RESEARCH PAPER P-108

Teleconferencing

PRELIMINARY EXPERIMENTS

H. Wallace Sinaiko

November 1963

INSTITUTE FOR DEFENSE ANALYSES
RESEARCH AND ENGINEERING SUPPORT DIVISION

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FOREWORD

This paper is one of a series on teleconferencing. The final report has been issued as IDA Study S-138, "Teleconferencing: Summary of a Preliminary Study," November 1963. The papers in this series, each of which deals with a particular phase of teleconferencing, contain detailed information not available in Study S-138.

LIST OF TELECONFERENCING PAPERS

1. Teleconferencing: Summary of a Preliminary Study, IDA Study S-138, IDA/HQ 63-2123, Nov 1963
2. J. Orlansky, Teleconferencing: Feasibility of a Research and Development Program, IDA Research Paper P-105, IDA/HQ 64-2309, Oct 1963
3. A. Bavelas, Teleconferencing: Background Information, IDA Research Paper P-106, IDA/HQ 64-2310, Nov 1963
4. A. Bavelas, Teleconferencing: Guidelines for Research, IDA Research Paper P-107, IDA/HQ 64-2312, Nov 1963
5. H. W. Sinaiko, Teleconferencing: Preliminary Experiments, IDA Research Paper P-108, IDA/HQ 64-2313, Nov 1963
6. E. S. Glenn, Teleconferencing: Language and Cultural Factors, IDA Research Paper P-109, IDA/HQ 64-2314, Nov 1963
7. J. W. Schwartz, Teleconferencing: Capacity of Current Communication Facilities, IDA Research Paper P-110, IDA/HQ 64-2315, Nov 1963
8. T. G. Belden, Teleconferencing: Procedures, IDA Research Paper P-111, IDA/HQ 64-2316, Nov 1963
9. Aircraft Armaments, Inc., Teleconferencing: An Experimental Task, IDA Research Paper P-112, IDA/HQ 64-2317, Nov 1963
10. Human Sciences Research, Inc., Teleconferencing: Literature Review, Field Studies, and Working Papers, IDA Research Paper P-113, IDA/HQ 64-2318, Oct 1963
11. T. G. Belden, Teleconferencing: Special Networks, IDA Research Paper P-114, IDA/HQ 64-2319, Nov 1963 (SECRET)

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PART I: BACKGROUND

As part of the IDA Teleconferencing Project* a laboratory facility was set up to enable the project personnel to observe directly a variety of teleconferencing arrangements. Over-all objectives of this phase of the study were: (a) to assess the feasibility of laboratory experimentation in a later project on teleconferencing, and (b) to provide direct experience which would assist us in defining problems for later research. This section describes the facility, the types of questions posed in the laboratory studies, and the results of these observations.

We would like to emphasize that the laboratory work was of a preliminary nature. The main purpose of the facility was problem definition. We assembled a laboratory in which a variety of networks could be observed under many conditions. The equipment in the laboratory was limited to that which could be obtained and installed immediately. Subjects in the studies were people who were steadily available--primarily IDA professionals, State Department personnel, and university students.

The laboratory consisted of five conference rooms linked to each other by telephone and teletype networks.**

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*Summarized in Teleconferencing: Summary of a Preliminary Study, IDA Study S-138, IDA/HQ 63-2123, Nov 1963

**We would like to acknowledge the excellent assistance provided by the following people in the Washington offices of both the American Telephone and Telegraph Company and the Chesapeake and Potomac Telephone Company: Messrs. Rhodes, Coates, Fischer, and Pennington.

Four of the rooms were identical and each contained one Automatic Send-Receive teletype machine (ASR, Model 28), one "page receiving only" teleprinter and a standard dial telephone with additional speaker phone (i.e., "hands off") equipment. The telephones were part of a five-station net that was independent of the larger internal IDA telephone service. Two of these four stations were equipped with plug-in tape reperforator units. (Reperforator units permit simultaneous reproduction of new punched tape from messages being received and printed.)

The fifth room served as an experimenter's control center and had, in addition to the telephone equipment mentioned above, one ASR 28, four "receiving only" teleprinter units, and four associated tape reperforator units. The control station also contained the patch panel used to modify the teletype networks. (Changing the telephone net was done automatically by dialing.)

PART II: LANGUAGE STUDIES

Introduction

A major interest of the Teleconference Project was language translation and interpretation. Prior to running bilingual conferences, a series of experiments was performed on language variables per se. To our knowledge, our studies are the only investigations in which the procedures of professional translators and interpreters have been tested under experimental control. In all, six methods of language translation were studied. We restricted ourselves to English and French because these are the most commonly used languages of bilingual conferences.

Experiment 1: Sight Translation

Sight translation is a new procedure which combines certain aspects of conventional translation and interpretation: written material being received via teleprinter is read and a translation is dictated to a typist simultaneously. Professional conference interpreters were used as subjects. One translated English into French, and one translated French into English.* The material used in the test was the complete text of the Minutes of the 921st Meeting of the United Nations Security Council. The official copy contains both English and French transcripts.

*Note that interpreters and translators traditionally work in the direction of their own native tongues; i.e., a Frenchman would go from his second language into French, an American into English. This is an important procedural consideration and it forms the basis of one of our later experiments.

Procedure. In the sight translation experiment this procedure was followed: An English teletype operator began by transmitting from the first station about two paragraphs of English text from the UN document. At the receiving, or second, station the English-to-French interpreter simultaneously read and dictated a translation to a French teletype operator who used his machine as a teletypewriter; i.e., off-line for purposes of getting both a written record and a punched tape of the translation. Experimenters recorded the total time elapsed from the beginning of the transmission in English, to the translator's statement that he had completed his translation, including editorial changes. Then succeeding runs of about two paragraphs were made by the same procedure, but reversing the order of the language translation. That is, the next passage in the UN document was copied in French by the teletype operator in the second station, and transmitted to the first station where it was simultaneously translated into English. These procedures were followed--alternately English to French and French to English--until the entire 125-paragraph record of the Security Council had been covered.

In addition to measuring the elapsed time, we also rated the translations for quality. We used the method of the Department of State which rates three attributes--accuracy, completeness, and style--each on a five-point scale. Ratings were a weighted composite of the three attributes and could range from 5 to 25 points. Each paragraph was judged separately.

The subjects--interpreters and teletypists--commented on their experiences during post-trial debriefing sessions to provide additional observations of the language techniques.*

Results. The original UN Security Council meeting, from which the translations were made, ran approximately two hours. Sight translation of the same material took 9.7 hours, nearly a five-fold increase.

