission with resultant reduction in costs. The systems for the production, transmission, and viewing the signals are completely conventional. However, additional devices are introduced to make optimal use of existing channels by transmitting more than one TV signal through a single channel.

The standard television system was designed to reproduce motion without apparent unevenness and display resolution was set by technical and economic considerations. Since that time considerable technical advances have been made, but the need for compatibility with the existing system prevents major change. One of the drawbacks of standard television in an educational application is the limited resolution. With a good quality standard signal only half a page of typed information may

be readily read on a monitor. Thus, any attempt to transmit more than one signal in a channel should not reduce the effective resolution of textual information.

As was noted, many ideas have been put forward and attempted, in order to send more than one picture through a television channel. However, no matter what approach is taken, one must sacrifice either the image or motion resolution or both. The work of this study has been to determine what compromise of these parameters is most suitable for educational application.

Applications and Requirements

The major obstacle to remote television teaching systems is the cost of the video transmission channel for the reason that the required bandwidth is equivalent to about 1,000 telephone lines. To justify this expense, the television channel should ideally be used 24 hours per day and be constantly transmitting new information. In fact, however, the average television picture is highly redundant within a frame, and from frame to frame, so that the bandwidth is essentially wasted transmitting the same information over and over again, with usually only small changes from one frame to the next. In effect, the motion capability of the television signal remains idle most of the time. Broadcast television only fully employs the motion capability when a scene change occurs or when following rapid motion such as in sporting events. Instructional television, on the other hand, typically makes very little use of this capability. As television per se, it is comparatively boring with its lack of motion. The obvious solution would seem to be to sacrifice motion capability, and substitute more video information.

The typical content of an instructional television program may be divided into two parts: a view of the instructor talking and a view of what he is talking about. These two television images have very different motion requirements. In the case of the instructor, considerable motion capability would be required in order to read his lips. It may be argued, however, that the most significant information conveyed by this view is non-verbal. This presumes that his gestures convey in-

formation and attitudes that are significant beyond his verbal communications alone. In that case, motion capability may possibly be reduced to the point where the instructors movements are no longer smooth and continuous yet still convey the non-verbal messages. To determine how far this may be carried without seriously impeding communications is not at all obvious, and calls for quite an extensive experimental evaluation. This will be described later in the report.

The determination of the required motion capability for the perception of objects or texts is somewhat easier. In this case, perception tests could be used to determine the frame rate necessary. However this channel must be versatile in its motion capability. While the other channel views basically the same scene at all times, the channel could be used for anything from videotape to still pictures. Thus, the channel must be adaptive from 30 frames per second downward in order to be efficiently used. The motion rate for this channel could be preset (knowing in advance what video material will be transmitted) or it could possibly be made automatically adaptive by measuring frame difference signals.

Bandwidth Reduction Techniques

The above arguments for reduced frame repetition rates suggest improved efficiency in instructional television by the transmission of several video images simultaneously through the same channel. Several technical methods are available. One could multiplex two television signals each with half normal bandwidth in a standard channel. This would retain motion capability but it would halve the resolution for both channels (at best). Other techniques such as alternate line transmission from two sources, or dividing the screen into halves or quarters, each from different sources, achieve the same result. Again, these techniques have the advantage that they retain full motion capability, and they are relatively inexpensive because they do not require video storage. However, they must be ruled out in this application because they sacrifice resolution.

In order to obtain full resolution without psychologically disturbing "flicker" of the image one must use some form of memory refresh. There are many suitable devices available employing various technologies from

persistent phosphor and change storage cathode ray tubes (CRT's) to magnetic and solid state storage devices. The CRT devices are the least expensive, however they can only hold an image for a short time and the quality of the image degrades with time. Magnetic disc recording is currently the industry standard for still frame refresh systems and as such was chosen as the storage device for the prototype system which will be described. Solid state devices are currently the most costly but they continue to fall in cost and provide the flexibility for optimizing the system.

However, the particular technology to use is not the issue in this research which is concerned with the effectiveness of the technique. The experimental requirement was for a flexible system for the simulation of a variety of possible approaches to bandwidth reduction. This was provided by the special video storage and processing facilities of the Wired City Laboratory.

The Experimental System

The technology employed in this work uses a standard television channel as a means for sending still pictures (one frame) from one location to another at a rate of 30 frames per second. These frames are chosen from the signal sources as required, addressed and sent to the corresponding refresh memory at the other end as shown below.

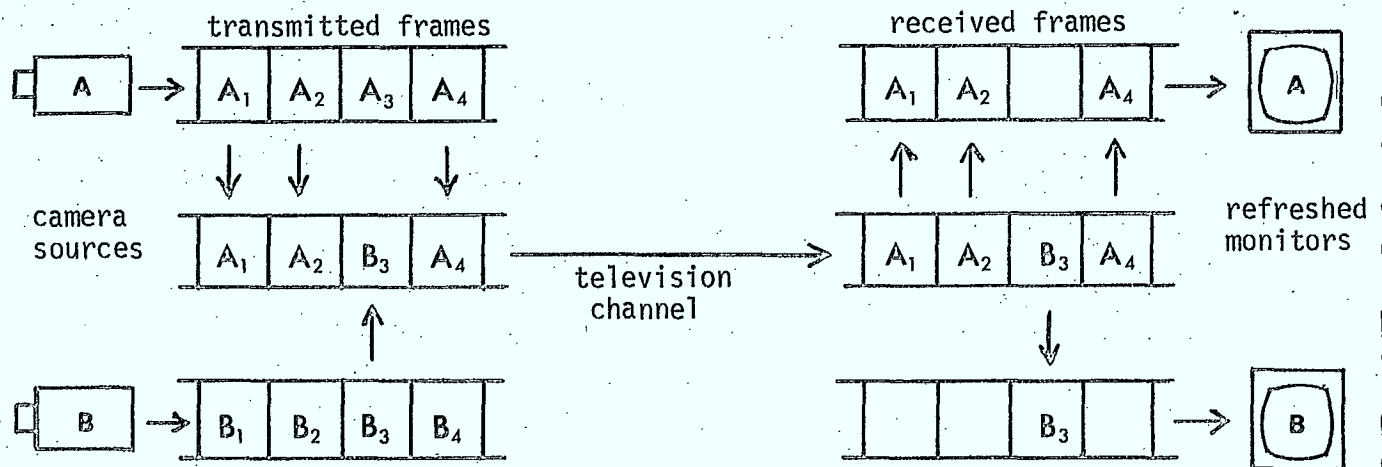


Figure 1: Frame Multiplexing on Standard TV Channel

Where blanks occur in each of the reconstructed display channels the previous frame is repeated. This provides a continuous picture without flicker. Each of the updated (or live) frames goes directly to the display monitor and is simultaneously recorded in the video disk. When a blank occurs, the first recorded picture is inserted repeatedly until a new one is available, as shown below.

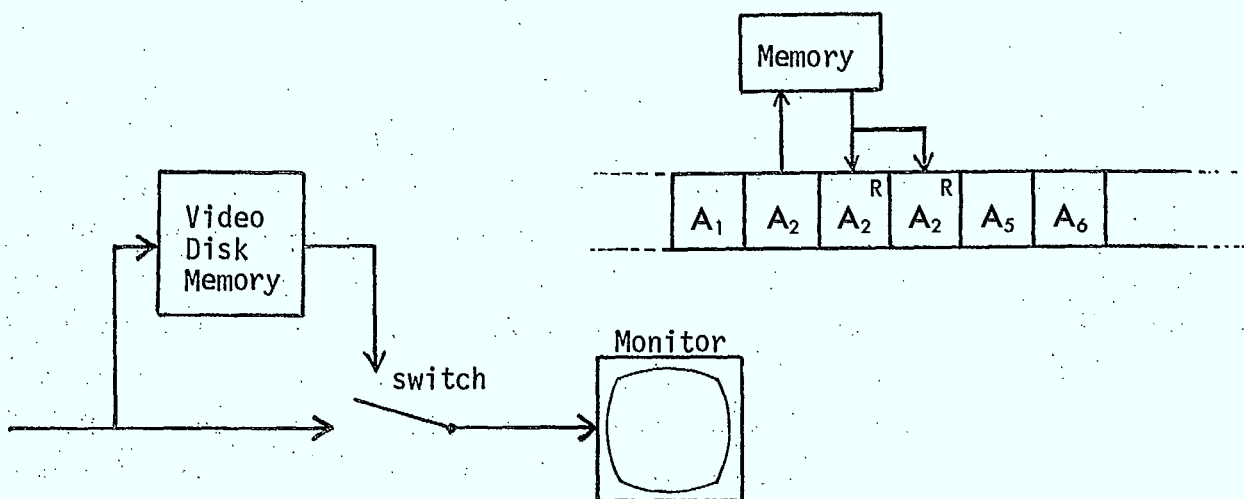


Figure 2: Frame Repeating to Refresh Monitor

All components of the system must be well synchronized in order to produce an undistorted picture. Most of the effort in the development of the prototype model was devoted to equalizing the recorded picture to make it indistinguishable from the live pictures. These technical problems have been solved so that even very slow frame rates give a flicker free signal which looks like any other television picture except that the motion within the picture is not continuous.

The system which has been constructed is designed basically to simulate a broad range of possible implementations. The frame rate can be varied from live video to one frame every four seconds. It can also be remotely controlled from a computer to allow more sophisticated update schemes to be employed. The following block diagram illustrates this arrangement.

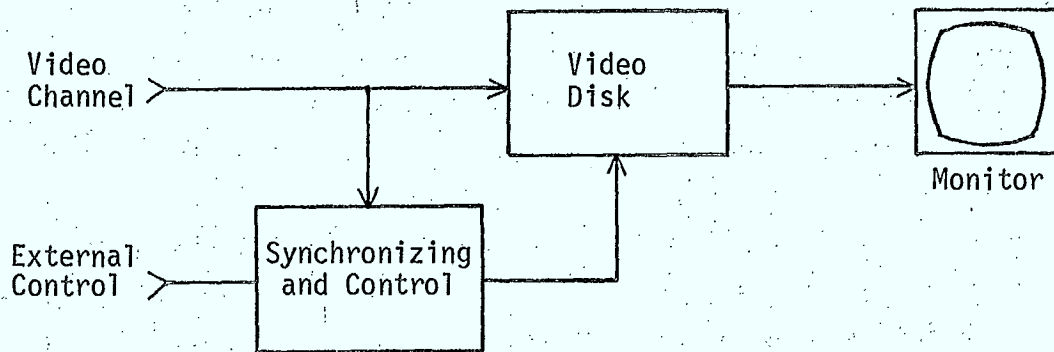


Figure 3: Remote Control of Refresh Rate

As the frame rate is reduced the display picture becomes more obviously a series of still pictures. In motion pictures or standard television each frame is displayed for only a fraction of a second and these pictures blend together to give apparent continuous motion. Any defect in a single frame is seen only fleetingly and is not objectionable. However, any defect in a reduced frame rate system is emphasized as the defect is repeated with each recycle. For this reason, the transmitted and received video signal must be of high quality since noise and distortion will often be more objectionable than with a standard television picture.

Similarly, a blurred frame due to high speed motion of the image becomes exaggerated. In conventional photography one uses a high shutter speed with short exposure time to freeze motion. Television and motion picture cameras use only sufficient shutter speed to reproduce motion slightly better than that which would normally be blurred to the eye. Thus moving objects will be frozen in a blurred position, with the amount of blurring depending on the speed of the object. Very fast moving objects will be invisible, but in an educational application this is not necessarily objectionable. For example, the motion of a pen writing on a piece of paper is not as important as the resolution of the words that have been written. In this case, considerable blurring of the moving object can be tolerated. On the other hand, if the motion of the object is important, then the frame rate should be increased proportionally to accommodate the motion. This need only be done for the period of the demonstration and then the frame rate can be returned to normal operating level.

In film motion pictures 24 frames per second are used to accomodate motion and each of these pictures is illuminated twice during projection. This produces the equivalent of 48 pictures per second (to eliminate visual flicker) with each picture repeated. A similar method is employed in television to eliminate flicker. Here the frame is divided into two interlaced field scans so that all the odd lines of the picture are traced out in the first sixtieth of a second, then all even lines are traced out in the second sixtieth of a second as shown below.

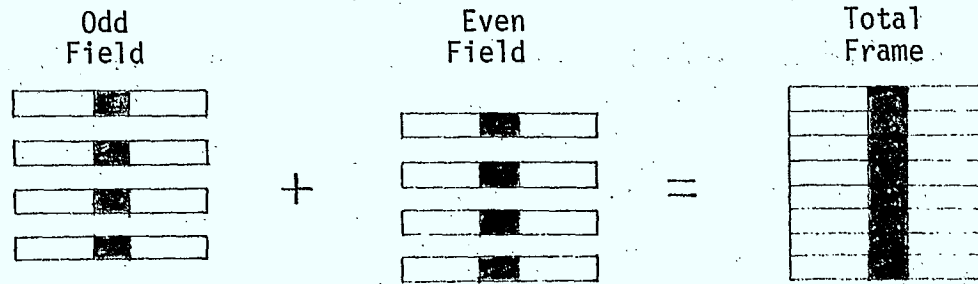
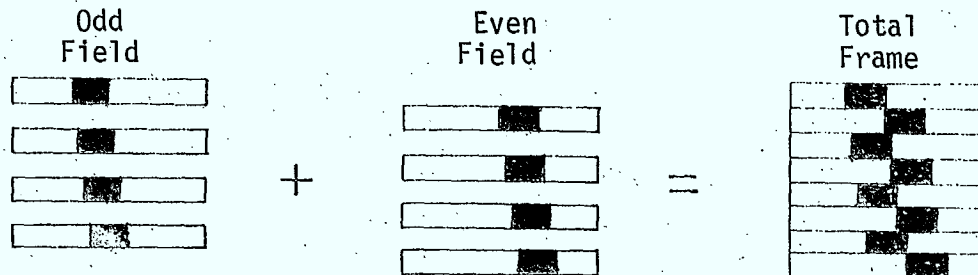


Figure 4: Field Interlacing to Overcome Visual Flicker

Each line still flickers at a rate of 30 per second, however this cannot normally be perceived.

The above example shows how the two fields combine to reproduce the total image of a black bar. If the bar had been moving from left to right at sufficient speed a different effect would occur as pictured below.



→ 1/60 second later

Figure 5: Effect of Motion Between Fields

Here we see that the odd field captured the bar in one position and the even field captured the bar in another position further to the right. Thus normal television is capable of following motion at an effective rate of 60 pictures per second each with half the normal vertical resolution. However, if these two fields are combined into a frozen frame as shown above, the bar will appear to switch back and forth between the two positions 30 times per second.

When Ampex developed the videodisk for slow motion and "instant" replay of sporting events, they knew of this problem and decided to refresh one field down one line and repeat it as shown below.

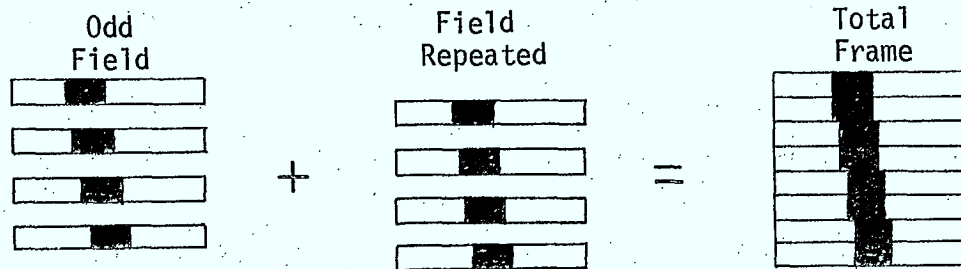


Figure 6: Field Repeat to Eliminate Double Exposure

Note that the bar is slightly displaced from top to bottom because the top lines are scanned first and the low lines occur later in time. At normal viewing distances this slant is not perceptible.

