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THE EFFECTS OF VISUAL SPATIAL AND VISUAL NUMERICAL SUPPLEMENTS ON TELEPHONIC COMMUNICATION EFFICIENCY

The University of Oklahoma PH.D. 1982

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECTS OF VISUAL SPATIAL AND VISUAL NUMERICAL SUPPLEMENTS ON TELEPHONIC COMMUNICATION EFFICIENCY

A DISSERTATION

Submitted To The Graduate Faculty

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

by

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Norman, Oklahoma

1982

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ON
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ACKNOWLEDGEMENTS

I would like to express my deepest, heartfelt appreciation and thanks to the chairman of my committee, Dr. Edmund C. Nuttall. Professor Nuttall's availability, guidance, criticism, support, patience and encouragement throughout this undertaking is worthy of the highest praise and exemplifies an academic and humanistic standard worthy of emulation. I thank also Dr. Roger Babich and Dr. William Carmack for their patience and constructive criticisms throughout my total doctoral program. I especially thank Dr. Babich for his editorial criticisms. My thanks and deepest appreciation is extended also to Dr. Frank Durso of the department of psychology, whose help in critically evaluating this dissertation and whose help in securing subjects for this investigation cannot adequately be explained. I thank also Dr. Richard Reardon of the department of psychology for his help and support in securing subjects for this study. I thank also Dr. Lauren Wispe and Dr. Gustav Friedrich for their criticism, support and helpful guidance throughout this undertaking. I acknowledge also my debt to the Graduate College of the University of Oklahoma for providing a research grant for this investigation. I am also indebted to Ms. Marva White and Ms. Phyllis Blickensderfer of Southwestern Bell Telephone Company for their help is securing the teletrainer for use in this study. I am also happy for my wife, Beverly, that this undertaking has now come to fruition.

THE EFFECTS OF
VISUAL SPATIAL AND VISUAL NUMERICAL SUPPLEMENTS
ON
TELEPHONIC COMMUNICATION EFFICIENCY

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This study examined the effects of two types of visual supplements on telephonic communication efficiency to determine if type of information (i.e., spatial relations and/or numerical chronology type of information) and the modality of presentation (either through audition only or as a visual supplement to the auditory discourse) were related to (1) communication efficiency (i.e., the time required accurately to complete a communication task), (2) success rate (i.e., number of inaccurate agreements to reach a criterion of sixteen accurate agreements), or (3) communicator confidence. The findings of this investigation indicate that visually supplementing the spatial relations type of informaion significantly increased communication efficiency, but had no effect on communicator confidence. Visually supplementing the numerical chronology type of information had no effect on communication efficiency, but significantly lowered communicator confidence.

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CHAPTER 1

INTRODUCTION

In an unpublished study which investigated the function and use of the telephone for business communication purposes for a large American corporation, Nuttall (1973) reported that fourteen percent of business telephone calls made by mid-level executives were made to set up a face-to-face meeting (p. 6). Analysis of these telephone calls by Nuttall revealed that these face-to-face meetings were arranged for business communication purposes only, apart from personal or social reasons. This finding is sufficient to warrant communication researchers to ask the question: What is it that caused these executives to feel that a telephone call was insufficient for their communications needs, and that a face-to-face meeting was necessary? Acknowledging that the lack of visual nonverbal factors may have motivated a face-to-face meeting, the question remains whether it is possible that apart from nonverbal considerations, the executives may

have felt that the communication goal would better be served or facilitated by means of a visual perusal of the information? If the visual availability of certain types of information does benefit the attainment of communication goals, then another question which communication researchers should ask is: What kinds of information facilitate communication efficiency through visual perusal?

STATEMENT OF PURPOSE

The purpose of this study was to investigate whether spatial and/or numerical types of information, when visually supplemented to a telephonic communication task, or auditory discourse, are related to communication efficiency. Specifically, Is the efficiency of telephonic communicaton facilitated by providing visual supplements of the spatial and numerical information which is being discussed?