Accuracy of the sight translations was uniformly high: the average score, for both interpreters, was 23.5 (maximum possible, 25.0). Only three messages of 124 that were translated scored below 20, which approximates the minimum acceptable level in the Department of State; two-thirds of all messages were rated 24 or 25.**

It can be concluded that sight translation is very accurate and requires about five times as long as conventional consecutive interpretation. (We estimate from this that sight translation would be eight to ten times longer than simultaneous interpretation.) These results are based only on the use of interpreters; additional experiments should be conducted to determine the capability of professional translators engaged in sight translation.

Experiment 2: Sight Translation with Target Languages Reversed

The method of this experiment was identical to the previous one except that the direction of translation was reversed for the subjects. That is,

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*The results reported here are based on the ratings of a single, highly experienced judge (Director of the Division of Language Services, Department of State). The limited time available did not permit additional independent scoring. Therefore, we have no data on the reliability of the judgments reported here.

**Edmund Glenn, Department of State, personal communication.

the native-speaking French interpreter did sight translations of incoming teletype texts from French into English; the American interpreter went from English into French. This experiment was conducted to determine if and to what extent decrements in performance, such as additional time delays and inaccuracies, would occur. The interpreters themselves predicted that their performance would be severely degraded when the target languages were reversed for them.

Results. The quality of sight translation deteriorated when interpreters worked in an unfamiliar direction. The drop in performance was most pronounced in the case of the American interpreter whose average score was 21. This would be considered marginally acceptable using Department of State criteria. The native French interpreter, who had the advantage of many years' experience in the United States, had an average performance score of 23. However, we estimated that the quality of translation in both cases was high enough to permit the use of this procedure under emergency conditions.

Although the number of messages handled by each interpreter was small, we made the following observations: The American interpreter took longer to translate into an unfamiliar language the same passages translated in the first experiment by the French interpreter; on the other hand, the native-speaking French interpreter did not require any more time to translate into English the passages translated by the American in the first experiment. Note, too, that French text tends to be 15% to 20% longer than the equivalent text in English due to structural differences in the two languages.

Our results showed that sight translation can be performed reasonably well in an unaccustomed direction, although it results in increased time and

more errors. From this we conclude that a highly skilled bilingual interpreter could carry the translation load both ways without seriously sacrificing accuracy or speed. We have no date concerning fatigue effects on interpreter performance over prolonged periods.

Experiment 3: Sight Retranslation Back Into the Original Language

This experiment measured the accuracy of retranslating back into its original language material that had already gone through one translation. The purpose of the experiment was to observe the extent to which successive translations, of the type that might occur in a verification procedure, would distort text material. The same UN Security Council material and the same interpreters of the two previous experiments were used. However, instead of having translated messages recopied by an operator, teletype tapes of the first study were transmitted directly between stations. For example, a tape containing the French translation of what had originally been an English passage of the UN document was sent via teletype to the American interpreter who dictated a sight translation to a typist.

Results. The number of messages retranslated by both interpreters was small so that very little can be said about performance beyond the suggestion that scores were high but not quite as high as in the original translations. The over-all sense of the original messages was preserved and there was virtually no change in meaning. Some examples of minor changes in the retranslations back into English are shown in Table 1. There were no observable differences between the two interpreters used in this test.

Table 1

REPRESENTATIVE CHANGES DUE TO RETRANSLATION

	Original Passage	Retranslation
Adjectives	"flagrant"	"blatant"
	"tottering"	"vacillating"
Nouns	"missiles"	"rockets"
Verbs	"to allow discussion"	"to permit debate"
Pronouns	"his"	"its"

Experiment 4: Full Translation

This language study followed the same procedure as the first experiment, the sole difference being that full translation and review was substituted for sight translation. Each translating review team (French-to-English and English-to-French) was made up of two translator-reviewers who, in general, divided each incoming batch of material between themselves, each translating a part of it and then reviewing the part translated by his colleague. Each team had a typish. Subjects were highly experienced translators with long histories of translation service in both the UN and the Department of State. The UN documents from the first experiment were also used in this experiment.

Results. The time required to produce a reviewed and corrected translation of the minutes of the Security Council was 37.6 hours. This was approximately 18 times longer than the duration of the original UN meeting (which used consecutive translation) and it was slower than the sight translation by a factor of about four. It was slower than simultaneous translation by a factor of 36. Performance was very high: mean score was 24.4 out of a possible 25.0. Only 2% of the passages were scored below 20,

which approximates the State Department's minimally acceptable score; 86% of the translations were scored as 24 or 25. Table 2 summarizes the times required to do sight and full translation compared with the original UN meeting on which the experiment was based.

Table 2

COMPARISON OF SIGHT AND FULL TRANSLATION METHODS

	Time, hr	Rate, wpm
Original UN Security Council Meeting, Consecutive Interpretation	2.0	102.0
Sight Translation	9.7	21.0
Full Translation	37.6	5.4

Experiment 5: Full Translation with Target Languages Reversed

This experiment was similar to the second sight translation experiment in that we reversed the directions of translation for the two teams. A short sample of paragraphs from the Security Council transcript was used instead of the complete document of the earlier experiments. The teams of translators differed in the accuracy with which they could work in an unaccustomed direction. The native French team scored nearly as high in translation into English as they did in translating from English to French; in both cases, the team's performance was good. The American team, however, did not score as high when its direction of translation was reversed: one passage was substandard (score: 18) and one was marginal (score: 20).

Experiment 6: Full Retranslation Back Into the Original Language

Each team was given an already translated portion of the Security Council Minutes for retranslation into the original language, either French

or English.* Both teams were near-perfect in terms of their retranslation scores. Although the number of passages retranslated by each team was small, all were scored 24 or 25. Retranslation back into French took less time than the original into English; retranslation back into English took more time than had the first translation.

Language Translation: Miscellaneous Findings

During the six experiments some additional observations were made. First, we learned that trained typists and teletype operators can, after some practice, take direct dictation. If moderate errors in spelling and punctuation are tolerable in a teleconferencing system, then the copy resulting from direct dictation to a teletype operator would be acceptable in real-time interactions. The teletype operators in the experiments varied widely in their previous experience with French; some had had no experience with the language, others had taken High School or College French; and two operators had learned French as a native tongue. One skilled teletypist, although totally inexperienced in French, was able to copy French text with minimal errors and at a speed fast enough to stay ahead of the sight translators.