The Ampex videodisc system used in this experiment utilizes the same technology as the instant replay system. The magnetic disc is divided into a number of concentric tracks and one picture is recorded per track. A flying magnetic head floats just above the track to record and replay pictures as desired. In the instant replay system the disc turns at 60 revolutions per second so that each track records one field. In the Wired City Laboratory system the disc rotates at 30 revolutions per second so that each track records two fields, i.e., one complete frame. Thus this system cannot simulate field repetition systems but it can reproduce twice as many full resolution frames as in the alternative approach.

The above arguments suggest that when motion without related inter-field flicker is more important than resolution, a field repetition system should be used. However, the same system should be capable of full resolution when required. Therefore, a dual field refresh system, as shown below, is recommended.

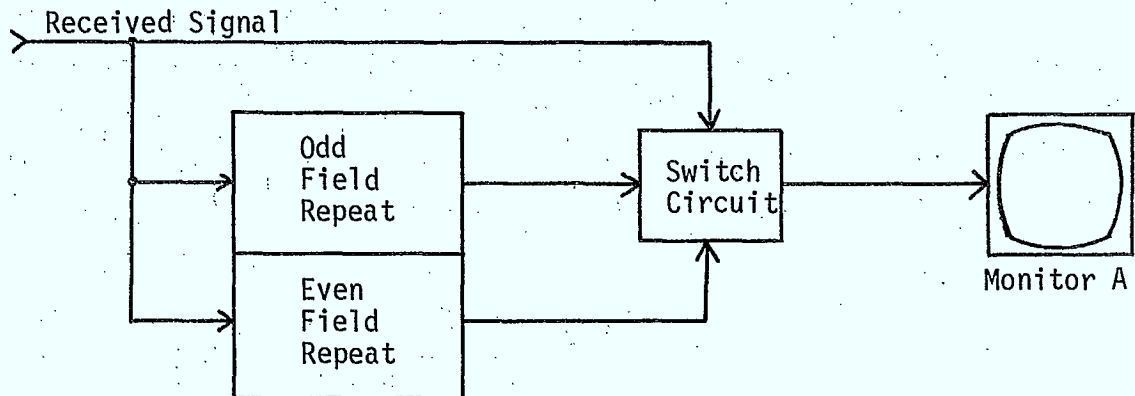


Figure 7: Dual Field Refresh System

When every other field of the received signal is for display on monitor A (the remains field are for display on the other monitor), that is the equivalent of 30 frames per second with full resolution, the switching circuitry will alternately select between the line received signal and the odd field repeat to produce the following depicted picture sequence.

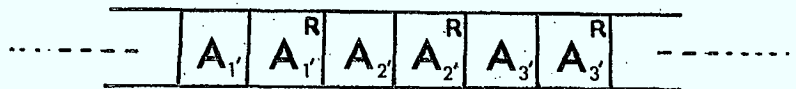


Figure 8: Odd Field Repeat *

* Note: 1 indicates the odd field
 11 indicates the even field
 R denotes a repeated film or frame

Subscripts denote frame number sequence

When every other pair of fields (one frame) is to be repeated (that is, 15 frames per second, each repeated) the switch will select the line signal for two sixtieths of a second, then the odd field repeat signal for a sixtieth of a second, and finally the even field repeat signal for the next sixtieth. This sequence, when repeated, reproduces the equivalent of 15 frames per second with full frame recording as shown below.

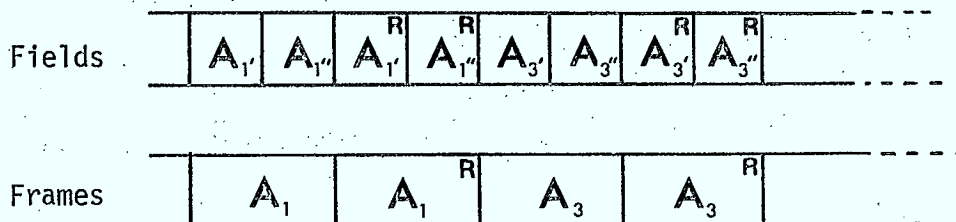


Figure 9: Paired Fields Give Frame Repeat Equivalence

The versatility of this arrangement is demonstrated by the following example where every fifth field is for monitor A and thus these three fields are alternately odd and uneven. This gives six full frames per second with a motion rate of 12 fields per second and leaves the transmission channel more open for the motion requirements of other signals.

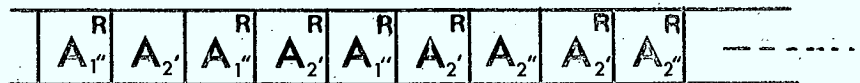


Figure 10: Example of 12 Field Per Second Updating

Modifying a standard television channel down to be a system for transmitting 60 frames per second obviously allows for considerable flexibility in assigning the number of sources and received frame rates per channel. In one extreme thirty people could receive a new frame of information every second, at another extreme one person could receive 29 frames per second (and that would be practically indistinguishable from standard television) while one other person still receives a new frame every second. In a practical application one needs only to know the required frame rate for each channel in order to design a transmission and control system with a minimum number of channels.

In order to demonstrate the application of the generalized results of this research, the following example is given.

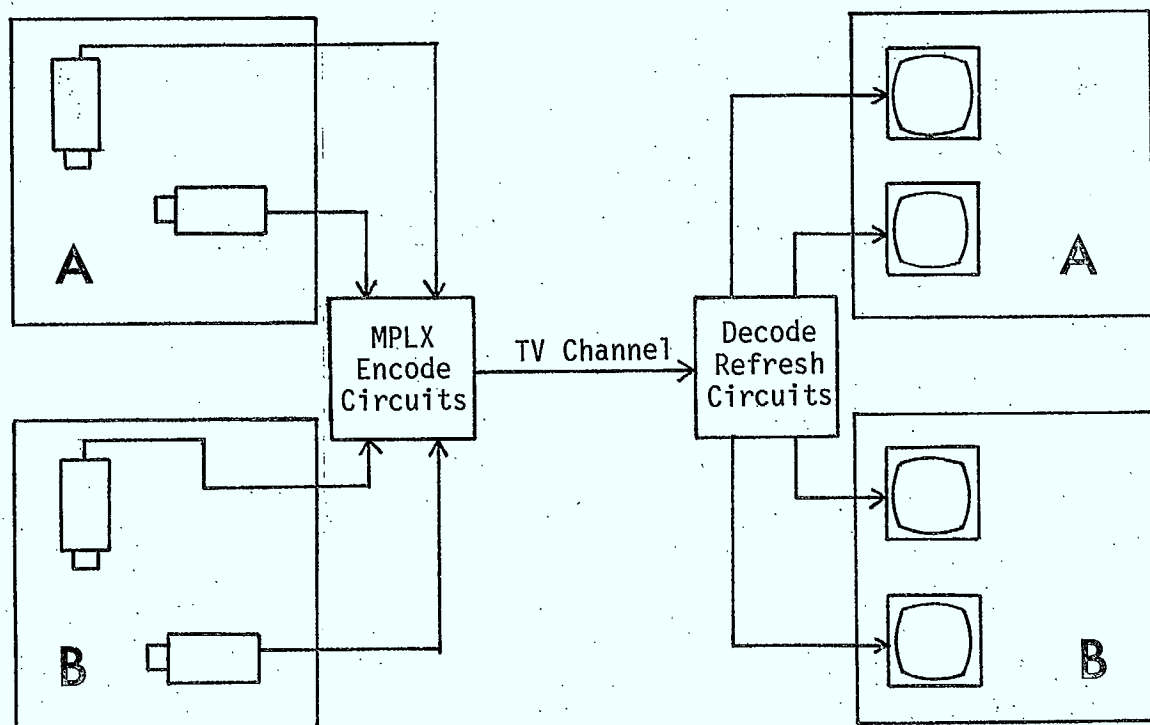


Figure 11: Example of Four Source Multiplexing

In this case we have two lectures to be transmitted simultaneously but to separate remote classrooms. At both ends, standard television equipment is used and a standard single television is used. That channel could be provided by broadcast, CATV, satellite, etc. The encoding/decoding equipment could be seen as part of the terminal apparatus or part of the transmission system, and could be a single unit as shown, or divided into two separate units if the remote classrooms are located at some distance from each other.

Each originating classroom has two cameras, one pointed at the teacher and the other in an overhead position for showing graphics and written material. Both cameras could be fixed in location so that camera operators were not required. The overhead camera has a zoom lens which the teacher can easily adjust to accomodate the size of the graphic material.

In the receiving classrooms there are two monitors (or more as required), one showing the teacher and the other the graphic material. Thus students are free to watch whatever they wish.

The multiplexing system is shown in more detail in the following diagram.

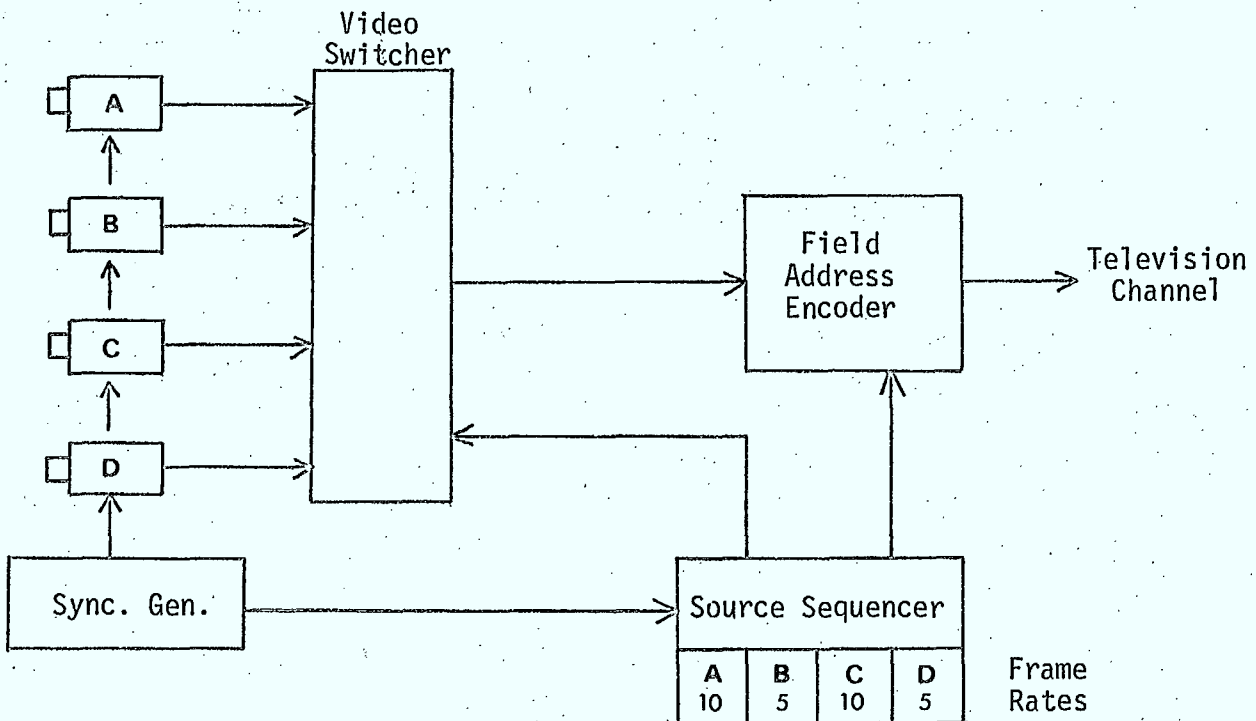


Figure 12: Field Multiplexer and Address Encoder

The source sequencer controls how many fields are transmitted at each time and how frequently. A sync generator locks the cameras and sequence together so that switching occurs in the vertical interval. The sequencer gives the source address encoder and at the beginning of the next frame it gives that address to the video switcher. The address must be sent in advance of the vertical sync pulse which is used to synchronize recording. Here the two "person viewing" cameras have been set for 10 frames per second each and the graphic camera for 5 frames per second. The sequencer then selects and addresses the frames as follows:

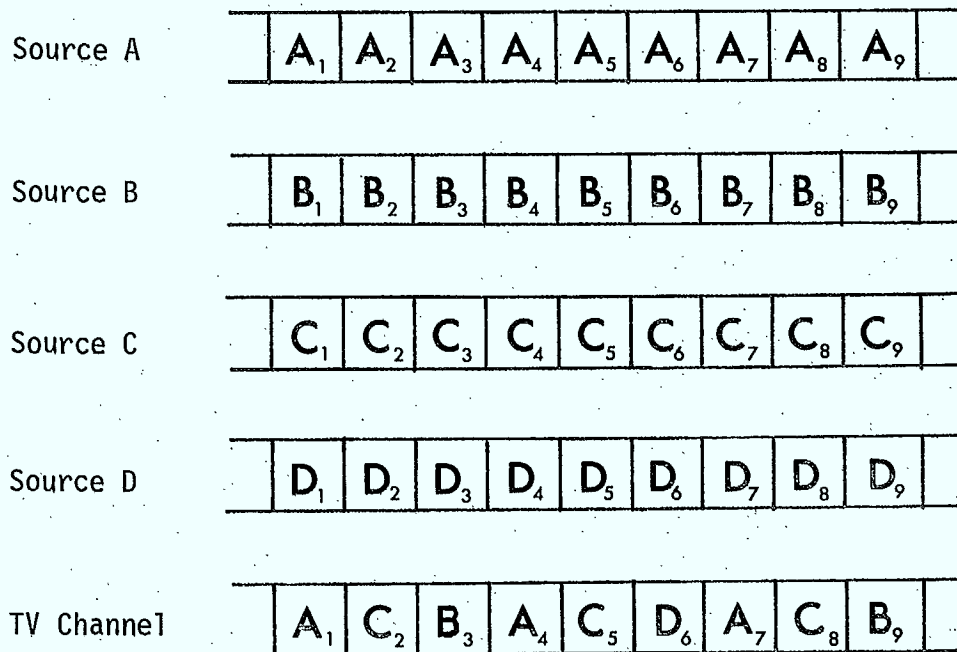


Figure 13: Construction of Transmitted Signal

The block diagram of the receive circuitry is:

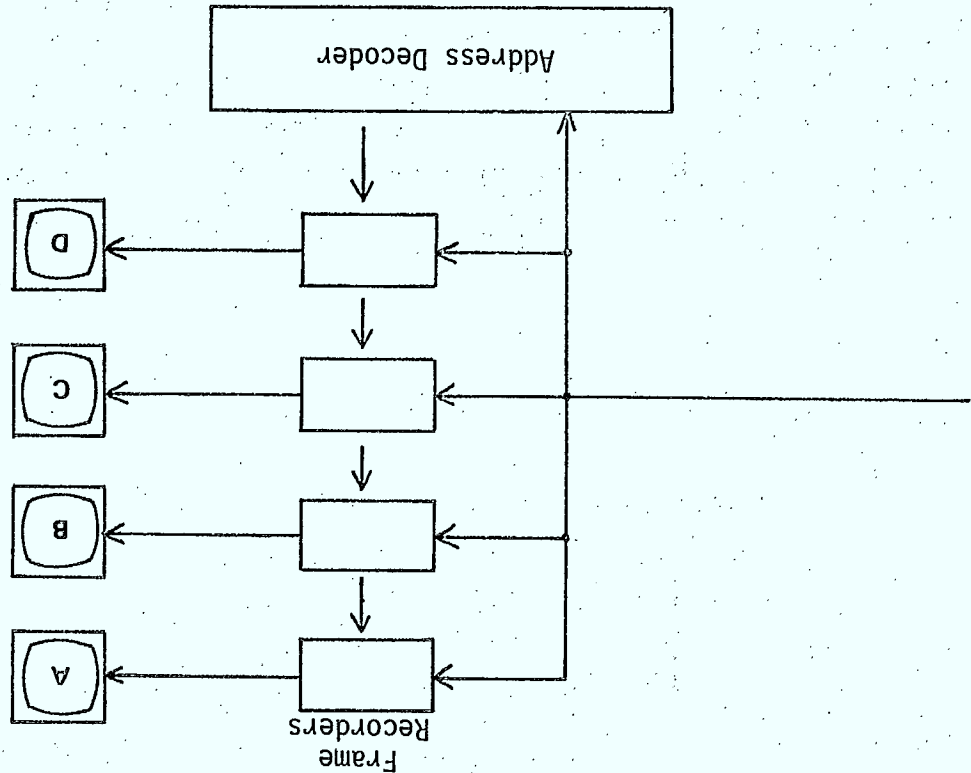


Figure 14: Frame Address Decoder and Refresh Control

Here the address decoder reads the sources address of each incoming video field and then instructs the corresponding frame recorder to record the next frame. When recording is taking place, the incoming frame goes effectively straight through to the display monitor. Unless otherwise instructed the frame memory will switch to playback and continue to refresh the last picture until a new frame arrives. Thus the channels are reconstructed as follows:

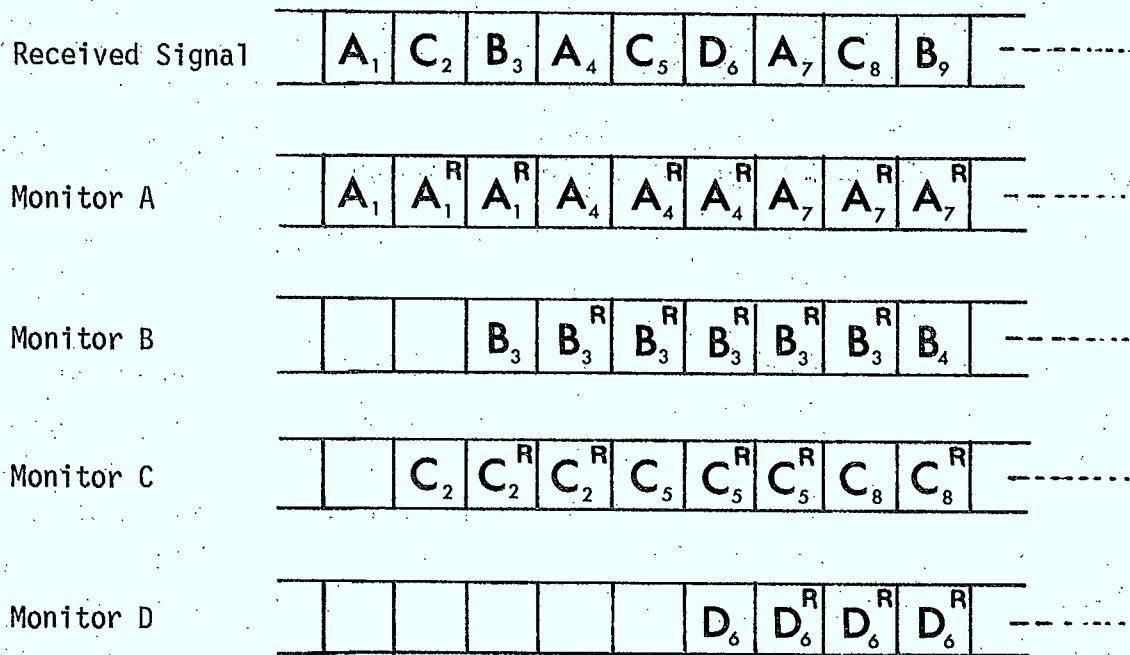


Figure 15: Reconstruction of the Four Video Signals

The frame rates used in the above example were chosen to simplify the explanation. In a practical application these frame rates should be chosen to meet the requirements of each channel. For example, it may be decided that the resolution of the view of the lecturer is of lesser importance, in which case only 10 fields per second need be transmitted. In that case, the A and C signals could be combined to consume 10 frames and the B and D signals could be increased to 10 frames per second each. However, the figure rates which should be used in various applications can only be known after experimentation and practical field trials. The next section of this report will describe a series of experiments designed to provide evidence of the appropriate frame rates.

DESIGN OF THE VIDEO COMPRESSION MEASUREMENT

Small reductions (by factors of 2 or 4) in the number of new frames of video displayed are not particularly obvious to the viewer as long as the "flicker" is eliminated by continuing the usual TV rate of 30 frames per second. As the rate is decreased further the effect becomes more noticable until at some point the process becomes quite clearly one of presenting a series of "still" pictures. Of course, our problem is the measurement of the effect of this on communications, not the determination of the detectability of the effect.

Such measurements are not easily made and involve both the selection and design of the appropriate experiments as well as a lengthy experimental process. Human subjects, of course, are needed and they are not always available in the numbers required. As was noted earlier in the report, it was not possible to conduct these measurements during the contract year and an annex to this report will be published to report on the results. In addition, the difficulties associated with testing a large number of conditions, with perhaps different experimental methods, make it necessary to conduct the experiments in stages with the details of each stage being adjusted in the light of previous results. Consequently the whole process will likely be spread over several years.

To evaluate the effects of various methods for the reduction of video bandwidths, a standard investigation technique has been devised. This has three components:

- 1) Person perception,
- 2) Simulated disarmament negotiation
- 3) Embedded word task

of which the first has the highest priority.

Person Perception

There are several reasons why a person perception task, based on viewing a specially designed videotape, has been employed for our compression studies. First, it provides a sensitive test of the utility

of video bandwidth because the information changes quite rapidly and there is little static redundancy in the communication of information. This would be in contrast to a graphics display with the information changing little from frame to frame. Another reason for the selection of this particular type of task is related to the fact that subjects viewing the film, and classifying the emotional reactions depicted in it, would themselves be situated in a teleconference or telelecture setting. It was, therefore, desirable to depict the emotional stimuli as originating through a teleconference system. This allowed a degree of experimental realism in that the subjects and the actors in the videotape were in a setting similar to each other. Another reason for the use of a person perception task in this study of bandwidth compression is that the classification of affect or emotion has been studied as a phenomena by social psychologists, and their work permits us to make certain theoretical predictions and to project the present studies from previous social psychological research.

The person perception task is completed by subjects under six conditions of video compression: 30 frames per second, 15 frames per second, 10 frames per second, 5 frames per second, 2 frames per second, and 1 frame per second. Any subject in the experiment views the entire standard person perception tape in one of these six compression level conditions. The tape itself is made up of 38 items, and each is a 9 second display of an emotional reaction. Half the displays are shown by an actor and half by an actress. Following each 9 second display there is a response time of 8 seconds during which time the subject is to classify the emotional reaction just displayed according to a binary choice offered in a questionnaire. These choices are not arbitrary but based on pilot studies which were used to determine the descriptions used in the questionnaire. In this way we have circumvented the issue of the validity of the person perception task in terms of actually producing accurate measurements of the perception of emotion. Instead it is a normative definition of the correct choice rather than a supposed absolute correct answer for each of the 38 item classification tasks.

Three versions of the questionnaire were created so that a number of parameters could be varied within the overall test. Usually one

of the two binary choices is the normatively correct answer for any given item in the 38 item test. At other times N/A (not applicable choice) is the correct choice. At yet other times it is expected that subjects will respond with the ? (question mark) response indicating that they are uncertain because of ambiguities within the questionnaire choices. Sometimes the apparent origin of the emotive stimuli, i.e., whether it appeared to be internal or external to the encoder, is altered and this is another parameter manipulation within the test. Also the relative strength of the emotive display is manipulated so that, at times, the emotion described is mild or strong, again affording a distinction of response to the subjects and, once again, one of the choices was the normatively most common choice selected by the pilot subjects.

All of these parameters were used to define easy versus difficult discrimination distinction within the questionnaire items. An a priori scoring schedule was devised for three versions of the test questionnaire. Thus, each item in each version had its own empirically generated normative answer. These were all determined by the standardizing procedure using pilot subjects.

For the purpose of this study we bypass the issue of the validity of the person perception standard film as it is not intended to be an instrument to measure the subjects' ability to accurately classify emotive stimuli. Rather, we are presently concerned only with changes in the usual classification that arise owing to the signal compression level. It is therefore a relative classification judgement, and changes in judgement, that are of interest.

In order to overcome the specificity of the various parameters under examination, and to increase the generality of our findings from these compression studies, a number of controls have been built in to the procedure. First of all, male and female subjects are in the conduct of this experiment. Both males and females perform the classification tasks on the person perception film at the various compression levels. Similarly, both a female and male encoder (actor) have been depicted in the stimuli within the standard film which has been used throughout these compression studies.

In the first experiments in our video compression studies, the higher levels of compression will be conducted in experimental procedures by using videotapes repeatedly for subjects within the same experimental group. This has the result that everyone within the same experimental group has seen exactly the same still frames for every given item of the 38 item test. A further study will investigate alterations in the performance of this task when different single frames are viewed by subjects within the same experimental condition. We expect a lower variance under the former condition of subject responses than in the latter.

Initial studies will also use a fixed interval sample from frame to frame within a given compression level, and in subsequent experimental sessions this will be changed to be a pseudo random interval with the same mean value but with a fluctuation in the actual inter-frame interval.

There is provision for treating the subject performance of a word perception task (an embedded word task to be described later) as a covariant for the person perception performance. This permits the partition of certain portions of extraneous variance in the subject scores to arrive at a cleaner prediction of subject performance at the various levels of video compression. Another provision which increases the generality of our findings is the use of three versions of the questionnaire instead of just one. This bypasses possible artifacts in sampling that could occur by the use of a single test instrument, i.e., a single questionnaire.

In all, a number of hypotheses will be under experimental investigation:

Hypotheses I: Based on overall test scores for the person perception standard film, it should be possible to identify a drop-off point in the usability of the video channel as defined by the various levels of signal compression.

Hypotheses II: The three versions of the questionnaire should yield compatible results. That is, they should represent replications of the findings throughout the compression studies.

Hypotheses III: Overall test scores should show an initial improvement under the lowest levels of compression compared to the performance at the full bandwidth of 30 frames per second.

Hypothesis IV: The so-called difficult items, when pooled into a single quotient per subject, should show greater compression effects than the so-called easy items within the test.

Hypotheses V: As compression levels increase, the number of responses of "uncertain" should increase, as will the number of responses of "not applicable".

Hypotheses VI: With increasing levels of compression there should be a greater degree of inter-subject variability demonstrating a lack of consensus in the judgement of specific stimulus items on any of the given test versions. This would be expected to be shown as an increased in variance.

Hypotheses VII: At a given compression level we would expect a greater consistency in classification when the frames sampled are much the same than when the frames are continually changing and different.

Hypotheses VIII: We expect a greater consistency when the frame rate is at a fixed interval than when at pseudo random interval.

Hypotheses IX: Use of the "word perception" covariant will make differences more salient in the person perception portion of the test. This will be due to a reduction in inner variance within that set of scores.

Hypotheses X: Any effect that is due to the regularity of sample rate (i.e., a fixed sample rate versus a pseudo random sample rate) should be discriminated.

In the analysis of the data, there will be one overall test score determined per subject, which is a summary of all 38 items of the test. There will also be a test score per subject which is the pooled effect of the difficult items on the test score, and another which is the pooled score for the easy items of the test. One performance score per subject on the embedded word portion of the experimental procedure will also be included. The experimental design represents a two by six completely randomized factorial, and the statistical test involved will be an analysis of variance on the overall test score, the difficult item test

score, and the easy item test score. As well, there will be an analysis of covariance on the embedded word test score and the overall performance test score.

Subjects for this experiment will be introductory psychology students at Carleton University, both male and female, who will receive experimental credit points for taking part in these experiments.

Appendix IV provides details of this experimental procedure.

Simulated Disarmament Negotiation

An alternate approach to the measurement of the effectiveness of a communications channel is to arrange for subjects to conduct a standardized task which necessitates extensive communication. Their relative success in performing that task is then a measure of communications effectiveness.

Previous work* in the Wired City Laboratory had shown the effectiveness of a simulated disarmament game in discriminating between communications modes, and so it was decided to modify that process for the present purposes. In the previous study, a two node configuration was established with a subject at each node. Between them three communication modes were possible:

- 1) face-to-face
- 2) audio plus video telecommunications
- 3) audio only

* The Wired City Laboratory: Studies in Interactive Broadband Communications, Carleton University, May, 1974, pp. 61-64.

and face-to-face proved the most potent mode with an average reduction of arms (ICBM's) of 42.4%. However video teleconferencing (i.e., mode 2) was almost as effective with 38.2%, while audio only achieved a reduction of 27.9%. It is hypothesized that if normal audio is retained, and the frame refresh rate varied from 30 per second to 15 per second to 7.5 per second, and so on, the arms reduction will decline gradually from the video teleconferencing figure to that for audio. The nature of that decline will infer the communications potential of the reduced bandwidth system.

The version of that process designed for the present purposes is described in detail in Appendix IV.

Due to the difficulties of conducting these experiments, and to the limited supply of subjects, we do not anticipate applying the measurement to the reduced refreshed rate video system described in this report. Rather, we shall take advantage of the Carleton-Stanford Curriculum Exchange* being conducted via the Communications Technology Satellite (Hermes) during 1976-77. A sophisticated Hadamard Transform based digital video compression system is incorporated in that experiment, and permits a unique opportunity for the measurement of a video compression system operating over a 2,500 mile distance. We expect to conduct the negotiated disarmament experiment over this facility.

Embedded Word Task

While current efforts are being devoted to a reduction of the information transfer associated with video communications by means of reducing the refresh rate, other simple methods are available. In particular, reducing the number of scan lines and reducing the video bandwidth have the effect of reducing the vertical and horizontal resolution, respectively, of each frame displayed. Although the previously described methods of measuring communications effectiveness may be used for these situations as well, they present particular problems in the display of graphical and textual information.

* see The Wired City Laboratory and Educational Communications Project: 1974-1975, Carleton University, May, 1975, pp. 146-156.

Since such information displays are common in the educational use of video systems, this aspect of the potential reduction of communications effectiveness cannot be neglected. For that reason a third measurement was devised in order to complete the "measurement package" even though this particular problem does not always arise. (In the method being emphasized at this time there is no reduction of the resolution properties of the individual frame, but an optimum system might well be comprised of a mix of compression techniques.)

In addition, the embedded word task has application in the person perception measurement, as was described.

The test chosen consists of a set of matrices of letters in the following format:

J	C	O	W	K	E
M	P	N	S	U	F
F	I	V	E	Z	K
L	H	B	U	V	C
G	S	L	Y	E	T

(but without special emphasis given to the embedded words as in this example). This is displayed for a few seconds to the subject who is then asked to write out the word in the position in which it is displayed, e.g.:

	C	O	W		
--	---	---	---	--	--

 an animal

As this example shows, a clue is given to aid the identification of the word.

This test is described in greater detail in Appendix IV.

SUMMARY

This report has presented the work conducted in 1975-76 in the Wired City Laboratory on contract #0505-0072 for research into more efficient use of standard television and telephone channels in educational communications systems.