DEFINITION OF TERMS

COMMUNICATION

In 1970 Dance examined the conceptual underpinnings of the various definitions of communication and sought to synthesize them into a single definition (p. 202). After his analysis, he concluded, "the concept of communication . . . is too loose, indeed includes contradictory components . . . to allow the synthesization of a single, internally consistent definition. . ." (p. 209). As a result of this situation, Dance called for a family of concepts, a variety of approaches and methodologies, to deal with the situation (p. 210). In view of the components and representative definitions listed by Dance

(pp. 204-208), for the purpose of this investigation communication was defined as the giving and receiving of information.

COMMUNICATION TASK

The giving and receiving of information can occur within a variety of circumstances, settings and situations. In order to gain insight into the efficiency of the giving and receiving of information, the concept of the communication task becomes important. A communication task is a structured event used to measure the efficiency of communication between two or more people. The task employed in this investigation was structured in such a way that varying amounts of the necessary information required to attatin the communication goal were held by the different participants at the beginning of the interaction. The participants were then required to communicate with each other until an accurate agreement concerning the application of the shared information was reached.

COMMUNICATION GOAL

The giving and receiving of information among people can be viewed teleologically, or as having a goal directed end. Communication efficiency, therefore, can be viewed as a function of the communication goal. In order to gain insight concerning efficiency as it relates to a specific communication goal, a communication goal, for purposes of this investigation, was defined as the objective of reaching an objectively correct agreement attained by applying the information possessed by the participants at the beginning of a communication task. Though agreement concerning the

correct application of the available information may have been reached, if it was not accurate as determined by the pre-set objective criteria, then the communication goal was not achieved.

INFORMATION STORE

Information store was defined as that information possessed by the communicants at the beginning of a communication task. The information store was not limited to one's knowledge or memory but include external aids in any form. In this investigation the information store consisted of a map (spatial information) and an itinerary (numerical information, see Chapter III).

COMMUNICATION EFFICIENCY

Communication efficiency can be viewed as a function of both the communication goal and the communication task. For this investigation, communication efficiency was defined as a score obtained on two components of a communication task: time to agreement and success rate.

Time to agreement

Time to agreement was defined as the total elapsed time needed to complete a unit of a communication task. A unit of a communication task was the reaching of one of two agreements required by the communication task.

Success Rate

Success rate was defined as the frequency of subject failure to complete a communication goal.

The idea behind success rate was: if one experimental condition had a higher number of failures to complete the required communication task than another experimental condition, then the experimental condition having the lower frequency of failure might be viewed as having a higher success rate.

COMMUNICATOR CONFIDENCE

Communicator confidence was defined as a score on a measure of assurance or certainty in one's correct application of the available information to achieve the communication goal.

COMMUNICATION MODALITY

Communication modality was defined as one of the human's interfacing "senses" with its environment. For purposes of this investigation communication modality was limited to the aural and visual senses, or a combination of the two.

TYPE OF INFORMATION

Information type was classified as being either auditory or visual, depending upon whetner it was more efficient to communicate that type of information through the aural or visual modality. In this study, only that information which was classified as a visual type of information was manipulated.

LIMITATIONS OF STUDY

This investigation asked the question "Is the efficiency of telephonic communication facilitated by providing visual supplements to the spatial and numerical information which is being discussed? In

view of this question, the focus of this study was limited to inquiring into and examining only those variables which were suspected to be a visual tpe of information and related to communication efficiency. Any other variable which was not directly relevant to this investigation for the following reasons:

COGNITION, MEMORY, PRIOR LEARNING

Communication was defined as the giving and receiving of information. In light of this definition it is separated from other processes that may frequently accompany it. The focus of this investigation was not to explain the mental processes by which certain types of information may be shown to be efficient, but rather to examine the relationship among that type of information classified as visual, modality of presentation and communication efficiency. Cognition, memory, and prior learning were viewed as involving mental process, or human factors, beyond those required for examining communication efficiency as the result of a given communicaion task.

PARALINGUISTICS

It is well known that auditory emphasis, pause, and inflection in spoken discourse can convey nonverbal social messages. These nonverbal messages can be interpreted as cues to a participant's attitude, either as to the substance of the information or as to the communicatee personally. Both the question asked in this investigation and the design of the experiment (see Chapter III) sought to exclude the contribution of paralinguistic variance that might have resulted as a consequence of social importance.