Another incidental finding was that the teletype equipment itself was slower than the typing rates of nearly every operator. The transmitting operators had to slow their typing speeds to match the maximum rate

*Note that some of the UN material had gone through at least one translation before our subjects had seen it. This was because some of the speeches had been delivered initially in Spanish and had been translated into English and French for publication by the UN. The professional translators pointed to this fact because they felt their output would be affected in some way by not being able to work with the original material.

acceptable by the teletype machines, i.e., 66 wpm. This in turn imposed a slight additional delay on the sight translators who, with rare exceptions, were able to keep up with the incoming messages. Also, early in the experiments, teletypists tended to skip letters--about one per word--possibly because of the mismatch between their typing rates and that of the machines. The net rate of sight translation, including teletype transmission, dictation, and editing by the interpreters, was about 30 wpm rather than the 66 wpm capacity of the machines.

During the sight retranslation experiment the interpreters received messages via automatic tape transmission at an even rate of 66 wpm. The interpreters commented that they preferred this evenness to the relatively sporadic typing rates of the teletype operators.

Sight translators said they were disturbed by the excessive noise generated by teletype equipment. This caused the men to raise their voices when they dictated translations. The over-all effect was to generate even more noise.

In Experiment 2--sight translation with reversed target languages--the typists found no difficulty in understanding their translators' dictation. This was somewhat surprising because the translators were dictating in a non-native tongue and we had anticipated problems due to unfamiliar accents. That is, the American sight translator dictated in French to a French typist; the reverse was true for the French translator.

PART III: CONFERENCE SIMULATION EXPERIMENTS

Background

In the second part of the laboratory program a variety of teleconferencing situations were simulated. Our purpose was to obtain first-hand observations of conferences conducted under different communication conditions and procedures.

The five remote stations, connected by the teletype and telephone facilities described earlier, were used. Teletype operators were IDA secretaries trained by us in the use of the Automatic Send-Receive equipment. Their lack of any extensive previous teletype experience probably had minimal influence on the outcome of the tests, considering the operating tasks we required of them.

Subjects who served as principals in the simulation tests were drawn primarily from the professional staffs of IDA and from ARPA. Backgrounds of our subjects included economics, political science, medicine, the physical sciences, military operations research, and the behavioral sciences. Each conference involved four principals. Some of the men participated in only two conferences, others served in as many as eight.

During some trials we used a French subject as one principal. This negotiator was a native Frenchwoman, recently arrived in the United States and currently on the faculty of Georgetown University. An experienced interpreter was also employed during the bilingual runs.

Considerable effort was devoted to developing a task about which to structure conferences. A negotiation problem, known as SUMMIT II, was

created. The task may be summarized as an allocation of resources exercise.* Conferees were represented as being members of a military alliance under acute external threat. Previous agreements supposedly had been made regarding the joint response of the alliance to such threats but the detailed levies on each member for support were not firm. It was the purpose of the conference to determine how much support each member would allocate to the common welfare of the alliance. Each member was constrained by self-interest, in the form of secret instructions from home, to give as little as possible commensurate with the emergency condition. At the beginning of each round of discussion, participants were provided with a short scenario consisting of some background material for arguments and suggestions about conference tactics. The primary objective of SUMMIT II, from the experimenters' point of view was to generate and to observe communications between the players.

Observations were made of the behavior of the conferees under different network and procedural conditions. Investigators working in the control center took notes during the runs; following each teleconference debriefing, sessions were held and conferees' comments were noted.

Experimental Procedure

Each team of subjects was given a brief orientation lecture, instruction in the roles to play as conferees, and taught the rules of the SUMMIT II task. This introductory phase required about 60 minutes. A trial face-to-face conference was also conducted. The duration of the test conferences was variable but most of them lasted approximately one hour. Following

*Aircraft Armaments, Inc., Teleconferencing: An Experimental Task, IDA Research Paper P-112, IDA/HQ 64-2317, Nov 1963

each teleconference, a debriefing session was held. Subjects were encouraged to comment freely on the conference just completed. We were particularly interested in procedural issues and tried to stimulate discussion of them.

Shake-down Trials

A series of nine test conferences was conducted, using IDA secretaries as participants, in order to refine laboratory procedures and to check the details of the SUMMIT-II problem. Two face-to-face, two telephone, and five teletype conferences were held during the shake-down period. The communication net structure was varied as were the procedures of conference chairmanship. While few conclusions could be drawn from these preliminary tests, the feasibility of conducting negotiations via teletype or telephone was obvious. Some tentative hypotheses were also given limited verification. For example, we suspected that the language of teletype communications would be somewhat terse, impersonal, and stilted. This was the case. It was our expectation that the teletype system, to a lesser extent than telephone, would "depersonalize" conferences. This was true but we also noted a more aggressive tone in the content of the messages sent over the teletype. Conferees took tougher positions when using that medium.

Experimental Trials

Fourteen conferences made up the main body of the SUMMIT-II experimental series. These were conducted on four days (not consecutive) with a change of some principals from one day to the next. Table 3 shows the number of trials by medium and language. A more complete description of each trial, in terms of the communications and procedural arrangements, is given in Table 4.

Table 3

SUMMIT-II CONFERENCES: NUMBER, MEDIUM, AND LANGUAGE

Media	English Only	English-French
Telephone	2	0
Teletype	4	5
Mixed Telephone-Teletype	3	0

We did not follow a rigorous experimental design. Each conference should be considered as a miniature experiment in itself. Changes in the composition of the conferee groups across trials also precludes rigorous deductions from the observations.

Telephone Conferences. Two conferences were run using the telephones exclusively. Both trials were in English and both used "Delta" or open party-line networks.* The first telephone conference was run without a chairman. During the second, one of the four conferees also served as chairman. The "hands-off" or speaker phones were used so that conferees were free of hand-held telephones.

The telephone trials tended to be faster--by a factor of 4 to 5-- than teletype runs in reaching agreement about the resource allocation problems. Participants said they preferred telephone to face-to-face negotiation because of the depersonalized aspect of the former.** Also, because only one person can speak at a time in telephone meetings, there is a sort of discipline

*See T. G. Belden, Teleconferencing: Special Networks, IDA Research Paper P-114, IDA/HQ 64-2319, Nov 1963

**All conferees had some face-to-face experience with the SUMMIT-II task since we practiced in that mode before running actual trials.