Major emphasis was placed on an approach to multiplexing several television signals into a single conventional video channel. The resulting video images would also be conventional, at least in a technical sense, but would exhibit discontinuities of motion. Unlike the vast bulk of video compression research, the goal was not images approximating those of commercial television. Rather, we wished to determine the relationship between bandwidth and the effectiveness of communications. As conventional image resolution is marginal for textual and graphical communications in educational applications, our efforts were concentrated towards sacrificing the reproduction of motion rather than the resolution of the image itself.

A flexible experimental apparatus has been assembled for this work, as has a carefully designed experimental process for the determination of the communications effected. This measuring instrument, using the methods of social psychology, is based on the previous experience of the Laboratory in teleconferencing research and educational communications.

Measurement requires the processing of a large number of subjects and needs a lengthy period for its completion. This could not be completed during 1975-76 due to lack of both time and subjects, as almost all of the year was necessarily devoted to development of the physical system and the experimental methods and subjects can be obtained only during the regular academic session (lasting but 25 weeks per year). Necessarily deferred then until the 1976-77 academic year, this final element will be the subject of an annex to this report which is scheduled for publication on April 1st, 1977.

In addition to wideband communications, the application of narrowband communications channels in education, and in the Laboratory during and prior to 1975-76, shows that this is a complex matter in practice. Each case has its own set of factors, and engineering and economic circumstances vary considerably. No general methodology is currently feasible and each case must be taken individually. Two particular situations (one involving remote teaching and the other an enhancement of in-class capabilities) received attention. In addition, a beginning was made toward the use of the touch-tone telephone pad as a device for feedback and interaction.

EFFECTIVE USE OF COMMUNICATION

CHANNELS IN EDUCATION

APPENDIX I

AMPEX VIDEO DISC SYSTEM

USER'S MANUAL

S F V - 1 0 0 0 O P E R A T I O N : U S E R ' S M A N U A L

Name: _____

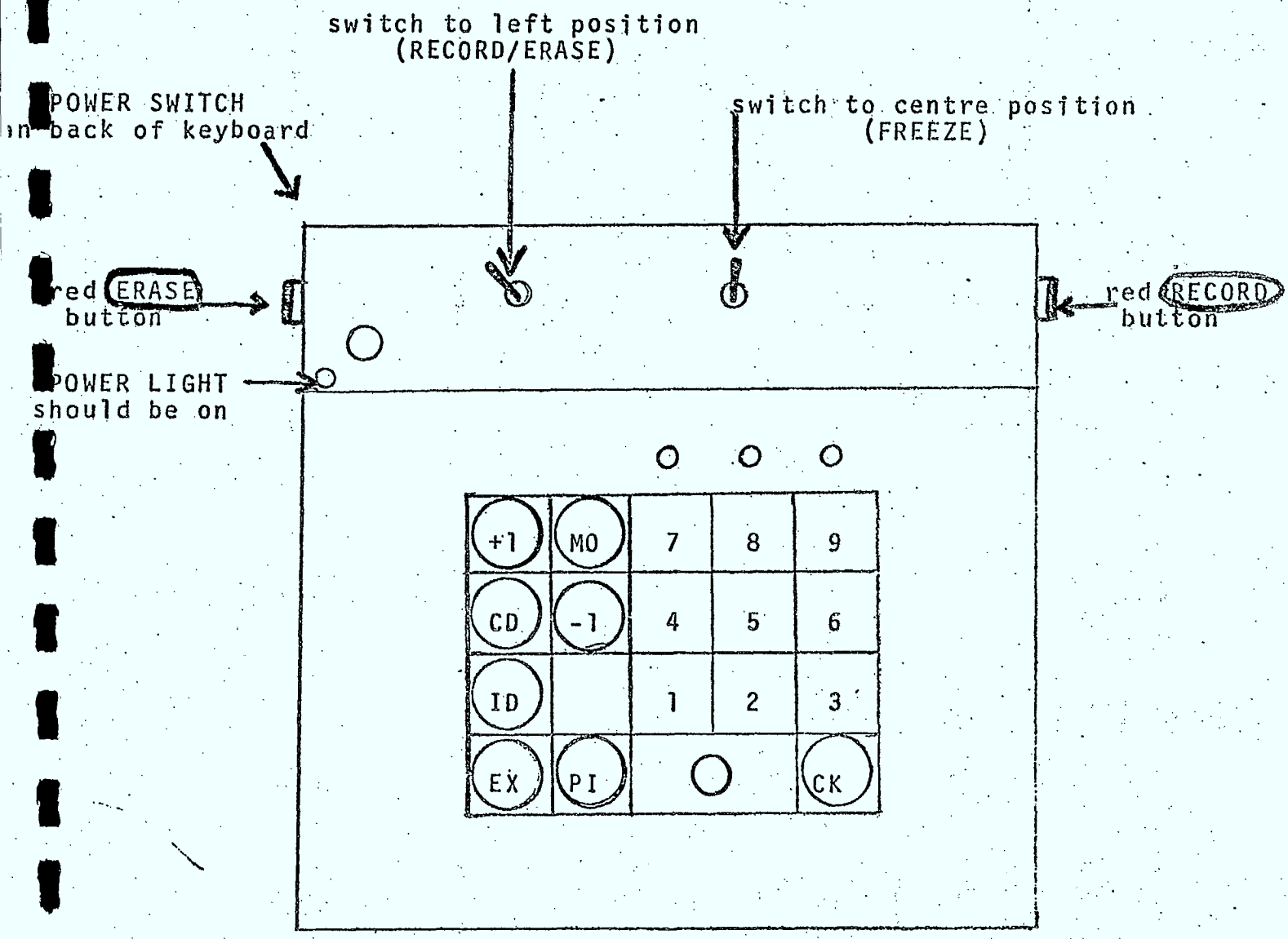
Your identification (ID) number is _____

You have been assigned _____ picture locations

Your picture locations are numbered 000 to _____ consecutively

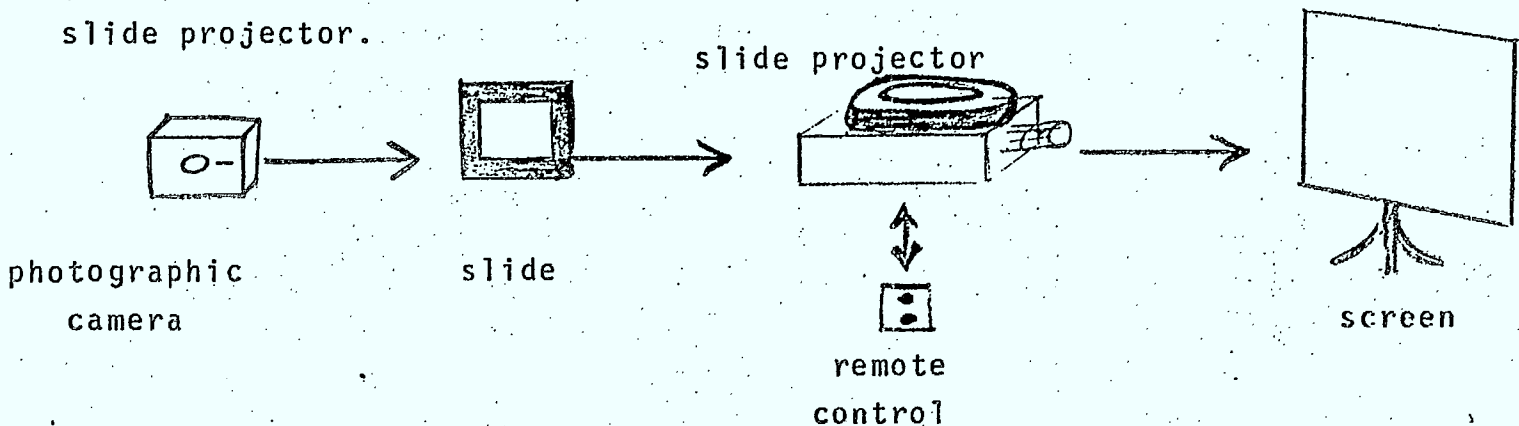
KEYBOARD:

The figure below indicates normal switch setting and the buttons are labelled with the nomenclature used in this description.

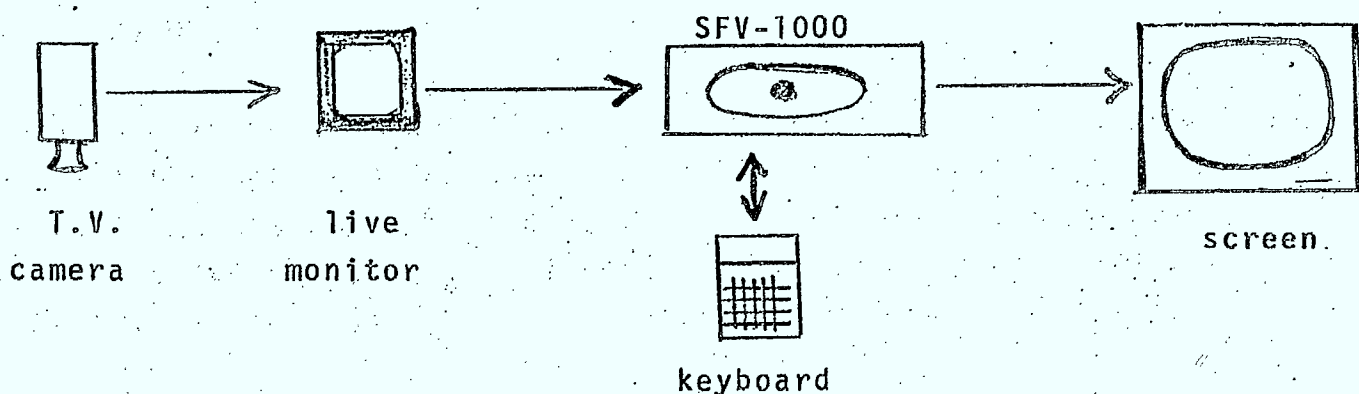


SYSTEM CONFIGURATION:

The figure shows the effective configuration of the SFV-1000 system. The system may be thought of as the electronic equivalent of a photographic camera with instant development on slides which are stored in a circular slide projector.



The T.V. CAMERA is used to "take" the picture
 The LIVE MONITOR is used to "frame" the picture
 The KEYBOARD is used to control all operations
 The PICTURE MONITOR is used to display the stored pictures



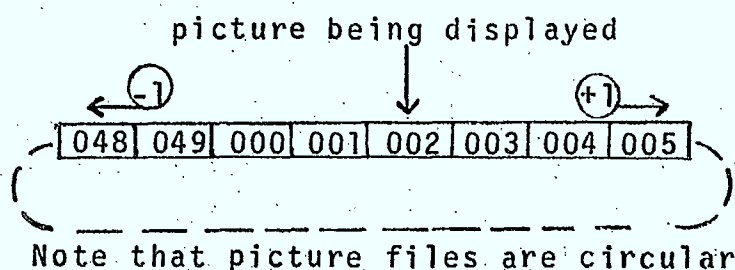
IDENTIFICATION:

The Single Frame Video system (SFV-1000) has storage locations for 1000 still pictures and you have been assigned a certain number of these. To protect against accidental erasure by other users, your pictures can only be accessed by using your identification number. Thus, each time you use the system you must first "LOGON" by entering your identification number.

OPERATION: GENERALSequential Retrieval:

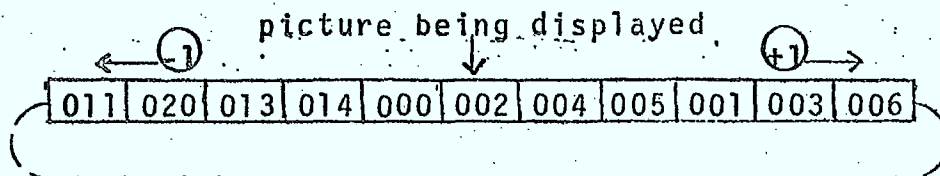
The SFV-1000 is designed to operate like a circular slide projector. With a series of pictures recorded in consecutive storage locations, the user can advance through them in increasing or decreasing numerical order by pressing the (+1) or (-1) buttons respectively. This ORDERED MODE is used to examine and record new pictures.

Example: sequential access in ORDERED MODE
(this user has 50 picture storage locations)



Unlike slides, the recorded pictures cannot be taken out of one storage location and moved to another. However, the SFV-1000 has an ARRANGED MODE which allows the user to rearrange the sequential playback order. Thus, the effect is the same as rearranging slides and is depicted in the following example.

Example: Sequential access in ARRANGED MODE
User has arranged slides to play in following order
0,2,4,5,1,3,6,11,20,13,14
(User has 50 picture storage locations as in previous example)



Note that a file has been formed which is a subset of the total file

Automatic Sequential Retrieval:

In either mode the pictures can be automatically sequentially retrieved by moving the SEQUENTIAL switch to the +1 (left) position for forward or -1 (right) position for backward. Automatic sequential retrieval does not start until a picture number has been entered or the (+1) or (-1) buttons has been pressed.

The picture DISPLAY TIME control is variable between a minimum of about half a second to a maximum of about 5 seconds.

Random Access:

In either ORDERED or ARRANGED MODE, pictures may be randomly accessed by entering a 3 digit picture number from 000 to nnn where nnn is one less than the number of picture storage locations assigned to the user.

ORDERED MODE:

Enter: (ID) iiii (PI) ppp

Notes: iiii is our 4 digit identification number

ppp is the 3 digit picture number (displayed on keyboard)

(ID) and (PI) buttons should light when pressed

(+1) adds 1 to ppp and retrieves picture

(-1) subtracts 1 from ppp and retrieves picture

(CK) erases entry

(EX) terminates user operation

(RECORD) erases picture being displayed and records

(ERASE) just erases the displayed picture

ARRANGED MODE:

1) Set-up Arranged Sequence:

(ID) iiii (MO) 1 (PI) ppp (PI) ---- (PI) qqq (PI)

Notes: ppp is first number of sequence

qqq is last number in desired sequence

entry not processed until (PI) or (EX) pressed

2) Playback Arranged Sequence:

(ID) iiii (MO) 2 (PI) ppp (+1) ---- (+1)

Notes: ppp is first picture number in sequence

3) Insert Picture in Sequence:

(ID) iiii (MO) 3 (PI) ppp qqq (PI) ---- (PI) ppp qqq (PI)

Notes: new picture number ppp to be inserted after existing picture number qqq in sequence

new pictures to go at beginning of sequence are inserted after last because sequences are circular

entries not processed until (PI) or (EX) pressed

to change the location of a picture in the sequence it must first be deleted (MODE 4) and then inserted (MODE 3)

4) Delete Picture from Sequence:

(ID) iiii (MO) 4 (PI) ppp (PI) ---- (PI) qqq (PI)

Note: ppp is first picture to be deleted

qqq is last picture to be deleted

entries not processed until PI or EX pressed

ENTER	PICTURE DISPLAYED	COMMENT
(ID)	---	(ID) button should light
iiii	---	enter your identification number, leading zeros assumed
(PI)	---	(PI) button should light
000	000	your first picture is retrieved
(+1)	001	adds one to picture No., retrieves picture
(-1)	000	subtracts one from picture No., and retrieves
(CK)	---	clears picture No. display
014	014	example of random access
(CK) 005	005	another example of random access
		Note: set up camera to take picture
RECORD	005	picture is recorded in picture No. location 005
(+1)	006	next picture retrieved
ERASE	006	old picture erased, "snow" recorded
(-1)	005	picture in location 005 retrieved
(CD)	---	picture display replaced by snow
(+1)	006	Note: picture No. 006 has been erased
(-1)	005	Note: picture No. 005 is still there
(EX)		EXIT must be pressed to terminate use of system

Example: User ID 4218 with 50 picture storage locations wants to set up arranged sequence.