SUMMARY

This study asked the question, "Is the efficiency of telephonic communication facilitated by providing visual supplements to the spatial and numerical information which is being discussed? The purpose of this investigation was to examine whether certain types of information, spatial and numerical, are more efficiently communicated through a visual supplement of these types of information when these form the substance of the auditory or telephonic discourse. The purpose was also to examine the relationship among type of information (spatial and/or numerical), modality of presentation (aural only or aural and visual), and communication efficiency. Further, the purpose of this investingation was to examine communicator confidence as it relates to type of information and modality of presentation.

Chapter II reviews that literature related to the issues raised in this investigation and presents the hypotheses to be tested. Chapter III describes the experimental design. Chapter IV explains the method used to analyze the data and reports the findings. Chapter V discusses the data, generalizes the findings and discusses further research.

CHAPTER II

REVIEW OF LITERATURE

This chapter reviews that literature relevant to any potential relationships among type of information, modality of presentation and communication efficiency. This review centered around two questions: (1) Has type of information been a variable in research and if so what are the general findings, and (2) What are the findings in the recent literature regarding the question raised by Day and Beach (1950), namely, "Under what conditions and to what extent has one sense modality been found superior to the other?" (p. iii). This review also sought to determine if numbers in the form of a numerical chronology and spatial relations type of information have been variables in communication research.

TYPE OF INFORMATION

The question concerning the relationship between type of information and comprehension, learning, retention or recall has been of particular interest to researchers in education, and educational communication and technology. Booher (1975) concluded that type of information displayed in visual channels was important in learning and comprehension. Gropper (1962) studied the role of vision in verbal learning. Gorman (1973) was concerned with the role of pictorial detail in concept formation. Spangenberg (1973) investigated the

"motion" variable in procedural learning. The bulk of research focusing on type of information as a variable has dealt mainly with the relationship between instructional or media type and either learning, comprehension, retention, or recall (see for example, Ksobiech, 1976; and Nasser and McEwen, 1976), or pedagogy (see for example, Campeau, 1974; Cabeceiras, 1972; Ellett and Smith, 1975; Okey and Majer, 1976; and Spangenberg, 1976). The question as to the relationship between type of information, modality of presentation and communication efficiency was not raised among those who before 1929 were concerned with the role and function of "sensory aids" and from 1929 to the present have been concerned with visual education, audiovisual communication, audiovisual instruction, educational communication and technology, or instructional systems technology (Miller, 1973, pp. 369-370).

Brody (1981) and Duchastel (1980) both reviewed the research on the use of pictures and illustrations in texts. Brody (1981) focused on whether there was an empirical basis for making decisions for pictorial and illustrative support for texts. Duchastel (1980) focused on the value of illustrations in texts. Brody (1981) stated:

> An examination of related literature reveals that there have been few attempts to examine closely the relationship between pictures and learning from instructional texts. Few studies have investigated the issue at all, and even fewer have explored it in any systematic manner. Thus, information related to the picture-text relationship often must be acquired through an analysis of research whose primary concern lies in other directions, resulting in a disparate group of studies differing in purpose, methodology, and conclusions. (p. 94)

Brody (1981) summarized saying, "though considerable pictorial

research has been conducted in related areas, such as the effect of pictures on learning to read individual words and passages, little is known about the effect of pictures on learning from reading" (p. 93, emphasis added). Brody argued that if the function of illustrations and pictures as supports for texts is to be understood the focus of investigation needs to be changed from asking "whether or not pictures help, (but) rather how they help" (pp. 94-95, emphasis added). Asking how a picture or illustration helps seems to be tantamount to asking if communicaton efficiency is facilitated through certain types of information being visually supplemented. Examining type of information for its communication efficiency through different modalities seems, therefore, to be essential in order to begin to determine if a picture or an illustration helps or supports the verbal text or discourse. Duchastel (1980) concluded as Brody, arguing, "despite many failures of research to support the value of illustrations in texts . . . researchers need to move on, using new frameworks to discover the reasons illustrations can aid learning" (p. 286, emphasis added).