Table 4

SUMMIT-II CONFERENCES: MEDIUM, NETWORK, CHAIRMANSHIP, AND LANGUAGE

Conference*	Communication Medium	Net Configuration	Chairmanship	Language	Remarks
1	Telephone	Common circuit (Delta)	None	English	
2	Telephone	Common circuit (Delta)	Principal was chairman	English	
3	Teletype	Central Control (Y)	Non-participant chairman	English	Routine store and forward; principals could request floor
4	Teletype	Central Control (Y)	Non-participant chairman	English	Chair could forward, modify, edit, principals' messages
5	Teletype	Central Control (Y)	Non-participant chairman	English & French simultaneous two-way interpretation	Chairman forwarded, edited, etc.
6	Teletype	Central Control (Y)	Non-participant chairman	English & French simultaneous two-way interpretation	Chairman forwarded, edited, etc. Private teletype connections permitted.
7	Teletype	Common circuit (Delta)	Principal was chairman	English	Two nets; stations A, B, and C; stations C and D; Chairman served only as relay between D and others
8	Teletype	Common circuit (Delta)	None	English	Each station transmitted to all others in turn
9	Teletype	Common circuit (Delta)	None	English and French; simultaneous, two-way translation	
10	Teletype	Common circuit (Delta)	None	English and French; simultaneous, two-way translation	Interpreter and French principal separated and talked by phone
11	Teletype	Common circuit (Delta)	None	English and French; consecutive, two-way sight translation	Interpreter separated from principal
12	Teletype & Telephon	Common circuit (Delta) plus two private phone lines	None	English	
13	Teletype & Telephone	Common circuit (Delta) plus selective call-up telephone	None	English	
14	Teletype and Telephone	Two common circuits (Delta)	None	English	Stations A, B, & C on teletype, C, D, and E telephone; C also served as relay between nets

*Conferences were not conducted in the order shown here or in the text describing them.

imposed on the group. Unlike the teletype meetings, with their record copy always available, telephone conferees occasionally had to ask for repeats of some messages, or identification of a spokesman (e.g., "Who said that?") and clarification (e.g., "What did you mean?"). About 20% of the telephone messages were concerned with procedural queries and replies; in the teletype runs fewer than 5% of the messages were so categorized.

Some conferees said that the telephone would be much more suitable than teletype in critical situations with limited time available. Others expressed the opinion that in circumstances with more time to compose and check messages before sending them, teletype would be preferable. We have no data to verify either attitude.

A conference chairman in one of the telephone conferences did not add to the effectiveness of the meeting. The chairman had no means to enforce his decisions. A unique attribute of voice communication is that it permits some types of expression not possible with teletype, e.g., inflection, loudness, tone, etc. These attributes of voice quality probably have an influence in meetings but we cannot say what it is. (Further, in face-to-face meetings, there is additional non-verbal communication in the form of facial expression, gestures, body movement, etc.)

With only four conferees, and using circuits of commercial quality, it was not difficult to identify each voice. We do not know what additional procedures would be needed if very many more people were in a telephone conference or if the circuit quality was poor. (We conducted one experiment with a large telephone conference network. This is reported in Part V of this paper.)

Teletype Conferences. Nine conferences were conducted using teletype only. Of the nine conferences, five were bilingual, involving English and French; four were in English. The bilingual conferences are described in the next section. The network structure and chairmanship arrangement of each teletype conference was unique.

Compared with telephone conferences, teletype is a highly depersonalized medium, but there is a surprisingly rich use of language. An obvious advantage of teletype--and a point mentioned repeatedly by our subject conferees--is the permanent record it produces of all transmissions. As procedures for numbering received and transmitted messages were developed during the conferences, principals were able to refer one another to previous transmissions very rapidly and unambiguously.

In the first meeting a party-line net was used without a chairman. Though rotation was not required, the conferees had no trouble getting the party line when they had something to say; but this would certainly be affected by increasing the size of the group.

The second teletype conference used a Y-network, or central control network, with a non-negotiating chairman. All conferees had to transmit to the chairman and this could be done simultaneously. The chairman simply received each message and rebroadcasted it to all stations via tape relay. We found that true simultaneity was possible, although it did not occur in all cases. In this mode conferees could transmit to the control center while receiving "rebroadcast" messages (i.e., messages transmitted to all conferees). Conferees regarded the simultaneous send-receive character of this net as a mixed benefit. Although there were no delays in getting into the circuit, replies to earlier messages were sometimes received during later transmissions. This was confusing and may have actually delayed the

over-all progress of the negotiation. (Part of the confusion arose from a poor message referencing procedure.) Conferees complained that they had no way of knowing whether their messages were actually received, either by the control center or by the ultimate addressees. In conclusion, the Y-network, or central control network, with a non-negotiating chairman, can provide a potentially very powerful chairmanship if the chairman does more than simple switching and relaying.

The third exclusively teletype conference used a central control network under a chairman who could exercise many discretionary powers. As in the Y-network conference, all conferees had to transmit the chairman's station, but they could receive messages from him simultaneously. The chairman was empowered to do the following: he could relay messages between principals in sequence via "torn-tape" rebroadcast; he could alter the order in which principals' messages were retransmitted; and he could edit or re-word principals' messages before rebroadcasting them. The latter action by the chairman produced unexpected and sometimes troublesome results. Conferees objected strongly when their messages were modified or taken out of sequence. Though the chairman used these powers to expedite the progress of the conference, the conferees became agitated and resentful toward each other and the chairman. At one point during this conference test, one conferee's transmitter was shut off temporarily and without his knowledge. This resulted in serious misunderstanding on the part of all the principals: the first, because he felt his messages were being ignored, and the other three because they were receiving no replies to their queries or new messages from the malfunctioning station. Some additional confusion resulted in using the central control chairman type network because too many offers and counter-offers were simultaneously broadcast. This again points to the

possible mixed blessing of this type of net structure, unless strict message procedures are incorporated.

In our fourth teletype conference, we set up one teletype network in which a single conferee was isolated and could communicate with only one other conferee who also served as a relay station. There was no chairman during this meeting. The conferee, serving in the dual role of relay for the isolated station and principal for his own station, was overworked (by his own estimate) and did not have time to attend to the business of negotiation. The isolated conferee felt completely out of the proceedings, even to the extent of believing the conference had been prearranged to oppose his position. This isolated conferee also claimed that he sent four messages for every one he received. One of the other principals confirmed this claim; i.e., he also believed that the isolated station was not receiving as much information as was intended for it. We conclude, therefore, that this network configuration demonstrated the importance of the role of a relay station in promoting a smoothly running negotiation.

Bilingual Teletype Conferences. Five of the teletype conferences used a French-speaking subject as one of the four conferees. In all five of these trials an interpreter mediated all communications to and from the French subject. In only one case did the French conferee have direct access to any teletype messages; i.e., most of his communication with other conferees was by first speaking to the interpreter who in turn dictated his message to a teletype operator.