22,24,26,28,30,23,27,25

User Enters	Picture Display	Comment
(ID) 4218 (MO) 1	—	(set up mode) (Use your ID in place of 4218)
(PI) 022	—	(enter picture numbers in sequence)
(PI) 024	—	
(PI) 028	—	(mistake: forgot 026)
(PI) 030	—	
(PI) 033	—	(mistake: should be 023)
(PI) 027	—	
(PI) 025	—	
(PI)	—	(processes last entry)
(CK)	—	(causes MO button to light)
2	—	(playback mode)
(PI) 022	022	(retrieve first picture)
(+1)	024	(check playback sequence)
(+1)	028	(note error: 026 missing)
(+1)	030	
(+1)	033	(note error: wrong number entered)
(+1)	027	
(+1)	025	
(+1)	022	(note: file is circular)
(CK) (CK)	—	(causes MO button to light)
3	—	(insert mode)
(PI) 026 024	—	(insert 026 after 024)
(PI) 023 030	—	(insert 023 after 030)
(PI)	—	(processes last entry)
(CK)	—	(causes MO button to light)
4	—	(delete mode)
(PI) 033	—	(delete picture number 033 from sequence)
(PI)	—	(processes entry)
(CK)	—	(return to MO)
2	—	(playback mode)
(PI) 022	022	(access first picture)
(+1)	024	(check playback sequence)

(+1)	026	
(+1)	028	
(+1)	030	
(+1)	023	
(+1)	027	
(+1)	025	
(+1)	022	(sequence is now corrected)
EX		(user finished)

EFFICIENT USE OF COMMUNICATION

CHANNELS IN EDUCATION

APPENDIX II

THE WIRED CITY LABORATORY

TEACHING SUPPORT SYSTEM

The Teaching Support System has been developed over a number of years by the Wired City Laboratory, and has seen a variety of uses. This description of the facilities has been taken from the Final Report DOC Research Contract No. O5T5-0059, "Carleton-Stanford Experiment: CTS-U-1, Progress Report on Pre-Experiment Activities", pp. 13 - 19.

Experimental System Configuration

The physical environment for this experiment consisted of a lecture theatre, small classroom and three small rooms for individual students. Coordination and control of the communication equipment available was provided by a control centre. In general, the electrical interconnections necessary for communication between rooms can be likened to the spokes of a wheel with rooms at the rim and the control centre at the hub. Figure 3 illustrates the experimental configuration and the routing of the major signals. There follows a description of the rooms as they were at the start of the school year.

Lecture Theatre

Providing a seating capacity of 120, the lecture theatre, (figure 4) was used as the live lecturing position for the major part of the school year. Four 23" television monitors were available and these were positioned for convenient student viewing. Two were situated at the front of the room at the sides and another two about half way back. A fifth monitor was mounted in the front of a teaching console. The teaching console will be described in more detail later, but essentially it contained some of the communication equipment utilized by the professor. Three touch-tone feedback pads were available to gauge student response.

Small Classroom

The small classroom seats 20 students (see Figure 5). For the experiment two 17" monitors were positioned at the front of the room to provide video contact and placed near the monitors, two speakers provided audio contact. Two microphones mounted on booms and suspended from the ceiling allowed access to the professor for questions and answers. Further feedback was provided in the form of three touch-tone pads.

Communication Nodes

Each of these three small rooms provided facilities for a single student (see Figure 6). He/she had the use of one 17" monitor, a microphone and a speaker. A touch-tone pad and telephone completed the set-up.

Equipment

Any basic communication over distance, be it one metre or one kilometre, requires sound and/or sight. The system utilized in this experiment consisted of an audio link from the professor to the students and television cameras to provide visual contact. The video link consisted of an overhead camera attached to the teacher's console (i.e., pictures, written information) and a frontal camera to provide a personal picture of the professor. Both pictures were not relayed to the students. Rather, the one most relevant to the situation was switched through by the operator in the control centre. This picture was displayed on all monitors in the classroom, and the communication nodes. This was the case in the lecture theatre as well, excepting only the unnecessary personal view of the professor. Later, in the first term, an audio link was established from remote students to the professor in the lecture theatre.

Several items of equipment at the disposal of the professor were expected to make more fluent the flow of ideas and information. There follows a brief description of each and their method of use.

Remote Control VTR

This is a reel to reel video tape recorder using a videotape on which there has been laid electronically, a series of addressed. Film clips or other information pertinent to a lecture are stored under different addresses and by means of a small touch-tone controller, can be called up and played to the class. This can be done either by the professor or an operator in the control centre by request.

Random Access VTR

This device, for all intents and purposes is the same as the Remote control VTR except that the videotape is a cassette format. The only other differences are in electronic circuitry. It, too, can be operated by the professor.

The advantages of both these devices are their relatively low cost, portability, ease in preparation of material and simplicity of operation. A disadvantage is that they do not stop exactly where requested but either a little before or after. With practice, this characteristic can be anticipated and is a minor vexation that does not disrupt the lecture.

Alpha-Numeric Device

Simply, this is an audio tape recorder that has been altered in such a way as to allow storage of printed information. This information is stored in addressed blocks on a small audio tape cassette and can be recalled for display on a television screen in a sequential or random manner. Preparation before the lecture entails only typing in the desired notes, graphs or tables. It can be operated directly or remotely via a touch-tone pad. It is a small and portable device.

Frame Storage Unit

A television picture is very similar to a motion picture in that it is a series of still pictures or "frames" played at a rapid rate to give the semblance of motion. The frame storage unit stores up to 1,000 of these frames of video information. Desired frames may be obtained from videotape, broadcast TV, or television camera. Several users can be storing or retrieving pictures at the same time. Each user is assigned a block of addressed locations which may be manipulated in several ways. Frames may be stored, deleted, or have their order switched around. A particular frame may be recalled by specifying its address or a series of frames may be stepped through by indicating a starting location. The internal processes of the unit are controlled by a microcomputer and the computer receives its orders from the user by way of simple push button console.

Touch-Tone Pad

This is a small (2" x 4" x 6") push button device which with attendant electronic hardware can act as a simple computer terminal or be used to control remote equipment (i.e. Alpha numeric device, random access VTR). Another application allows simultaneous manipulation of student responses. These responses can be taped for later study or through the intermediary of a computer, be evaluated, correlated

and displayed immediately on a TV monitor to the professor in the form of a histogram. When one of the highly pressure sensitive buttons on the pad is touched a tone is generated. One advantage of tone generation is that the tone may be transmitted over limited bandwidth channels such as the telephone system. As well, there is a very low degree of error possible and interfacing with peripheral devices is simple and inexpensive.

Teaching Console

The teaching console used in this experiment is located at the front of the lecture theatre (Figure 7). Its built-in equipment gives the lecturer complete control over the data stream. There is a video switcher on the console which allows the professor to select the TV picture that he wishes the students to see. One of the most useful video tool is the overhead graphics camera which is mounted vertically on a support over the console, lens down. Lecture notes, pictures, excerpts from texts and objects can be placed in the field of view with equal facility. A combined zoom lens and close-up lens allows the professor to choose a field of view between 3" x 4" to 12" x 15". Focus is preadjusted before the lecture and so there is no need to refocus during the lecture. The system operates satisfactorily under normal room lighting. Two ceiling cameras, front and side, provide views of the professor to the remote students.

Besides the 17" monitor built-in to the front of the console for the students, the professor has a 9" monitor mounted in the table top in front of him for keeping track of the picture that he has selected for the students.

The teaching console also has a built in computer terminal with an acoustic telephone coupler for accessing a computer via the telephone system. The output is a video signal which can be displayed on the classroom monitors.

Communication with the computer is accomplished by means of a keyboard. When not in contact with the computer, alpha-numeric information such as names or dates, can be typed in for display on the monitors. Using the video switcher two TV pictures can be superimposed. Thus, a professor can point out or "write" on top of the alpha, numeric printout.

Another source for alpha-numeric printout is the previously mentioned alpha-numeric tape deck. In the experiment it was situated in the control centre and accessed remotely with a touch-tone pad. Since the teaching console is connected to the Control centre, the professor can remotely access additional video information sources such as the frame storage unit and the two remote controllable video tape recorders.

There is a speaker mounted on both sides of the teaching console. Beside the video switcher on the console table top is an audio mixer. It allows the mixing and volume control of several audio sources. Some such sources would be the remote classroom and nodes, or the remote VTR's. A small neck microphone is worn by the professor and it provides the audio for the remote students. Two ceiling microphones allow the remote students to monitor questions and answers from the students in front of the professor. To summarize, the professor can retain complete control of his audio/visual aids if he so desires. Alternatively, switching and control functions can be provided by the control centre.

Control Centre

The control centre functions basically as a distribution centre. The cables which carry the communication and control signals throughout the facility all terminate or originate on two large patch panels; one for audio and one for video. Any combination of rooms is possible including connection with facilities outside the university. Combining signals from different sources for use on a single channel (special effects video mixing) and audio mixing are included in the system's capabilities. Facilities for recording; lectures and experiments are present in the form of reel to reel and cassette videotape recorders. Playback of tapes may be activated remotely or directly.

EFFECTIVE USE OF COMMUNICATION

CHANNELS IN EDUCATION

APPENDIX 111

INFORMATION SHEET ON PSYCHOLOGY

04.100, 1975-76

PSYCHOLOGY 04.100

Psychology 04.100 (Introductory) will have an innovative and experimental aspect this year. So we are looking for students who would like to try something different. Anyone interested in taking introductory psychology is eligible. The number to be enrolled will be limited. The introductory course, 49.100 is still offered this term.

The 04.100 course has been divided into twelve units. A self-administered study text provides core content. There will be lectures by the instructor and by guests. In addition, there will be some top quality and thought provocative films, a student hour with a teaching assistant, and quizzes. In the lectures we will experiment with various information delivery systems and will use a library of readily-accessible video-taped material, and an updated student-to-teacher feedback system. Student hours examine various materials, but what is studied depends partly on group consensus. Quizzes are quizzes in any system.

Students will be called upon from time to time to evaluate what we are doing. The dominant philosophy underlying the course is that education is an individual matter and responsibility. We provide, therefore, for the student to have a say in the process.

For participation in this research while learning, students can expect limited credit toward the final grade which nevertheless will be based primarily on a midterm and final exam.

Should you want more information, please call 231-2666.

EFFECTIVE USE OF COMMUNICATION

CHANNELS IN EDUCATION

APPENDIX IV

WORD PERCEPTION

and

PEOPLE PERCEPTION

PERCEPTION EXPERIMENT

This is the questionnaire material and preparation guide to be used with "Person Perception" and "Word Perception", the films for the video compression studies. There are three versions of the questionnaire, each one approaching the problem in a different way.

The experimental procedure should be adhered to closely. This material is supplemented by an audio tape.

EXPERIMENTER'S PREPARATION FOR THE STUDY

1. Subjects should be conscripted from the Psychology Department subject pool. Advertise the experiment as a study in interpersonal communication ~~and state that it pays \$1.00 for less than half an hour.~~ For each session, the design calls for 2 males and 2 females.
(Total N = 192)

2. Reproduce the six questionnaires (versions identified by roman numeral in the upper left corner of first page)

Copies required: I...50 IV...100
 II...100 V...100
 III...50 VI...200

Every subject gets a copy of VI and one of either IV or V (randomly assigned). In addition, each subject gets one of I, II or III according to the schedule described as point 4. Thus, each subject gets three questionnaires that are collated and stapled in this order:

- a) one of I, II or III
- b) one of IV or V (randomized)
- c) VI.

3. Reserve the W.C.L. facility according to availability and subject bookings. Stu Paterson and/or Fred Barrett should be available for consultation when the facility is in use.

4. Use four W.C.L. nodes, rotating ^{assignment of} the experimental conditions manipulated by the variation of questionnaires I, II and III. This is to remove any systematic effect that may be introduced due to the node differences.

	node 1	node 2	node 3	node 4
t1	I	II M	III	II F
t2	III	I	II F	II M
t3	II M	III	I	II F
etc.				

5. At the W.C.L. nodes where the subjects would view the videotape only the large size Sony monitor (19" ?) should be operating. It may be necessary to maintain an audio link with each node from the master control room but no audio or video link between the nodes. This is so that when subjects see the videotape during the experiment they will not be able to influence each other's reactions by talking or laughing.
6. Become familiar with the experimental task; run yourself as a subject.
7. Obtain the subject payment money.
8. Discuss the experimental procedure and, especially, the question of the number of signal compression levels to be tested in the study with D.A. George and S.A. Paterson. If you find it necessary to deviate from the proposed experimental design (including the proposal in point 9) please check with P.D. Guild before making change.
9. The other main independent variable (in addition to the I.V. manipulated via the questionnaires described as point 4) is the various levels of video compression that the filmed material ("Person Perception" and "Word Perception") is given. Although not yet finalized, this experimental procedure proposes that there be eight conditions defined by the number of frames per second seen by the subjects.

	<u>frames</u>	<u>time(sec)</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>n</u>
1.	30	1	3/3	6/6	3/3	24
2.	16	1				
3.	8	1				
4.	4	1				
5.	2	1				
6.	1	1				
7.	1	2				
8.	1	4				

independent variable "H" independent variable "B" Σ = 192

(3/3) means 3 nodes and 3 frames in that condition

A videotape of each of the above compression levels should be produced ahead of time to ensure that the same material is seen by every subject in a given condition. (It is best if the compression is given to only the actual acting scenes and not the inter-scene intervals or the scene

numbers. Make certain that the scenes are displayed to the subject for the same amount of time regardless of the compression level. This is most critical is the 6 to 8 conditions where a single frame is held for a long time.)

10. Randomize the order of condition 1 to 8 (I.V. "A") when actually conducting the experiment. (I.V. "B" is also randomized in running order.)
11. Be certain that the conditions in which the subjects see the videotape is, as much as possible, the same at all four nodes. Special attention to levels of light and noise, size of monitors, distance from monitors (about 6 feet if 19" monitors are used), etc.

1. Check that the video system is operating in the appropriate way, delivering the video signal to the 19" Sony monitors. Place the videotape cassette into the VTR.
2. Distribute the appropriate questionnaires and pencil to each of the seating positions for the subjects.
3. Keep careful records of the conditions that have been run; identify each questionnaire after the experimental session according to the condition run.

EXPERIMENTAL PROCEDURE

1. As the subjects arrive, introduce yourself as the experimenter and assign them to experimental conditions.
2. Describe the study as concerned with interpersonal communication. Give subjects the questionnaires and say that the written instructions on the response booklet should explain the experimental task. Give subjects a few minutes to read the first page of the questionnaire and ask if there are any questions about what is expected of them during the experiment.
3. Start the videotape containing the "Person Perception" task and allow it to run until "The End" after scene 38. Pause for 5 to 10 minutes while subjects complete questionnaire IV or V.
4. Restart the tape at the start of the "Word Perception" task and stop it again 10 seconds after the 10th letter array has been given.
5. After the experiment, debrief the subjects, ask them not to discuss the experiment outside of the laboratory; pay subjects.
6. Identify the questionnaires according to the experimental conditions and transcribe responses to the data sheets.

Data Sheets for Video Compression Studies

Follow the same type of procedure used for the "negociation study". This was described on page 5 of the "Experimenter's Preparation forthe Study" that was included in that package.

It will be necessary to code:

Column

1	subject number
3	sex of subject male=1; female=2.
5	I.V. compression level 1 to 8.
7	I.V. questionnaire version I=1;II=2;III=3.
9	I.V. " " IV=4;V=5.