None of the research on visual aids or visual supplements sought to answer the question, What is it about the type of information that these aids contain by which learning, comprehension, retention and recall are facilitated by having a visual supplement? Though type of information has been a variable in visual research, numbers and spatial relations have not been examined as independent variables. No previous investigation has classified information as visual and examined that type of information to determine if it was more

efficient to see that type of information while talking about it. To seek an answer to the second question, the sesnsory modality literature was examined.

SENSORY MODALITY SUPERIORITY

In 1925, Worchester undertook to answer the question, "By which method of presentation, visual or auditory, of meaningful connected material is learning most easily accomplished?" (p. 18). Worchester's review of the literature to that date revealed that though the relationship between modality and efficiency was of interest to researchers, no specific study had yet been undertaken to examine the relationship. Worchester specifically was concerned with the relationship between learning and memory as functions of vision and audition.

In 1950, Day and Beach, by means of a literature review, undertook to answer two questions, namely, (1) Is material better understood when presented visually or aurally? (2) Under what conditions and to what extent has one sense modality been found superior to the other? (p. iii). Day and Beach summarized their findings,

> the results of this survey have indicated that no meaning can be given to the first question as it stands; whether or not a given presentation system is more efficient in an auditory or visual form depends upon the messge, the system, and the receiver. Thus a more useful statement of the first question takes the form: under a given set of circumstances, which is more efficient for the comprehension of messages, an auditory or visual presentation? This is the structural converse of the second question: Under what particular circumstances is an auditory or visual presentation more efficient for the comprehension of messages? (pp. 9-10)

From their literature review, Day and Beach were not able to answer their second question. They argued that the question still is in need of an answer and that an answer must await future empirical studies. To help focus future research, Day and Beach generated the following hypotheses:

> 1. A combined visual and auditory presentation of material leads to more efficient comprehension than the presentation of either auditory or visual material alone . . .
>
> 2. Meaningful, familiar material is more efficiently presented aurally, whereas meaningless and unfamiliar material is more efficiently presented visually . . .
>
> 6. Unusually difficult material is more effectively received with a visual presentation, whereas particularly easy material is better understood with an auditory presentation. The relative effectiveness of the visual presentation increases with increasing difficulty of the material . . .
>
> 10. Such organized and related material as prose or factual information is better understood with an auditory presentation; material such as code that is comparatively discrete and unrelated is more effectively received with a visual presentation . . . (pp. 8-9)

Cheatham's (1950) review of the literature, entitled, "A Comparison of the Visual and Auditory Senses as Possible Channels for Communication," was concerned "mainly with recent studies on the direct comparison of vision and audition, and on these senses as viewed in various communication systems" (p. 1). Cheatham's focus was directed at those studies which compared visibility and audibility and legibility and intelligibility. Cheatham concluded that "research studies which compare vision and audition directly in relation to

communication, or which are concerned mainly with the presentation of complex information by the coding of sensory dimensions, are noticeably scarce in the . . . standard psychological literature" (p. 17). Also, in 1950, Harris published the book entitled Some Relations Between Vision and Audition in which their decoding efficiency was not compared but rather their sensory-neural activity.

The issue as to the empirical basis for either audition or vision being the more efficient sensory channel through which to present certain types of information was summarized by Henneman (1952), who stated:

> a survey of the research literature in this field obviously does not provide the answers to the questions of the communications engineer. In order to determine the most efficient "division of labor" between the visual and auditory senses for communication purposes, one is compelled either to make the most "educated" guesses possible from a theoretical analysis of the known facts of perception, or to undertake a program of laboratory research. (pp. 161-162)

Henneman, therefore, set as his objective "a theoretical comparison of the two senses from the experimental psychology of visual and auditory perception..." (p. 162). From this comparison, Henneman generalized and hypothesized the following:

1. Audition is essentially a temporal sense; data received through the ears are extended in time, whereas vision is essentially a spatial sense and is therefore particularly well adapted to the presentation of spatial relations data, as by maps, diagrams, charts, and pictures. The visual sense is perhaps the only efficient medium by which the information conveyed in mathematical equations and graphic functions can be intelligibly received . . .