The first bilingual conference used a simple Delta network without a chairman. The interpreter did sight translations of incoming English messages into French and he dictated English interpretations of the principal's spoken French to a teletype operator. The French conferee felt at a

disadvantage because he had not written record of the negotiation, while the English-speaking conferees could refer to their teletype records. As a matter of procedure, the subjects were not given identities of any of their fellow conferees before the conference began. It was particularly interesting that, following the meeting, none of the English-speaking principals knew which of the other three stations had the French-speaking principal. One English-speaking subject suggested that it might be possible to overload a subject who had to use an interpreter by being excessively verbal and swamping his interpreter. The other conferees, including the French subject, did not agree that this could be done. At one point during the conference, we removed the French subject and had him communicate with his interpreter via telephone; neither person liked this arrangement.

The second bilingual conference used a Y-network, or central control network, configuration in which all conferees transmitted to a chairman who played an active role: he could edit, delete, or relay the conferees' messages to one another, and he could interject his own messages to expedite the negotiation. (The procedure of this run was identical to the third teletype conference which used only English-speaking subjects.) Nothing unusual occurred that could be attributed to the presence of the French subject. All conferees reacted strongly to some of the chairman's actions: considerable hostility developed between principals because of changes interjected into their messages by the chairman. Analysis of message content showed that more collaborative statements were made during this run than in any other previous conferences, regardless of net configuration or medium.

The third bilingual conference used a centrally controlled network with an active chairman. This differed from the previous conference in that private, two-party teletype connections between principals could be set up.

Conferees felt that the private lines available to them had little utility. The subjects believed that meetings of this type would be better if they could use a telephone for private conversations and a teletype for broadcasting to the entire group. The French principal was at no disadvantage during this meeting beyond the previously mentioned lack of a record copy of the transaction.

The fourth bilingual conference used a Delta or party-line net. The teletype operator serving the French station was physically separated from the interpreter but connected by a telephone line. Separation of the teletypist from the interpreter proved no problem for either party. All the principals were permitted to pre-cut tapes of their messages before sending them through the network. The latter procedure was useful during a long transmission which tied up the net. Conferees waiting to get into the circuit could prepare messages in advance of transmitting them.

The final bilingual conference also used a Delta or party-line network. Language interpretation was consecutive rather than simultaneous; i.e., every message in the net, irrespective of its original language, was translated into either French or English so that both languages were used consecutively throughout. Although this procedure worked well, the over-all time required to conduct the conference was greater due to the greater volume of translation necessary. All principals tended to pre-cut their messages during the translation delays as a means of saving time later. An unsatisfactory aspect of the consecutive translation procedure was noted by some principals who said that a snowballing effect occurred because long incoming messages gave them time to compose and pre-cut even longer messages of their own. The consecutive translation procedure would also be unsatisfactory for rapid interchange between principals but this was not tested.

In summary, a non-English speaking subject in the SUMMIT-II conferences did not create any unusual problems. Except for the meeting which used consecutive translation, the French subject had no record copy of the teletype messages. This put the French-speaking subject at some disadvantage. The interpreter and the French subject seemed to work more efficiently when they were able to see as well as hear each other. Consecutive translation of all messages caused delays that appeared to encourage the composition of longer, rather than briefer messages.

Television Conference.* We conducted one conference using television as the communication medium. Two four-man teams carried on a negotiation and a third group of observers monitored the conference. A "split-screen" TV presentation was used. That is, each team had a monitor screen on which it could view both the chairman of the opposing team and its own chairman. The observer group had the same video presentation and could speak with each negotiating team but could not be seen. The entire meeting, which lasted about an hour, was recorded on video tape for later playback and analysis.

The bargaining teams represented a committee of scientists and a management group who were to negotiate a grievance.** Subjects who served as conferees were IDA professional staff members and consultants. Only

*We want to express our thanks to Major Thomas Capraro, Hq USAF Television Center, who made the television facility available.

**The specific issue, chosen because it would engender strong feelings in all participants, had to do with company rules requiring tourist-class air travel.

one meeting was held and there was no variation in television technique. Results of this single trial are impressionistic only; they are based on participants' and observers' post-conference comments.

There appeared to be no outstanding advantage in being able to see one's opposing member in a session of this type. In fact, most participants objected to the split-screen technique which was distracting, particularly the part of the screen on which they viewed themselves. Further, there were disadvantages in the transmission of non-verbal, non-auditory information. Gestures, facial expressions, and other movements of the team members were believed to be distracting, if no damaging to the bargaining. One value of television was that it allowed very rapid transmission of graphic material which had been generated on-the-spot; i.e., sketches, graphs, etc., were drawn to illustrate certain arguments and these could be shown by each team to the other.

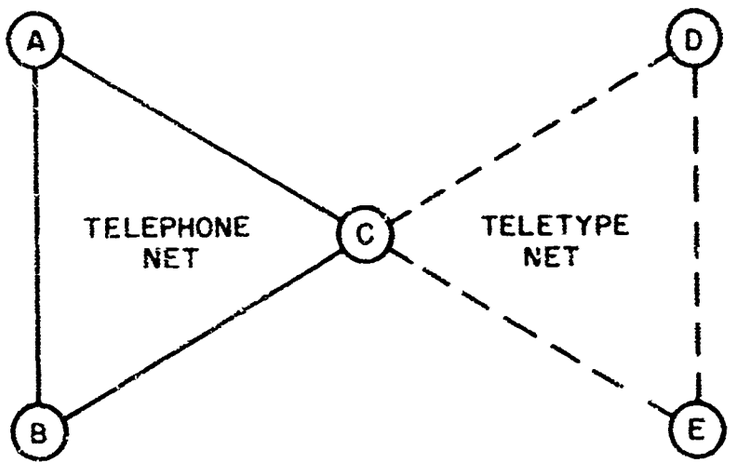
Television might offer possibilities as a remote conferencing medium but should be assessed more thoroughly than we have done. Different screening techniques, as well as a variety of conference tasks, should be tried and evaluated under controlled conditions.

Mixed Media Conferences. The last three negotiation conferences were held using networks that combined telephone and teletype in various ways.

The first of these used a party-line teletype network with two bilateral telephone connections. Although the network was set up so that two-party private negotiations could take place, conferees never exercised this capability. Subjects rarely used the telephones. When they did, it was for purposes of checking each others' calculations or for other minor reasons.