1. making a point in an argument ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

2. greeting a long lost friend ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

3. talking to a cheerful person ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

4. concerned about an ill friend ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

5. being introduced to someone ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

6. pleasantly surprised with a gift ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

7. waiting in a dentist's office ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

8. about to try an exam ??__
very appropriate ____:____:____:____:____:____:____:____ very inappropriate

9. happily thinking about the future ??
 very appropriate : : : : : very inappropriate

10. having difficulty communicating ??
very very
appropriate _____:_____:_____:_____:_____:_____ inappropriate

11. seeing someone assaulted ??
very
appropriate : : : : : very inappropriate

12. trying to understand something ??
very
appropriate : : : : : very inappropriate

13. showing great relief ?? _____

very very
appropriate : : : : : : : inappropriate

[illegible]

15. wishing to express an opinion ??

very very
appropriate : : : : : : inappropriate

16. receiving criticism ??
very
appropriate : : : : : very inappropriate

17. told something unbelievable ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

18. trying to start a conversation ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

19. feeling physically exhausted ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

20. bored by dull conversation ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

21. expressing affection for close friend ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

22. feeling pity for another person ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

23. unwilling to cooperate ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

24. expressing jealousy ??
very appropriate ____:____:____:____:____:____:____ very inappropriate

25. contemplating a philosophical question ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

26. being interviewed for a job ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

27. feeling lonely ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

28. relieved at having passed an exam ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

29. mistaking someone's identity ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

30. bored by conversation ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

31. patiently explaining a point ??
very appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

32. feeling very unlucky ??
appropriate _____:_____:_____:_____:_____:_____:_____ very inappropriate

34. insulted by a question ??
very very
appropriate : : : : : : inappropriate

35. threatened with a gun ??
very
appropriate : : : : : : very inappropriate

36. introduced to an exciting person ??
very
appropriate : : : : : very inappropriate

37. showing kindness towards an old person ??
very
appropriate : : : : : : very inappropriate

38. listening to bad news ?? ____

very very
appropriate : : : : : : inappropriate

PERSON PERCEPTION

In a moment you will view a videotape that contains brief displays of feelings, reactions or emotions demonstrated by two people. Your task will be to judge what feeling, reaction or emotion has been demonstrated in each of 38 scenes. On the pages which follow there are classification choices offered to you. Here is an example:

40.	<div style="border: 1px solid black; width: 40px; height: 40px; display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; width: 30px; height: 30px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 30px; height: 30px;"></div> </div>	annoyed surprised	<div style="border: 1px solid black; width: 40px; height: 40px; display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; width: 30px; height: 30px; margin-bottom: 2px;"></div> <div style="border: 1px solid black; width: 30px; height: 30px;"></div> </div>	n/a ???
-----	--	----------------------	--	------------

The number to the left corresponds to the scene. Please make certain that your responses in the questionnaire are in step with the numbers of the scenes.

A scene may be classified one of four ways. Two descriptors are offered for each scene. In the example above, the two descriptors were "annoyed" and "surprised". If you felt that scene 40 could be classified one of these ways, you would place an **X** in the box which corresponds to your judgment of the best descriptor. It is possible that neither of those descriptors would be appropriate for that scene. If that were the case, then you might wish to indicate "neither appropriate" by placing an **X** in the box marked "n/a". The remaining classification choice is the "???" which indicates that you are not certain of what was demonstrated in the scene.

Throughout this Person Perception task, your aim should be to achieve the highest possible overall score. For every correct choice, you gain two points, for every incorrect choice, you lose one point. Usually, one of the two descriptors is the correct choice, however, the "n/a" classification may also be the correct choice. If you select the "???" classification, you do not gain or lose points. Please turn the page and wait for the videotape to begin.

Name _____

correct = 2 points incorrect = -1 point ??? = 0 points

- | | | | | |
|----|-----------------------------------|-----------------------------|-----------------------------------|------------|
| 1. | <div><div></div><div></div></div> | irate
displeased | <div><div></div><div></div></div> | n/a
??? |
| 2. | <div><div></div><div></div></div> | elated
hospitable | <div><div></div><div></div></div> | n/a
??? |
| 3. | <div><div></div><div></div></div> | indignant
distrustful | <div><div></div><div></div></div> | n/a
??? |
| 4. | <div><div></div><div></div></div> | pensive
grievous | <div><div></div><div></div></div> | n/a
??? |
| 5. | <div><div></div><div></div></div> | intimidated
contemptuous | <div><div></div><div></div></div> | n/a
??? |
| 6. | <div><div></div><div></div></div> | attentive
thoughtful | <div><div></div><div></div></div> | n/a
??? |
| 7. | <div><div></div><div></div></div> | apprehensive
indignant | <div><div></div><div></div></div> | n/a
??? |
| 8. | <div><div></div><div></div></div> | shy
patient | <div><div></div><div></div></div> | n/a
??? |
| 9. | <div><div></div><div></div></div> | resentful
jealous | <div><div></div><div></div></div> | n/a
??? |

correct = 2 points incorrect = -1 point ??? = 0 points

- | | | | | |
|-----|-----------------------------------|-------------------------|-----------------------------------|------------|
| 10. | <div><div></div><div></div></div> | indignant
angry | <div><div></div><div></div></div> | n/a
??? |
| 11. | <div><div></div><div></div></div> | dejected
astounded | <div><div></div><div></div></div> | n/a
??? |
| 12. | <div><div></div><div></div></div> | pensive
disgusted | <div><div></div><div></div></div> | n/a
??? |
| 13. | <div><div></div><div></div></div> | repulsed
discouraged | <div><div></div><div></div></div> | n/a
??? |
| 14. | <div><div></div><div></div></div> | hopeful
delighted | <div><div></div><div></div></div> | n/a
??? |
| 15. | <div><div></div><div></div></div> | outraged
terrorized | <div><div></div><div></div></div> | n/a
??? |
| 16. | <div><div></div><div></div></div> | frightened
loathing | <div><div></div><div></div></div> | n/a
??? |
| 17. | <div><div></div><div></div></div> | agitated
menacing | <div><div></div><div></div></div> | n/a
??? |
| 18. | <div><div></div><div></div></div> | coy
happy | <div><div></div><div></div></div> | n/a
??? |

correct = 2 points incorrect = -1 point ??? = 0 points

19.

☐
☐

worried
alarmed

☐
☐

n/a
???

20.

☐
☐

bored
contemptuous

☐
☐

n/a
???

21.

☐
☐

affectionate
nervous

☐
☐

n/a
???

22.

☐
☐

annoyed
sympathetic

☐
☐

n/a
???

23.

☐
☐

uncooperative
sullen

☐
☐

n/a
???

24.

☐
☐

astonished
startled

☐
☐

n/a
???

25.

☐
☐

worried
bewildered

☐
☐

n/a
???

26.

☐
☐

coy
shy

☐
☐

n/a
???

27.

☐
☐

horrified
uneasy

☐
☐

n/a
???

correct = 2 points incorrect = -1 point ??? = 0 points

28.

 relieved

 n/a

 ashamed

 ???

29.

 amused

 n/a

 embarrassed

 ???

30.

 bored

 n/a

 brokenhearted

 ???

31.

 angry

 n/a

 impatient

 ???

32.

 happy

 n/a

 astonished

 ???

33.

 perplexed

 n/a

 sober

 ???

34.

 resentment

 n/a

 anxiety

 ???

35.

 threatened

 n/a

 worried

 ???

36.

 affectionate

 n/a

 agitated

 ???

correct = 2 points incorrect = -1 point ??? = 0 points

37.

seductive

apprehensive

n/a

???

38.

bewildered

offended

n/a

???

PERSON PERCEPTION

In a moment you will view a videotape that contains brief displays of feelings, reactions or emotions demonstrated by two people. Your task will be to judge what feeling, reaction or emotion has been demonstrated in each of 38 scenes. On the pages which follow there are classification choices offered to you. Here is an example:

40.

annoyed
surprised

n/a
???

The number to the left corresponds to the scene. Please make certain that your responses in the questionnaire are in step with the numbers of the scenes.

A scene may be classified one of four ways. Two descriptors are offered for each scene. In the example above, the two descriptors were "annoyed" and "surprised". If you felt that scene 40 could be classified one of these ways, you would place an **X** in the box which corresponds to your judgment of the best descriptor. It is possible that neither of those descriptors would be appropriate for that scene. If that were the case, then you might wish to indicate "neither appropriate" by placing an **X** in the box marked "n/a". The remaining classification choice is the "???" which indicates that you are not certain of what was demonstrated in the scene.

Throughout this Person Perception task, your aim should be to achieve the highest possible overall score. For every correct choice, you gain two points, for every incorrect choice, you lose one point. Usually, one of the two descriptors is the correct choice, however, the "n/a" classification may also be the correct choice. If you select the "???" classification, you do not gain or lose points. Please turn the page and wait for the videotape to begin.

correct = 2 points incorrect = -1 point ??? = 0 points

1.

☐
☐

irate
excited

☐
☐

n/a
???

2.

☐
☐

panic
hospitality

☐
☐

n/a
???

3.

☐
☐

distrustful
indignant

☐
☐

n/a
???

4.

☐
☐

brokenhearted
sad

☐
☐

n/a
???

5.

☐
☐

cheerful
unnerved

☐
☐

n/a
???

6.

☐
☐

envious
afraid

☐
☐

n/a
???

7.

☐
☐

indignant
apprehensive

☐
☐

n/a
???

8.

☐
☐

nervous
shy

☐
☐

n/a
???

9.

☐
☐

resentful
ashamed

☐
☐

n/a
???

correct = 2 points incorrect = -1 point ??? = 0 points

- | | | | | |
|-----|-----------------------------------|--------------------------|-----------------------------------|------------|
| 10. | <div><div></div><div></div></div> | angry
indignant | <div><div></div><div></div></div> | n/a
??? |
| 11. | <div><div></div><div></div></div> | excited
astounded | <div><div></div><div></div></div> | n/a
??? |
| 12. | <div><div></div><div></div></div> | repulsed
joyless | <div><div></div><div></div></div> | n/a
??? |
| 13. | <div><div></div><div></div></div> | disgusted
discouraged | <div><div></div><div></div></div> | n/a
??? |
| 14. | <div><div></div><div></div></div> | outraged
delighted | <div><div></div><div></div></div> | n/a
??? |
| 15. | <div><div></div><div></div></div> | angry
excited | <div><div></div><div></div></div> | n/a
??? |
| 16. | <div><div></div><div></div></div> | frightened
ashamed | <div><div></div><div></div></div> | n/a
??? |
| 17. | <div><div></div><div></div></div> | threatening
agitated | <div><div></div><div></div></div> | n/a
??? |
| 18. | <div><div></div><div></div></div> | happy
coy | <div><div></div><div></div></div> | n/a
??? |

correct = 2 points incorrect = -1 point ??? = 0 points

- | | | | | |
|-----|--------------------------|---------------|--------------------------|-----|
| 19. | <input type="checkbox"/> | shy | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | gloomy | <input type="checkbox"/> | ??? |
| 20. | <input type="checkbox"/> | depressed | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | contemptuous | <input type="checkbox"/> | ??? |
| 21. | <input type="checkbox"/> | affectionate | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | proud | <input type="checkbox"/> | ??? |
| 22. | <input type="checkbox"/> | satisfied | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | sympathetic | <input type="checkbox"/> | ??? |
| 23. | <input type="checkbox"/> | content | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | uncooperative | <input type="checkbox"/> | ??? |
| 24. | <input type="checkbox"/> | astonished | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | jolted | <input type="checkbox"/> | ??? |
| 25. | <input type="checkbox"/> | worried | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | bewildered | <input type="checkbox"/> | ??? |
| 26. | <input type="checkbox"/> | confident | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | shy | <input type="checkbox"/> | ??? |
| 27. | <input type="checkbox"/> | overjoyed | <input type="checkbox"/> | n/a |
| | <input type="checkbox"/> | surprised | <input type="checkbox"/> | ??? |

correct = 2 points incorrect = -1 point ??? = 0 points

28.	<input type="checkbox"/>	scornful	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	mournful	<input type="checkbox"/>	???

29.	<input type="checkbox"/>	startled	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	tormented	<input type="checkbox"/>	???

30.	<input type="checkbox"/>	bored	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	repulsed	<input type="checkbox"/>	???

31.	<input type="checkbox"/>	outraged	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	impatient	<input type="checkbox"/>	???

32.	<input type="checkbox"/>	amused	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	astonished	<input type="checkbox"/>	???

33.	<input type="checkbox"/>	perplexed	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	displeased	<input type="checkbox"/>	???

34.	<input type="checkbox"/>	relief	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	anxiety	<input type="checkbox"/>	???

35.	<input type="checkbox"/>	threatened	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	worried	<input type="checkbox"/>	???

36.	<input type="checkbox"/>	affectionate	<input type="checkbox"/>	n/a
	<input type="checkbox"/>	annoyed	<input type="checkbox"/>	???

correct = 2 points incorrect = -1 point ??? = 0 points

37.

nervous
disbelieving

n/a
???

38.

fearful
discouraged

n/a
???

We are interested in the overall impressions that you have formed of the two persons who were shown in the videotape. Please place an **X** on the scale point which corresponds to your impression of the personality of the male in the tape.

relaxed	___:___:___:___:___:___:___	uneasy
unfriendly	___:___:___:___:___:___:___	friendly
intimate	___:___:___:___:___:___:___	distant
untrustworthy	___:___:___:___:___:___:___	trustworthy
agreeable	___:___:___:___:___:___:___	disagreeable
comfortable	___:___:___:___:___:___:___	uncomfortable
informal	___:___:___:___:___:___:___	formal
insensitive	___:___:___:___:___:___:___	sensitive
good	___:___:___:___:___:___:___	bad
personal	___:___:___:___:___:___:___	impersonal
cold	___:___:___:___:___:___:___	warm
emotional	___:___:___:___:___:___:___	unemotional
artificial	___:___:___:___:___:___:___	natural
confusing	___:___:___:___:___:___:___	understandable
unpleasant	___:___:___:___:___:___:___	pleasant
genuine	___:___:___:___:___:___:___	phoney
unreliable	___:___:___:___:___:___:___	reliable
strong	___:___:___:___:___:___:___	weak
secure	___:___:___:___:___:___:___	insecure
boring	___:___:___:___:___:___:___	interesting
unsociable	___:___:___:___:___:___:___	sociable

Please place an X on the scale point which corresponds to your impression of the personality of the female in the tape.

relaxed	___:___:___:___:___:___:___	uneasy
unfriendly	___:___:___:___:___:___:___	friendly
intimate	___:___:___:___:___:___:___	distant
untrustworthy	___:___:___:___:___:___:___	trustworthy
agreeable	___:___:___:___:___:___:___	disagreeable
comfortable	___:___:___:___:___:___:___	uncomfortable
informal	___:___:___:___:___:___:___	formal
insensitive	___:___:___:___:___:___:___	sensitive
good	___:___:___:___:___:___:___	bad
personal	___:___:___:___:___:___:___	impersonal
cold	___:___:___:___:___:___:___	warm
emotional	___:___:___:___:___:___:___	unemotional
artificial	___:___:___:___:___:___:___	natural
confusing	___:___:___:___:___:___:___	understandable
unpleasant	___:___:___:___:___:___:___	pleasant
genuine	___:___:___:___:___:___:___	phoney
unreliable	___:___:___:___:___:___:___	reliable
strong	___:___:___:___:___:___:___	weak
secure	___:___:___:___:___:___:___	insecure
boring	___:___:___:___:___:___:___	interesting
unsociable	___:___:___:___:___:___:___	sociable

We are interested in the overall impressions that you have formed of the two persons who were shown in the videotape. Please place an X on the scale point which corresponds to your impression of the personality of the female in the tape.