2. Message units presented to the observer through the auditory sense arrive sequentially, whereas

visually presented message units may be shown either simultaneously or sequentially.

3. As a result of sequential presentation, aurally presented stimuli have poor referability (i.e., they cannot be kept continuously before the observer for reference as can visual stimuli). . . . In contrast, most forms of visual presentation afford good referability because of "storage" characteristics inherent in the display. . . . The importance of referability in minimizing errors in memory is obvious.

4. Auditory stimuli possess fewer dimensions for "coding" of message data than do visual stimuli.

7. Non-language visual displays such as pictures, symbols, or instrument dials can be interrupted more rapidly than the same information could be presented in words.

The validity and degree of generalization of the above theoretical comparison of the two senses requires verification in the laboratory or in practical operation before widespread application to specific communication needs should be attempted. Indeed the chief value of such a theoretical analysis of visual and auditory perception is deemed by the present writer to be the yield of hypotheses for experimental investigation. (pp. 162-163)

Mowbray and Gebhard (1961) reviewed studies comparing the eyes and ears as information channels in relation to prose comprehension. They generalized that "for prose material that is unusually complicated or difficult, there is some evidence that a visual method of presentation is to be preferred" (p. 6). Hartman (1961), having reviewed the literature on single and multiple channel presentation of information in relation to learning, concluded, "the accumulated evidence is not sufficient to allow generalization from the studies comparing the pictorial channel with the audio and print channels" (p. 241). Hartman claimed that, "the comparisons of pictorial verbal

presentations with single channel presentations strongly indicate advantage for the combination of channels" (p. 245). Hartman specifically was concerned with learning as a function of channel modalilty and not with type of information or communication efficiency; none of the studies reviewed by Hartman have such a focus.

Menne and Menne (1972) observed, "studies designed to determine directly whether or not simultaneous bimodal presentation of highly redundant information results in better learning than single modality presentation are both scarce and inconsistent in their findings" (p. 170). Menne and Menne went on to assert that "more empirical data from controlled experimentation in at least a semi-applied setting are necessary prior to the development of a theory of relating aural versus visual, versus aural-visual, material presentation to the learning process" (p. 173).

Larson (Note 1) summarized the status of modality related research saying, "Generally, the studies which have appeared investigated the potential relationship between sensory modality and learning mode preference . . .; the bulk of the research on sensory preference and learning mode preference has focused on the implications of sensory preference for <u>reading instruction</u>" (p. 5, emphasis added). Larson reported that message content had been a variable in modality research but, in reviewing the variable, noted,

> no one has yet undertaken an examination of the relationship between preferred sensory input channel and appropriate levels of vocabulary, abstraction, organization, etc. . . . The fact that communication research has largely overlooked this area makes it

> difficult to foresee what specific implications for theory-building these questions might entail. (pp. 10-11)

Freides (1974), having reviewed the sensory modality literature in an article entitled, "Human Information Processing and Sensory Modality," generalized that "the data seem consistent with the idea that the senses are specialized for different tasks, . . . vision best suits a spatial task and . . . auditory coding best suits a temporal task" (pp. 295-296). Freides also stated, "it appears that modality plays a nonspecific role with simple information but a selective role with more complex information, actually requiring translation to the adept modality for the most proficient processing to occur. . . . Evidence suggests that modalities, at least in part, are different information processing systems" (pp. 296, 301). Taub and Kline (1976) came to the same conclusion as Freides, saying that, "while a simple sequential presentation may be optimal for auditory processing . . . performance for visual stimuli may be improved if spatial cues are provided . . . and may be optimal only with simultaneous presentations" (p. 84). McHenry (1974) argued that "visual input might complement the auditory input and result in increased comprehension and retention of the total information content of a presentation" (p. 89).

The foregoing discussion reveals that researchers have been interested in sensory modality (or sensory modality superiority) and its relation to comprehension and learning. The literature in this area does not provide an answer to questions about the relationships among type of information, modality of presentaion, and communication efficiency.