A second combined net used a Delta teletype arrangement and permitted conferees to telephone each other selectively. Again, the voice medium was rarely used by these principals except to correct technical errors that had gotten into the teletype record. There were a few attempts at setting up private collaborative efforts but none of these materialized. All telephone calls were very brief. We suspect that little use was made of the telephones, in both conferences, because principals had no staff assistance and were too busy reading incoming teletype messages to shift to the other medium.

The final combined-medium conference involved two Delta networks--one in each medium with one participant who had both telephone and teletype and who served as a link between the nets. That is, Stations A, B, and C were connected by a telephone party-line; Stations C, D, and E had a teletype Delta net. Station C, which had both telephone and teletype, served as a relay as well as a negotiator.



The conferees who had only telephone inputs felt at a disadvantage, largely because of the absence of any record copy. These telephone conferees had to request repeats and made more procedural errors than the

conferees using teletype. Also, for reasons not obvious to us, the telephone stations complained that information was received from the teletype net too late to permit adequate bargaining. The most difficult task was that required of the one conferee who had both teletype and telephone (Station C) and who had to serve as a relay between the two nets. This subject, working without staff assistance, was too fully occupied with relaying messages to attend to his main job of negotiating. No collusions between principals were formed, although the two media made it possible for this to happen.

Summary of Conference Simulation Experiments

Fourteen four-party conferences were conducted using the SUMMIT-II negotiation task. Very little can be said quantitatively about the affects of media, network configurations, procedures, and bilingual characteristics on the outcome of negotiations. However, some tentative conclusions can be made concerning teleconferencing.

The value of "hard copy" records, available with teletype, was mentioned repeatedly by the conferees. The role of a chairman, even when defined as neutral with respect to other conferees, was shown to be powerful. Some unexpectedly strong negative reactions occurred in response to actions of the chairman, even though the chairman's actions were meant to benefit all. The presence of a non-English speaking principal at one station caused no unusual problems. The French subject was at a disadvantage, he said, because he had to wait for spoken sight translations of incoming teletype messages. The interpreter and his subject were most efficiently teamed when they could see each other. Separating the teletype operator from the interpreter made no apparent difference. Finally, networks combining teletype and telephones were rarely used to the advantage we had expected. More experiments are needed to determine whether this was a procedural artifact or a true preference of negotiators.

PART IV: CONVERGENCE OF CONCEPTS EXPERIMENTS*

Nature and Purpose

One use of a communication system was the exchange of information for the purpose of facilitating agreement between parties with different initial positions. The experiment described here was designed to discover if the medium of communication--in this instance telephone or teletypewriter--affected this agreement process significantly. (These experiments differed from the others in that only pairs of subjects, rather than groups, were observed.)

The experimental plan was a simple one. Two subjects with known differences of opinion communicated over one medium or the other, and subsequent changes of opinion and estimates of each other were recorded.

The only non-routine aspect of this experiment was the generation of opinions in the subject by a process of "non-contingent reinforcement." The method is described in detail below. Its use appears advantageous.

Experimental Procedure

Learning a Concept. After a brief explanation of the nature of the experiment and its aims, the subjects were taken--each to a different room - where they tried to learn a concept by trial and error. The stimuli were small photographs of paintings. The subject was asked to respond to each of the 40 photographs in the learning series by stating whether it was an

*This section was prepared by Alex Bavelas of Stanford University who served as a consultant to IDA.

X-type or Y-type composition. The experimenter said "right" or "wrong" after each response. The subject did not know that the reinforcement schedule was not contingent either on the photograph or his responses. Thus the subject was led into fabricating a concept, under the impression that he was discovering a unique one imbedded in the stimulus material. Both subjects received twenty-five "rights" so arranged in the sequence as to give the impressions of successful, although not perfect, learning. That is, the "rights" were scheduled to imply a learning curve in which correct responses became more and more frequent as the series progressed.

Taking the First Test. After the learning series was completed (about 20 minutes), the subjects took an objective test represented to them as a way of measuring how much and what parts of the concept they had mastered independently. The test consisted of twenty photographs they had not seen before. The subject again responded by labeling each one as an X-type or Y-type composition. He was not told whether he was right or wrong.

Communicating with the Other Subject. After the first test was completed (about 10 minutes), the subjects were allowed to communicate for 30 minutes--some by telephone, some by teletype, in order to share what they had learned, so that when they took the second test, which follows immediately, they would both score as high as possible.

Estimating Test Performance. When the communication period was over and before the second test was taken, each subject was asked to state whether he thought that he or the other person had done better on the first test, and who would do better on the second test.

Taking the Second Test. The second test consisted of the same twenty photographs used in the first test, although the order of the items was

changed. The subject answered this test in the same way he answered the first test, but was asked, in addition, to indicate after each item how he thought the other member of the pair would answer.

Experimental Findings. Three pairs of subjects were tested with telephones as the means of communication, and three pairs of subjects with teletypewriters. The numbers obtained from the six pairs of subjects are presented as answers to questions that were considered pertinent.

Question: Of the 40 items of the learning series, do the responses of the members of a pair agree more than they might by chance?

Answer: No. The average number of agreements recorded by the three telephone pairs was 19.3. The average number of agreements recorded by the three teletype pairs was 21.2. The average number of agreements expected by change is 20.0.

Question: Did the non-contingent-meaning learning series deceive any of the twelve subjects into "learning a concept?"

Answer: Yes. All the subjects "learned" concepts which they were able to describe and which they defended with spirit.

Question: Did the communication period lead to changes of response to the same test items? Was the communication medium a factor?

Answer: Probably yes. A comparison of the first and second tests shows that changes took place; they may have been caused by the communication with the other subject. Further, there seemed to be a differential effect due to the medium of communication used by each pair. The average number of changes made by the six teletype subjects is 4.0; the average number of changes made by the six telephone subjects is 9.6.

Question: If the responses of a pair disagreed on the first test, were they more likely to agree on the second test depending on the communication medium used?

Answer: Yes. The total number of disagreements on the first test was 24 for the teletype subjects and 29 for the telephone subjects. The percentage of those instances in which both parties refused to "yield" was 79% for the teletype subjects and 35% for the telephone subjects.

Question: After the communication period, each subject estimated the over-all relative test performance of the other member of his pair. Were these estimates affected by the communication medium used?