relaxed	___:___:___:___:___:___:___	uneasy
unfriendly	___:___:___:___:___:___:___	friendly
intimate	___:___:___:___:___:___:___	distant
untrustworthy	___:___:___:___:___:___:___	trustworthy
agreeable	___:___:___:___:___:___:___	disagreeable
comfortable	___:___:___:___:___:___:___	uncomfortable
informal	___:___:___:___:___:___:___	formal
insensitive	___:___:___:___:___:___:___	sensitive
good	___:___:___:___:___:___:___	bad
personal	___:___:___:___:___:___:___	impersonal
cold	___:___:___:___:___:___:___	warm
emotional	___:___:___:___:___:___:___	unemotional
artificial	___:___:___:___:___:___:___	natural
confusing	___:___:___:___:___:___:___	understandable
unpleasant	___:___:___:___:___:___:___	pleasant
genuine	___:___:___:___:___:___:___	phony
unreliable	___:___:___:___:___:___:___	reliable
strong	___:___:___:___:___:___:___	weak
secure	___:___:___:___:___:___:___	insecure
boring	___:___:___:___:___:___:___	interesting
unsociable	___:___:___:___:___:___:___	sociable

Please place an X on the scale point which corresponds to your impression of the personality of the male in the tape.

relaxed	___:___:___:___:___:___:___	uneasy
unfriendly	___:___:___:___:___:___:___	friendly
intimate	___:___:___:___:___:___:___	distant
untrustworthy	___:___:___:___:___:___:___	trustworthy
agreeable	___:___:___:___:___:___:___	disagreeable
comfortable	___:___:___:___:___:___:___	uncomfortable
informal	___:___:___:___:___:___:___	formal
insensitive	___:___:___:___:___:___:___	sensitive
good	___:___:___:___:___:___:___	bad
personal	___:___:___:___:___:___:___	impersonal
cold	___:___:___:___:___:___:___	warm
emotional	___:___:___:___:___:___:___	unemotional
artificial	___:___:___:___:___:___:___	natural
confusing	___:___:___:___:___:___:___	understandable
unpleasant	___:___:___:___:___:___:___	pleasant
genuine	___:___:___:___:___:___:___	phony
unreliable	___:___:___:___:___:___:___	reliable
strong	___:___:___:___:___:___:___	weak
secure	___:___:___:___:___:___:___	insecure
boring	___:___:___:___:___:___:___	interesting
unsociable	___:___:___:___:___:___:___	sociable

Word Perception

In a moment you will be shown a videotape that contains ten arrays of letters which are six columns wide and five rows deep. The arrays are numbered individually, one to ten. By reading these letters horizontally in the usual fashion you may see some common words hidden in the rows as the example below illustrates.

J	C	O	W	K	E
M	P	N	S	U	F
F	I	V	E	Z	K
L	H	B	U	V	C
G	S	L	Y	E	T

Each array is displayed for only a few seconds. Your task will be to locate the hidden words which are suggested by the clues written to the right of the response space. Print the word in the same position in the response space as the word occupied in the row of the array. Thus, in the example below, **COW** is printed in the 2nd to 4th spaces.

eg.

F	I	V	E		
---	---	---	---	--	--

a number

	C	O	W		
--	---	---	---	--	--

an animal

Word Perception

1.

--	--	--	--	--	--

an animal

--	--	--	--	--	--

a month

2.

--	--	--	--	--	--

a colour

--	--	--	--	--	--

part of the body

3.

--	--	--	--	--	--

part of the body

--	--	--	--	--	--

an animal

4.

--	--	--	--	--	--

a number

--	--	--	--	--	--

part of the body

5.

--	--	--	--	--	--

a flower

--	--	--	--	--	--

part of the body

6.

--	--	--	--	--	--

a metal

--	--	--	--	--	--

an animal

7.

--	--	--	--	--	--

part of the body

--	--	--	--	--	--

an animal

8.

--	--	--	--	--	--

a colour

--	--	--	--	--	--

a number

9.

--	--	--	--	--	--

a number

--	--	--	--	--	--

part of the body

10.

--	--	--	--	--	--

a month

--	--	--	--	--	--

an animal

PRE-EXPERIMENT CHECKLIST

1. Check that the video system is operating in the appropriate way, delivering the video signal to the 19" Sony monitors. Place the videotape cassette into the VTR.
2. Distribute the appropriate questionnaires and pencil to each of the seating positions for the subjects.
3. Keep careful records of the conditions that have been run; identify each questionnaire after the experimental session according to the condition run.

EXPERIMENTAL PROCEDURE

1. As the subjects arrive, introduce yourself as the experimenter and assign them to experimental conditions.
2. Describe the study as concerned with interpersonal communication. Give subjects the questionnaires and say that the written instructions on the response booklet should explain the experimental task. Give subjects a few minutes to read the first page of the questionnaire and ask if there are any questions about what is expected of them during the experiment.
3. Start the videotape containing the "Person Perception" task and allow it to run until "The End" after scene 38. Pause for 5 to 10 minutes while subjects complete questionnaire IV or V.
4. Restart the tape at the start of the "Word Perception" task and stop it again 10 seconds after the 10th letter array has been given.
5. After the experiment, debrief the subjects, ask them not to discuss the experiment outside of the laboratory; pay subjects.

EFFECTIVE USE OF COMMUNICATION

CHANNELS IN EDUCATION

APPENDIX V

MEDIATED BARGAINING EXPERIMENT

MEDIATED BARGAINING EXPERIMENT

This is the experimental procedure for the Mediated Bargaining Experiment (an adaptation of the Turnbull, Strickland and Shaver study) to be used in the video compression studies. Most of the experiment will be run using the 2-node set up shown in Figure 1, but one additional control condition will be run with the negotiators face-to-face as shown in Figure 2. On the hardware side, the system should be operating at its optimum and consistent performance level throughout all of the experiment. A number of measurements related to the outcome of the negotiations will be made using the questionnaire enclosed, but there are numerous behavioural indices of interest in these studies. It is necessary to video tape the experimental sessions and later analyze the tapes in some detail to give a good picture of what is happening at the various compression levels.

The procedure is designed with economy of time, subjects and tape, etc. in mind but this has its restrictions. A sufficient number of levels of video compression must be run to allow definition of the expected relationships between compression and subjectivity utility of the channel capacity.

The following experimental design is suggested:

<u>Experimental Condition</u>	<u>Compression level</u>		(Cumulative)	(Cumulative)
	<u>Number of Frames</u>	<u>Number of Seconds</u>	<u>Number of Subjects</u>	<u>Number of Tapes (1 hr.)</u>
1. Control (face-to-face group)			16	2
2. Full Bandwidth	30	1	32	4
3. Lowest compression	15-16	1	48	6
4.	8	1	64	8
5.	4	1	80	10
6.	2	1	96	12
7.	1	1	112	14
8.	1	2	128	16

FIGURE 1

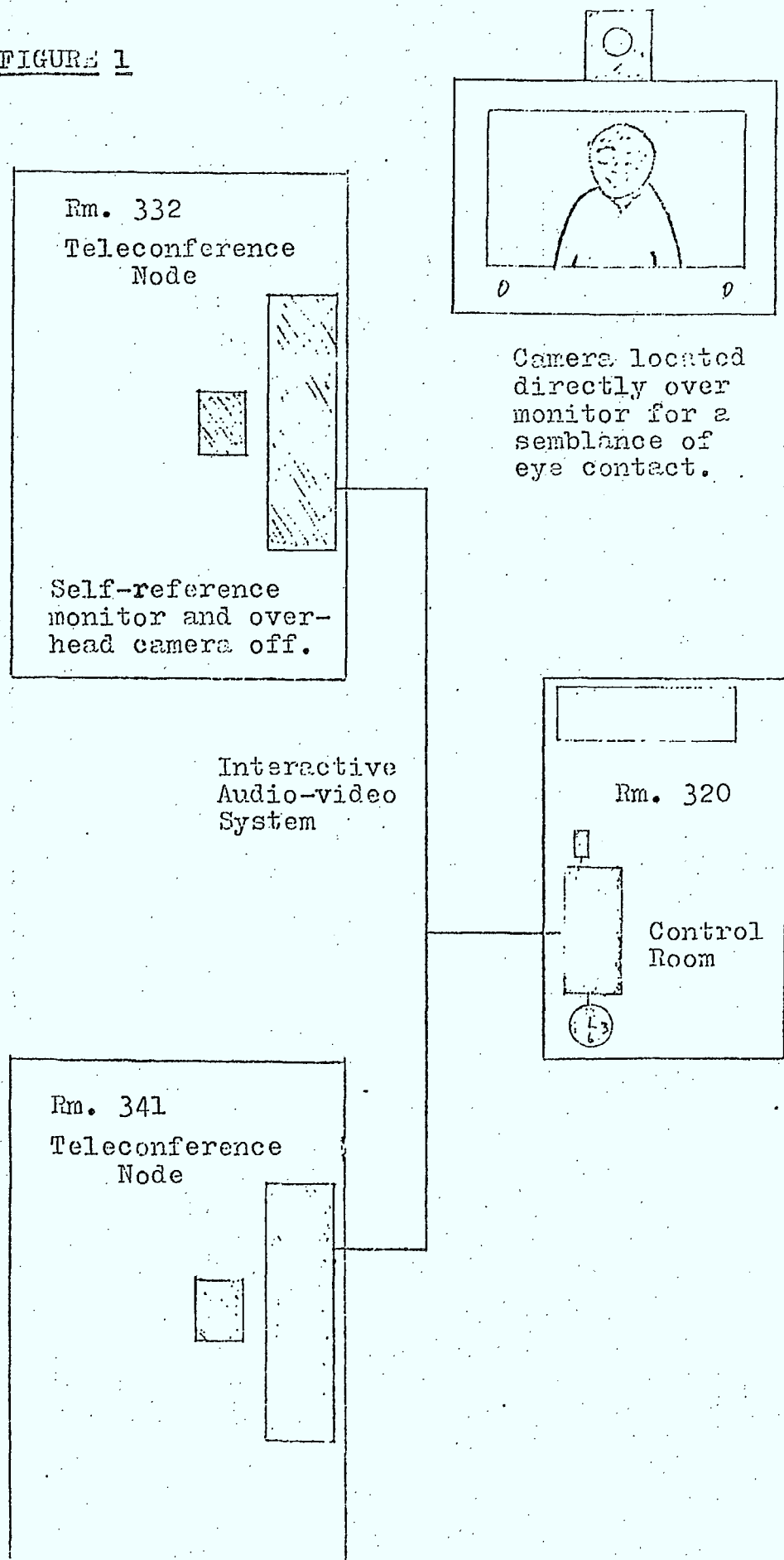
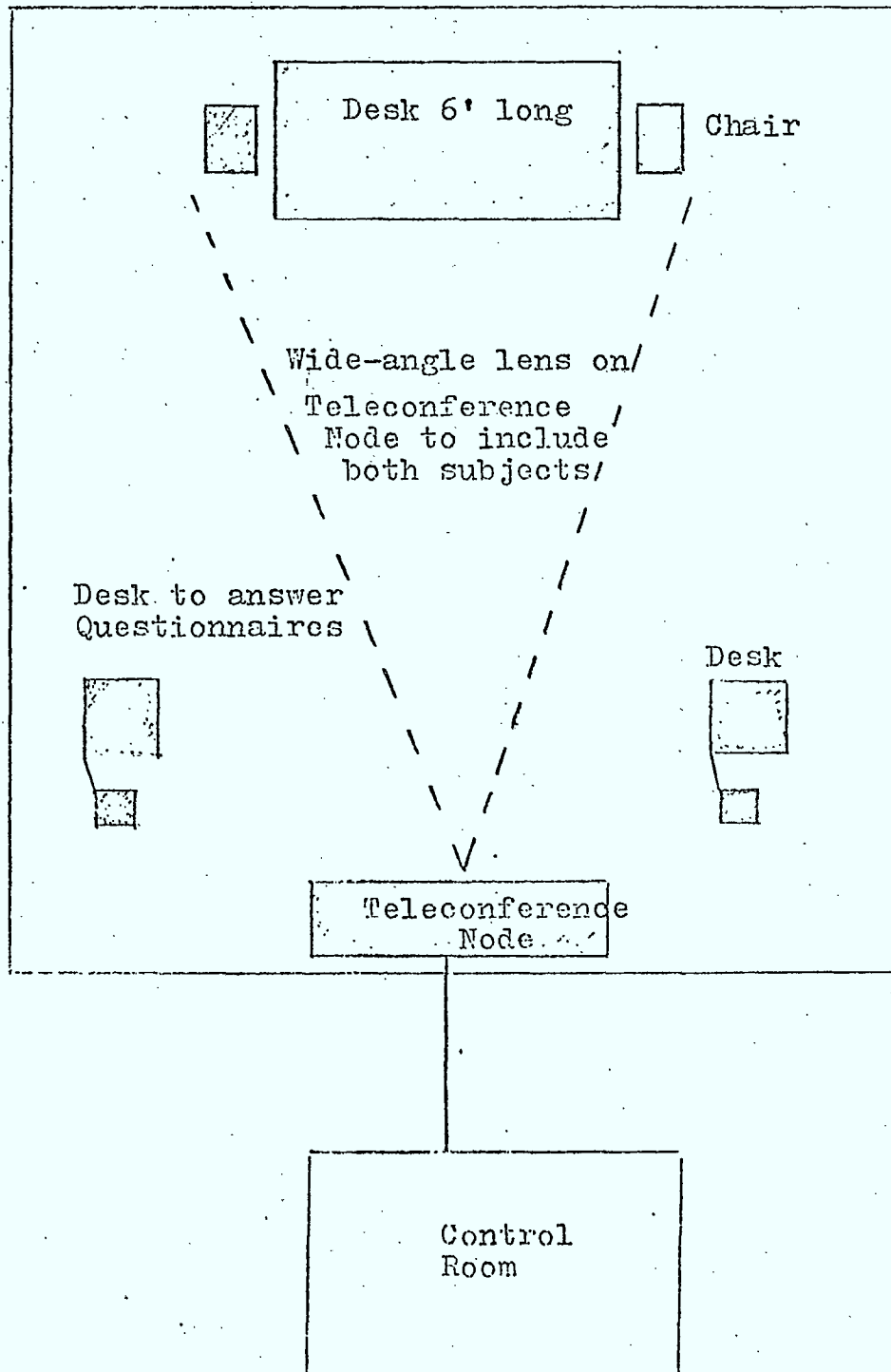


FIGURE 2



EXPERIMENTER'S PREPARATION FOR THE STUDY

1. Subjects should be conscripted from the Psychology Department subject pool. Advertise an experiment in interpersonal communications, ~~and state that it pays \$1.50 per hour for approximately one hour.~~ Specify males only; pairs should be unacquainted. (8 dyads per cell)
2. Reproduce the "Negotiation Booklet". Prepare Nation A and Nation B labels.
3. Reserve the W.C.L. facility according to availability and subject bookings. Stu Paterson and/or Fred Barrett should be available for consultation when the facility is in use.
4. Plan to run experimental conditions in random order, i.e., random assignment of S pairs to conditions.
5. Become familiar with the experimental procedure (i.e., audio cassette and negotiation booklet) and pilot test both the mediated and face-to-face conditions, using at least one dyad per condition.
6. Obtain
 - a) subject payment money
 - b) video cassettes to record sessions
7. Discuss the experimental procedure and, especially, the question of the number of signal compression levels to be tested with D.A. George and S.A. Paterson.
8. If there are any further questions, inquire from P.D. Gould c/o D.A. George.