THE VIDEO TELEPHONE

It was thought that a major selling point to businesses for the purchase of a video telephone network might be the substantiation, through empirical data, of the limitations of the auditory modality by which certain business telecommunications goals might be achieved. Therefore, the video telephone literature was reviewed specifically for such empirical considerations. None of the literature raised any question about the relationship among type of information, modality of presentation, and communication efficiency.

LITERATURE REVIEW: SUMMARY

None of the literature reviewed focused on the relationship among type of information, modality of presentation and communication efficiency. Brody (1981), Cheatham (1950), Hartman (1961), Henneman (1952), Freides (1974), McHenry (1974) and Menne and Menne (1972) have all argued that empirical studies focusing on this relationship are either scarce or completely lacking. Many researchers, nevertheless, have indicated a need for such research (for example Cheatham, 1950; Day and Beach, 1950; Freides, 1974; Jakobson, 1964; McHenry, 1974; Menne & Menne, 1972; and Mowbray & Gebhard, 1961).

The purpose of this study was to investigate this relationship by seeking an answer to the question Is the efficiency of telephonic communication facilitated by providing visual supplements to the spatial and numerical information which is being discussed?

The decision to classify spatial relations and numerical

chronology type of information as a visual type of informaton and to examine these as independent variables was made after considering the generalizations, speculations and hypotheses of previous researchers. Henneman's (1952) generalized that vision is essentially a spatial sense and is therefore particularly well adapted to the presentation of spatial relations data, as by maps, and that the visual sense is perhaps the only efficient medium by which the information conveyed in mathematical equations can intelligibly be received (p. 162). Freides (1974) stated that vision bests suits a spatial task and auditory coding bests suits a temporal task (p. 295). He also speculated that the human auditory mechanism is not well constructed to handle most numerical concepts. Taub and Kline (1976) generalized that performance for visual stimuli may be improved if spatial cues are provided (p. 84). And Day and Beach (1950) hypothesized a combined visual and auditory presentation of material leads to more efficient comprehension than the presentation of either auditory or visual material alone (p. 8). (For a compilation of generalizations and hypotheses derived from the literature, see Appendix A.) From these considerations the following hypotheses were produced.

HYPOTHESES TO BE TESTED

H1 A combined visual and auditory communication task, consisting of unfamiliar spatial or/and numerical information, will be more efficient, in terms of time to agreement, than the same communication task through audition only.

From this hypothesis, the following were derived for testing:

H1a. A visual spatial supplement to the auditory discourse will be more efficient than the communication of that same information through audition only.

H1b. A visual numerical supplement to the auditory discourse will be more efficient than the communication of that same information through audition only.

H1c. A combined visual spatial and visual numerical supplement to the auditory discourse will be more efficient than the communication of that same information through audition only.

If having a combined visual and auditory presentation of material leads to greater efficiency, as Day and Beach (1950) predict, then it would seem that this efficiency should reveal itself through fewer errors being made in completing a communication task by those individuals having access to a combined visual and auditory presentation of material. Therefore, it was hypothesized that:

H2 A combined visual and auditory communication of unfamiliar spatial or/and numerical information will be more efficient, in terms of success rate, than the communication of that same information through audition only.

From this hypothesis, the following were derived for testing:

H2a. A visual spatial supplement to the auditory discourse will be more efficient, in terms of success rate, than the communication of that same information through audition only.

H2b. A visual numerical supplement to the auditory discourse will be more efficient, in terms of success rate, than the communication of that same information through audition only.

H2c. A combined visual spatial and visual numerical supplement to the auditory discourse will be more efficient, in terms of success rate, than the communication of that

same information through audition only.

If having a combined visual and auditory presentation of material leads to greater efficiency, it is reasonable to assume also that being able to see the information being talked about should cause a communicant to have more assurance in any agreements reached concerning the information. The resulting hypothesis is:

H3 A combined visual and auditory communication of unfamiliar spatial and/or numerical information will increase communicator confidence as measured immediately after completing a specific communication task and when compared to the communication of that same information through audition only.

From this hypothesis the following were derived for testing:

H3a. A visual spatial supplement to the auditory discourse will increase communicator confidence as measured immediately after completing a specific communication task when compared to the communication of that same information through audition only.