Answer: Probably yes. Each subject was asked, individually after the conference and before the second test, whether he thought he had done better than his partner on the first test, and whether he thought he would do better than his partner on the second test. Thus, the responses can be tabulated as follows:

Table 5

ESTIMATES OF OVER-ALL PERFORMANCE

	Who did better?	Teletype		Telephone	
clear dominance	I on the first test I on the second test	1	1	3	5
	He on the first test He on the second test	0		2	
no dominance	I on the first test He on the second test	2	5	0	1
	He on the first test I on the second test	3		1	

Question: On the second test was there a difference in the accuracy with which one member of a pair could predict the other member's specific responses depending on the communication medium used?

Answer: Yes. The telephone subjects were more accurate. The average number of prediction errors made by the six telephone subjects was 8.3. The average number of prediction errors made by the six teletype subjects was 18.0.

Discussion

Any comment on the meaning of the numbers obtained from this experiment must rest on the assumption that additional cases would confirm the differences reported above. (Our personal judgment is that this would be the case.)

Effects of Media. The over-all impression gained from watching or listening to the subjects as they worked was supported by the following quantitative results:

(1) The amount of convergence (from disagreement on the first test to agreement on the second test) was greater by telephone than by teletypewriter.

(2) The dominance of one member of a pair over the other was more definitely established by telephone than by teletypewriter.

(3) Knowledge of the other person's position appeared to be more accurate if the communication was by telephone rather than by teletypewriter.

Methodology. The generation of opinion by "non-contingent reinforcement" appears to be a device useful for our purposes. It has the following advantages:

(1) The subject's personal involvement with and commitment to a set of ideas is sufficiently great and real. This is preferable to simply

instructing the subject to act as though he were strongly committed to an assigned opinion.

(2) The strength of the subject's commitment is to some extent manipulatable by the amount of success he is given and the shape of the imposed "learning curve." Moreover, the subjects can be given identical records of success during the learning series.

(3) Other studies employing non-contingent reinforcement have shown that the complexity of the concept developed and its susceptibility to disconfirmation are to a considerable extent functions of the reinforcement schedule. Both complexity of concept and susceptibility to disconfirmation may be variables of interest in future studies of teleconferencing.

Conclusions

(1) More personal influence could be exerted by telephone than by teletypewriter.

(2) Further experimentation along these lines should explore the use of other contents (for instance, political data rather than paintings). The concepts generated should be used as a basis for true negotiations rather than for the simple exchange of information. Time and complexity variables should be considered, and larger groups than pairs should be tested.

Other experiments might include such variables as bilingual communications, duplex teletype connections, and a period of time preliminary to the conference in which each party can study a written summary statement of the other's position.

PART V: LARGE TELEPHONE CONFERENCE EXERCISE

Background

In addition to the simulated four-party conferences described in the previous section, we conducted a single large telephone conference using twelve subjects. (Current limitations on teletype equipment available to us prevented our using a large network in that medium.)

Experimental Procedure

Participants in the conference were four people each in Cockeysville, Maryland; McLean, Virginia; and Washington, D. C. Conferees worked at their own desks and used available telephones.

This was a problem-solving conference the task of which was to choose a date and place for a three-hour meeting. Each participant received a letter prior to the conference telling him that such a call would take place on one of two days in the near future. Also enclosed were two sealed envelopes. The first, to be opened when the call began, contained a fictitious calendar for the month with some dates filled-in and some dates open. These calendars were to be used as an information base by each conferee. All calendars were unique and had been arranged so that only one half-day in the month would be commonly available to all twelve people. It was the task of the group to discover this date.

The second sealed envelope contained a rating form to be filled in and returned to IDA after the call was completed. Conferees were asked not to open their rating forms until the end of the call.

The covering letter did not specify a chairmanship arrangement although one man at each location was named as potential co-chairman.*

Results

The conference call was initiated by an IDA secretary at 9:15 a.m. on one of the days previously designated. None of the telephone operators involved had been previously alerted. Following is a time table of the history of the conference.

Table 6

EVENT SEQUENCE FOR LARGF TELEPHONE CONFERENCE

TIME	EVENT
9:15 AM	IDA operator given names and locations of 12 conferees, and told to initiate a conference call.
9:29 AM	IDA operator reports all parties on line.
9:32 AM	Roll-call by chairman pro-tem. Procedural discussion. Place of meeting selected.
9:40 AM	Response order established and procedure set for selecting date. Record-keeping co-chairman selected. Each conferee runs through his available dates in turn.
9:50 AM	Tentative solution reached, rejected.
9:54 AM	Final solution achieved.
9:55 AM	Sign-off.

All participants in the call knew how many people were involved, probably because they kept count during roll calls. Personal identification of each speaker was not universally accurate, particularly for the peopie

*The appendix contains copies of instructions, rating forms, and one calendar.

located in Cockeysville who complained of low audio volume. The McLean group had less difficulty identifying speakers than the first group.

The conferees evaluated the success of the call in terms of attaining the stated objective of the meeting. Nine people rated the call "reasonably successful," two thought it was a "fair meeting," and one said he had "operated at a considerable handicap." The extreme points on the scale, "very efficient" and "couldn't accomplish anything," were never checked.

Conferees also estimated the effectiveness of a meeting for the same purpose if it had been run in a face-to-face situation. Responses were: "very efficient" 3, "reasonably successful" 5, "fair meeting" 3, and "operated at considerable handicap" 1.

The participants were asked to say whether a chairman had emerged and, if so, to name him. All agreed that there was a chairman but disagreed as to who it was and to the nature of the chairmanship. Nine people thought one man had served as chairman, two named a second person, and one named a third.* Generally, the man who volunteered to call the roll during the first few minutes of the call was regarded as the chairman. One conferee suggested a record-keeping procedure, and agreed to this for the group, probably spoke more frequently than any other conferee, but could not confirm this.

According to some post-call comments on the rating forms, the meeting was very successful and rapid; however, this may reflect a high degree of cooperation between participants who shared a common goal. Some

*Only the first person nominated was one of the three named in the covering letter as a potential co-chairman.

participants felt the call was too time consuming. They thought that even greater efficiency would have been attained if a chairmanship and procedures had been pre-arranged.

Recommendations

Though not extensive, the present investigations showed that a twelve-person telephone conference could be set up quickly and, for a problem of the type we used, work efficiently. However, many questions for further study of large networks are raised as a result of this one-trial experiment. A task should be set up to promote conflicting goals among individuals. Procedures should be established to enable much faster group solutions to problems. Various chairmanship and sub-chairmanship arrangements should be tested. Also, physical variables such as noise, distance, and voice quality need investigation. The present study was actually a three station net with four extensions at each station. Further studies should be conducted involving truly separated stations and greater use of outside operators in the public telephone system.