PRE-EXPERIMENT CHECKLIST

1. Audio system: check that the audio link works and that the levels are adequate and balanced in volume.*
2. Video system: check that the cameras and the monitors are working and that the VTR in the master control room is also functioning.*
3. Audio cassette playback: make certain that the "procedure audio tape" can be heard clearly at both nodes.
4. Video cassettes for recording are on hand.
5. Stop watch to time negotiation session duration (14¹/₂ minutes per session). *(This will allow recording of 4 sessions in a one-hour videotape)*
6. Nation labels are displayed at correct seating position (alternate Nation A and Nation B in each node).
7. Questionnaires and pencils are ready for the negotiators.
8. Decide in advance (with the control room operator) which level of video compression is to be used during the session. *The order of video compression condition should be random.*

* In the face-to-face condition, it is important to check the video camera, VTR, audio microphone and audio cassette playback. Also, it is important to check that the desks and the chairs are located properly in camera view.

PROCEDURE FOR THE EXPERIMENTER

1. When the Ss arrive, introduce E to each S and the Ss to one another, and then to the W.C.L., etc.
2. Describe the study as an experiment in interpersonal communications concerned with the process of negotiation. Give only minimal descriptions at this point; the audio cassette should be enough. In the face-to-face condition, point out the video camera, explaining that it will be recording the session but do not draw undue attention to this fact.
3. If at any point, a subject does not wish to continue with the experiment, terminate the session (this would be very unusual).
4. Locate the subjects at their respective negotiation positions. Point out the questionnaires and ask them to follow along in the booklet as the audio tape directs. Tell the Ss that the experiment will begin shortly.
5. E returns to the control room, plays the "procedure cassette" and follows along in E's booklet. (60 to 70 min. Total)
6. Stop the cassette at the point indicated in the booklet.
7. Give the Ss time to completed the Pre-Negotiation Questionnaire part of the booklet.*
8. When the Pre-Negotiation Questionnaire is completed, ask the Ss to set them aside (or the E could collect the booklets at this point).

9. Continue to play the next part of the "procedure cassette". (179 to 201, about one minute)
10. Start the VTR at the beginning of the negotiation, timing the session carefully to run for $14\frac{1}{2}$ minutes.
11. Indicate to the Ss when the session is 3 minutes from the end. (Do this verbally or play cassette 202-205, 5 minutes)
12. Stop the VTR at the $14\frac{1}{2}$ minute mark. Be as precise as possible.
13. Play the last part of the "procedure cassette". (207 to 211, about 10 minutes)
14. Give the Ss time to complete the Post-Negotiation Questionnaire part of the booklet, and then collect them.
15. Debrief the Ss and pay them.
 "We are interested in the negotiation outcome and the feelings expressed in the questionnaires. No deception was involved during this study."
 "Please do not discuss the experiment outside of the laboratory, etc.".
16. Record the questionnaire data on the Data Sheets as indicated in the instructions. Clearly label each VTR cassette and S's questionnaire booklet according to the experimental condition. Staple the two Ss' booklets together.

* In the face-to-face condition, ask the Ss to move to the desks shown in figure 2 to complete the questionnaires. This is done to avoid either S from influencing the other's responses.

DATA SHEETS FOR NEGOTIATION STUDY

There will be about 88 datum per subject on the completed questionnaires and, with spacing and the occasional three digit numbers, transcription should require the columns of three of the 80 column data sheets used when computer key-punching. There are available in the Carleton Bookstore. Put only one experimental condition on each set of three data sheets. The data sheets should be coded as follows:

Sheet one

column	question	page
1-2	dyad number(1 to 8)	
3	compression level(1 to 8)	
5	nation represented (A=1; B=2)	
12-14	1	4
16-18	1	
20-22	2	
24-26	2	
28-30	3	
32-34	3	*
36-37	4 a	5
39-40	b	
42-43	c	
45-46	d	
48-49	e	
51-52	5 a	
54-55	b	
57-58	c	
60-61	d	*
63-64	e	*
66	6 w-s	6
68	f-u	
70	c-u	
72	w-p	
74	g-b	
76	u-r	
78	b-u	*

Sheet two

1	6 w-s	6
3	f-u	
5	c-u	
7	w-p	
9	g-b	
11	u-r	*
13	b-u	*
15-17	1	9
19-21	1	
23-24	2 a	
26-27	b	
29-30	c	
32-33	d	
35-36	e	*

Sheet two

column	question	page
38-39	3 a	9
41-42	b	
44-45	c	
47-48	d	
50-51	e	*
53	4 A	10
55		
57		
59		
61		
63		
65	*	*
67	4 B	10
69		
71		
73		
75		
77		
79	*	*

Sheet three

1	5	11
.		
.		
.		
43	*	*
45	6	12
.		
.		
61	*	*

re: last item p. 13
 - identify digit #, compression
 and nation and then back
 to ? D limit
 - Xerox all data sheets

START CASSETTE: 000 to 176

NEGOTIATION EXPERIMENT

Today, you will be participating in an international arms control and disarmament negotiating session between two fictitious countries that shall be referred to simply as Nation A and Nation B. We are going to ask each of you to represent one of these countries at the disarmament talks today. Your task will be to role play the part of your nation's chief disarmament negotiator. In order to do this you will need to be briefed concerning the previous disarmament talks between Nation A and Nation B. It will be necessary for you to know the issues they discussed and their resolution. Accordingly, in a moment you will receive a briefing on the past ten years of arms control talks between the two countries.

Throughout today's negotiation session you will be asked to follow along in this booklet and proceed to subsequent pages only as you are told to do so. Hopefully, the written instructions in your booklet and the verbal instructions will be clear enough to enable you to follow along correctly.

You may begin by turning to page 2.

NAME: _____

Today you will be representing the nation shown on the card before you. As their chief disarmament negotiator it is extremely important that you understand the agreements reached in the past ten years, in order that you can later negotiate intelligently. It is also very important that you keep in mind your Nation's present ICBM (Intercontinental Ballistic Missile) level as you are being briefed. The present ICBM levels for each nation are:

Nation A
968

Nation B
954

Each ICBM has the destructive capability of 200,000 lives, and the population of each nation is approximately 100,000,000. Nation A and Nation B are nearly equal in terms of manpower, transportation, gross national product, GNP per capita, energy production, steel production and literacy. In other words, vis a vis each other, only the present ICBM levels are of central importance in determining each nation's military might. It should be added that for the past ten years the ratio of ICBMs between Nation A and Nation B has been approximately the same as it is now.

Remember, it is important to keep in mind your nation's and your adversary's military capability as you receive the historical account of the disarmament talks.

Page 3, to which you may now turn, contains an overview of the ten disarmament issues which have been extensively discussed in the post World War II arms control talks. You may want to refer to this overview as you receive the briefing on the previous arms control and disarmament talks, which will be given by a student of International Affairs who has been closely following the talks between Nation A and Nation B.

Issues Discussed at Each Session

1967	Nuclear Testing
1968	Military Bases on Foreign Soil
1969	Nuclear Free Zones
1970	Biological Warfare
1971	International Arbitrator
1972	Inspection Procedures
1973	Anti-ballistic Missiles
1974	Submarine Launched Ballistic Missiles
1975	Updated "Hot Line"

PRE-NEGOTIATION QUESTIONNAIRE

Your Nation _____

Nation A

968

Nation B

954

The purpose of this questionnaire is to see what expectations negotiators have about the up-coming talks prior to their taking place. Please respond to the questions on pages 4-6 now.

STOP CASSETTE (176)

1. I would like to conclude this negotiation with a _____ % reduction of ICBMs for my nation and a _____ % reduction for the other nation.
2. I predict that my adversary would like to conclude this negotiation with a _____ % reduction of ICBMs for his own nation and a _____ % reduction for my nation.
3. I predict that, following this negotiation session, the reduction of ICBMs will be _____ % for my nation and _____ % for the other nation.

Obviously, many different factors contributed to the success or non-success of the previous talks. Since we are interested in some of these factors affecting negotiations, we would like you to state to what extent you think the factors listed on the following page influenced the negotiating outcomes. Out of 100 points please allot a certain number to each factor, with your total allotment of points equaling 100. If you do not think that a particular factor was at all important, you do not have to allot any points to it.

4. The other nation conceded to your nation on certain issues because of:

- a) its sincere desire for peace
- b) your nation's persuasive negotiating
- c) external considerations (i.e. national security, economic considerations, etc.)
- d) characteristics of the communication setting for negotiation
- e) chance

Total

100

5. Your nation conceded to the other nation on certain issues because of:

- a) its sincere desire for peace
- b) the other nation's persuasive negotiating
- c) external considerations (i.e. national security, economic considerations, etc.)
- d) characteristics of the communication setting for negotiation
- e) chance

Total

100

6. Below each nation several polar adjectives are listed. Please place an X on the scale point which corresponds to your feeling about the extent to which you think the adjectives describe your nation and your adversary.

Nation A

weak	___:___:___:___:___:___:___	strong
fair	___:___:___:___:___:___:___	unfair
cooperative	___:___:___:___:___:___:___	uncooperative
warlike	___:___:___:___:___:___:___	peaceful
good	___:___:___:___:___:___:___	bad
unresponsive	___:___:___:___:___:___:___	responsive
benevolent	___:___:___:___:___:___:___	uncharitable

Nation B

weak	___:___:___:___:___:___:___	strong
fair	___:___:___:___:___:___:___	unfair
cooperative	___:___:___:___:___:___:___	uncooperative
warlike	___:___:___:___:___:___:___	peaceful
good	___:___:___:___:___:___:___	bad
unresponsive	___:___:___:___:___:___:___	responsive
benevolent	___:___:___:___:___:___:___	uncharitable

START CASSETTE: 179 to 201

In a moment you will begin negotiating for bilateral ICBM reductions. You will have 15 minutes to reach an agreement. You must reach an agreement on a percentage reduction of ICBMs for each nation within this time period. Of course, the percentage reduction need not be the same for each country. Remember, a very large reduction might endanger your national security, yet, at the same time, a reduction of only 1-2% will benefit neither country.

As chief disarmament negotiator for your nation, you do not have to clear any proposal with other officials in your government. You have complete autonomy in decision-making and you alone are responsible to your country and its citizens. You are free to talk about anything you feel bears on the ICBM issue. However, please keep in mind the facts listed on the reference sheet (page 19). You may use the reference sheet as scratch paper during the negotiations.

Please begin the negotiation session now.

STOP CASSETTE

FACT SHEET

Present Armament Level:

Nation A		Nation B
968	ICBMs	954

1. Each ICBM has the destructive capability of 200,000 lives.
2. The population of each country is approximately 100,000,000 with urban and rural density the same.
3. You have the authority to accept or reject any proposal without checking with higher officials in your respective countries.
4. You are the only countries on the planet Earth with this number of armaments. At the moment, it is inconceivable that you would ever be threatened with an attack by a hostile third country.
5. You are negotiating for a one year period only.
6. During the negotiating session you will be working toward a certain percentage reduction of ICBMs for each country, which, of course, does not have to be the same for both Nation A and Nation B. Keep in mind that you should not go below a level detrimental to your country's national security, but that it is nevertheless advantageous to reduce the present level of ICBMs.

At the 11 1/2 minute point: START CASSETTE: 202-205 STOP

9.

START CASSETTE: 207-211

POST-NEGOTIATION QUESTIONNAIRE

The negotiation session is now finished. Would you please complete pages 9-13 which make up the Post-Negotiation Questionnaire.

STOP CASSETTE

1. The other nation's final ICBM reduction was ____ %
and my nation's final ICBM reduction was ____ %

2. The other nation agreed to this ICBM reduction because of:

- a) its sincere desire for peace
- b) my nation's persuasive negotiating
- c) external considerations (i.e. national security, economic considerations, etc.)
- d) characteristics of the communication setting for negotiation
- e) chance

Total

100

3. My nation agreed to this ICBM reduction because of:

- a) its sincere desire for peace
- b) the other nation's persuasive negotiating
- c) external considerations (i.e. national security, economic considerations, etc.)
- d) characteristics of the communication setting for negotiation
- e) chance

Total

100

4. Below each nation several polar adjectives are listed. Please place an X on the scale point which corresponds to your feeling about the extent to which you think the adjectives describe your nation and your adversary.

Nation A

weak	___:___:___:___:___:___:___	strong
fair	___:___:___:___:___:___:___	unfair
cooperative	___:___:___:___:___:___:___	uncooperative
warlike	___:___:___:___:___:___:___	peaceful
good	___:___:___:___:___:___:___	bad
unresponsive	___:___:___:___:___:___:___	responsive
benevolent	___:___:___:___:___:___:___	uncharitable

Nation B

weak	___:___:___:___:___:___:___	strong
fair	___:___:___:___:___:___:___	unfair
cooperative	___:___:___:___:___:___:___	uncooperative
warlike	___:___:___:___:___:___:___	peaceful
good	___:___:___:___:___:___:___	bad
unresponsive	___:___:___:___:___:___:___	responsive
benevolent	___:___:___:___:___:___:___	uncharitable

5. Please place an X on the scale point which corresponds to your feeling about the communication setting in which you have just negotiated.

relaxed	___:___:___:___:___:___:___	uneasy
friendly	___:___:___:___:___:___:___	unfriendly
unreliable	___:___:___:___:___:___:___	reliable
intimate	___:___:___:___:___:___:___	remote
untrustworthy	___:___:___:___:___:___:___	trustworthy
agreeable	___:___:___:___:___:___:___	disagreeable
comfortable	___:___:___:___:___:___:___	uncomfortable
informal	___:___:___:___:___:___:___	formal
insensitive	___:___:___:___:___:___:___	sensitive
rough	___:___:___:___:___:___:___	smooth
cold	___:___:___:___:___:___:___	warm
personal	___:___:___:___:___:___:___	impersonal
free	___:___:___:___:___:___:___	constrained
public	___:___:___:___:___:___:___	private
emotional	___:___:___:___:___:___:___	unemotional
cooperative	___:___:___:___:___:___:___	uncooperative
pleasant	___:___:___:___:___:___:___	unpleasant
hazy	___:___:___:___:___:___:___	clear
good	___:___:___:___:___:___:___	bad
unsatisfactory	___:___:___:___:___:___:___	satisfactory

6. (a) Do you feel that this communication system:

- i) Permitted the negotiators to conceal facial expressions?
not at all ____:____:____:____:____:____:____ a great deal
- ii) Contributed to the ease of agreement between the negotiators?
not at all ____:____:____:____:____:____:____ a great deal
- iii) Allowed you to ignore the requests made by the other negotiator?
not at all ____:____:____:____:____:____:____ a great deal
- iv) Created a sense of interpersonal contact between you and the other negotiator?
not at all ____:____:____:____:____:____:____ a great deal

(b) Compared with face-to-face negotiation, do you feel this communication system was:
greatly inferior ____:____:____:____:____:____:____ greatly superior

(c) Compared with telephone negotiation, do you feel this communication system was:
greatly inferior ____:____:____:____:____:____:____ greatly superior

(d) Did you feel close to or far from the other negotiator?
close to ____:____:____:____:____:____:____ far from

(e) Did you feel that you could understand the other negotiator's point of view?
not at all ____:____:____:____:____:____:____ a great deal

(f) Did you feel that the other negotiator could understand your point of view?
not at all ____:____:____:____:____:____:____ a great deal

7. General Comments:



RESEARCH INTO MORE EFFICIENT USE OF
STANDARD TELEVISION AND TELEPHONE
CHANNELS IN EDUCATIONAL COMMUNICATION
SYSTEMS: FINAL REPORT. -- George, D.A.

P
91
C655
G465^a
1976
c.1

Date Due

[illegible]

FORM 109