PART VI: CONCLUSIONS

Two purposes of the experimental phase of the Teleconferencing Project were:

(1) to learn whether it would be profitable to conduct laboratory research in a later, more formal, teleconferencing project, and

(2) to gain some first-hand experience in order to define procedural problems of teleconferencing. The laboratory studies gave positive support to both aims.

While the laboratory studies were preliminary, we believe that certain findings will stand up under more rigorous tests. The numbers associated with our findings should be viewed as merely indicators and nothing more. In the language experiments, for example, the interpreters and translators were top caliber people but only a few of them were used. The material that was translated was political in substance only. Reliability of the performance measures used to evaluate the subjects' translating was not known. We believe, in spite of these limitations, that the striking differences in the time required to translate the UN material--9.6 hours by sight translation and 37.5 hours by the full translation technique--were due to real, not chance, factors.

Most important, we demonstrated that certain phenomena characteristic of teleconferencing and heretofore believed impossible could occur:

- sight translation (which had been said to be too difficult to do well);
- reversal of translators' target languages (which had been said to be impossible);

- the conduct of multi-party negotiations wholly by teletype;
- the combination of telephone and teletype media in multi-party bargaining;
- the use of telephones for conferences by as many as 12 people simultaneously.

Implications for Future Research in Teleconferencing

In the language area we know that it is possible to test objectively the methods used by professional linguists. Some of these techniques are currently followed because they are, in fact, the best ways of accomplishing language services, others are based on professional folklore; i.e., "we do it this way because we always have done so." Experiments should be conducted to separate fact from fancy. Our experiments on sight translation and target language reversal demonstrate the value of subjecting previously untried language practices to objective tests. Further research in language technique should be more objective in the methods of measuring accuracy; this should be a high priority requirement of any continuation of this type of research. Studies should be conducted in which the roles of translators and interpreters are further varied or reversed. Further research and development should emphasize the need for other wholly new language techniques for situations in which great speed is required. The Washington-Moscow teletype link is an example of this requirement.

Research on teleconference procedures should be continued. In our studies, the SUMMIT-II task was a good vehicle for creating an environment in which bargaining behavior of four-man teams could be generated rapidly and observed in a variety of communication nets. The simulated conferences provided some insights into the effects of using teletype and telephone in the conduct of meetings. The power of an active chairman, who also has control

of the communications net, was demonstrated. Some effects of two-way simultaneous communication were brought out. The following additional research on conference simulation should be conducted:

- Develop more objective ways of observing and recording the processes of conference behavior.
- Develop additional tasks which can be used to test different aspects of conferences, e.g., conferences involving non-allied principals, greater emphasis on crisis situations, tasks suitable for the two-party "hot-line" simulation, tasks which test certain properties of language.
- Conduct larger experimental conferences more closely approximating the size of typical alliance or military group membership so that net saturation can be measured.

Further experimental work on teleconferencing would require the following moderate changes in the laboratory facility we used:

- At least one additional station is needed so that nets with five or six conferees can be observed.
- Improved observer facilities (e.g., a multi-channel voice recorder, multi-channel event recorder).
- Training and debriefing rooms for subjects.

As demonstrated in the large teleph meeting exercise, effective research need not be limited to a laboratory facility. Additional studies should be conducted using other outside facilities as appropriate (e.g., television, facsimile). The obvious advantage of this approach is that costs can be held to a much lower level than if highly specialized equipment is installed in the laboratory.

Finally, future experimental research should include as conferees people whose backgrounds are similar to the ultimate users of an operating teleconference system. People who have had high-level foreign service experience or other governmental experience, particularly where they have had to represent the United States in multi-national meetings, would be excellent subjects. And subjects who are not American nationals would be valuable when cultural and linguistic variables are studied.

APPENDIX

INSTITUTE FOR DEFENSE ANALYSES

Research and Engineering Support Division IDA 1666 Connecticut Avenue, N.W., Washington 9, D.C., Telephone 234-9350 (Area Code 202)

October 7, 1963

Dear

During the morning of October 10 or 11 we are going to try to set up and conduct a large telephone conference call. The purpose of the conference will be to decide on a date and time for a 3-hour meeting of people from IDA, HSR, and AAI; the meeting must be held during October.

We would appreciate your participation in the following way. There are two enclosures with this letter. Please don't open either one. When the conference begins open Enclosure 1 which is a calendar of appointments (fictitious) for you for the month. This will be your base of information from which to operate. Note that some dates on your schedule can't be altered, some commitments are relatively flexible, and some days are free. When the conference ends -- and this shouldn't occur until the meeting date and time are selected -- please open Enclosure 2 and fill in a brief questionnaire. Then mail Enclosure 2 to me.

We are deliberately leaving the issue of chairmanship vague. However, consider the following as co-equal sub-chairmen of their respective groups: Jesse Orlansky, Jerry Kidd, and Pete Nordlie. I will serve as overall chairman only if need for such things as calling a halt, ecc.

If you can't be available on the 10th or 11th (mornings) please designate a substitute and be sure he has the enclosures.

Thanks very much.

Sincerely,

H. Wallace Sinaiko

Sunday	Monday	Tuesday	Wedne
	7	8	Research Committe Meeting
			All Day
13	14	15	
	SAB Meeting - Cannot be postpone		
	- - -	Must attend	- - -
20	21	22	
27	28 Founder's Day	29	
	Try not to miss		

Typical Calendar Supplied to

ENCLOSURE 1

ednesday	Thursday	Friday	Saturday
arch 9 nittee ing	10	11 N.Y. Trip: May be post-	12
Day		poned until the 21st	
16 poned	17	18	19
23	24 Space panel	25 presentation	Kids' party 26 at home --
	All	day	Could be de- layed until 5:00
30	31		

d to Telephone Conferees

ENCLOSURE 2

NAME: _____

1. How did the teleconference work out, in general?

   Were you able to hear all the other participants? _____

   How many people do you think were in the conference? _____

   Could you identify the speakers? _____

2. Was a chairman used? _____

   Who was he? _____

3. Give your estimate of the success of the conference in terms of attaining the objective (check).

Couldn't Accomplish Anything		Operated at Considerable Handicap		Fair Meeting		Reasonably Successful		Very Efficient	

Now do the same with your estimate of how the same meeting would have gone if you were all face-to-face.

Couldn't Accomplish Anything		Operated at Considerable Handicap		Fair Meeting		Reasonably Successful		Very Efficient	

Any additional comments?

Please mail this to me as soon as possible.

Thank you.

H. Wallace Sinaiko