H3b. A visual numerical supplement to the auditory discourse will increase communicator confidence as measured immediately after completing a specific communication task when compared to the communication of that same information through audition only.

H3c. A combined visual spatial and visual numerical supplement to the auditory discourse will increase communicator confidence as measured immediately after completing a specific communication task when compared to the communication of that same information through audition only.

INDEPENDENT VARIABLE

The independent variable in this investigation was type of information supplemented. It was either (1) visual spatial, (2) visual numerical, or (3) visual spatial and visual numerical.

DEPENDENT VARIABLES

The dependent variables in this investigation were two: (1) communication efficiency (consisting of [a] time to agreement, and [b] success rate), and (2) communicator confidence.

Success rate was evaluated using the frequency of failure to complete the communication task per experimental condition. Communicator confidence was evaluated using a one item five choice Likert type scale.

SUMMARY

None of the literature focusing on type of information, sensory modality superiority, perception or the video telephone has addressed empirically the question raised in this investigation, though a number of researchers have called for the needed research. After reviewing the literature three specific hypotheses, with three sup-hypotheses each, were set forth for investigation.

Chapter III explains the experimental design and dependent measurements. Chapter IV explains the method of data analyis and reports the findings of the experiment. Chapter V discusses the results of the findings of Chapter IV and generalizes the conclusions with a view to further research.

CHAPTER III

EXPERIMENTAL DESIGN

This study was designed to initiate investigation on the general question: What kinds of information, visually supplemented to auditory discourse, facilitate communication efficiency? Or, Does the visual availability of information benefit the attainment of communication goals? This chapter explains the experimental design used to investigate this question and to test the hypotheses presented in the previous chapter. This discussion focuses on the experimental conditions, task, materials, subjects, setting, instructions and procedures, and dependent measurements.

EXPERIMENTAL CONDITIONS

There were four experimental conditions: audition only (E1); audition with a visual spatial supplement (E2); audition with a visual numerical supplement (E3); and, audition with both spatial and numerical visual supplements. The visual spatial supplement was in the form of a map. The visual numerical supplement was in the form of an itinerary. A Latin Square design was used in distributing the spatial and numerical supplements. For the procedures by which the materials used in the experiment were distributed and which the subjects were to follow, see Appendix C.

AUDITION ONLY: E1

In this condition, each of the subjects in each pair had one-half of the information to be communicated. Each had one of two itineraries covering a two day traveling period. Each subject also had one-half of a flight map, which included the cities to be visited by that subject. To reach agreement, the subjects had to communicate half of the numerical and spatial information to each other.

AUDITION WITH A VISUAL SPATIAL SUPPLEMENT: E2

The subjects followed the same procedures as for those in condition E1 (audition only). However, in this condition, besides each subject having one of two itineraries and one-half of a regional flight map, the subjects were given a visual supplement of the other subject's map.

AUDITION WITH A VISUAL NUMERICAL SUPPLEMENT: E3

The subjects received the same instructions as those in condition E1 (audition only). However, in this condition, each subject was given a visual supplement of the other subject's itinerary in addition to one of two itineraries and regional flight maps.

AUDITION WITH BOTH SPATIAL AND NUMERICAL VISUAL SUPPLEMENTS: E4

The subjects experienced the same instructions and procedures as those in condition E1 (audition only). However, in this condition each subject was given a visual supplement of both the other subject's itinerary and map.

TASK

As a minimum the subjects had in each experimental condition one itinerary (visual numerical chronology) and one map (visual spatial). The task of the subjects was, through the use of the telephone, to communicate with each other the avilable information store which each had until agreement was reached as to how to apply the information in order to complete the communication task. The communication task itself required that the subjects determine places and times that the two of them could meet face-to-face for a minimum of one hour on two separate days, once in one of their regions and a second time in the other's region. This was to be done without either violating the constraints of either the itineraries or flight maps, or the specific instructions of the president of the company. The subjects were also instructed to reach this agreement as quickly as possible.

MATERIALS

In order that all the necessary information to be communicated be unfamiliar to the subjects (so that any variance that might be a function of cognitive processes could be viewed as random), (a) original itineraries in the form of a numerical chronology (visual numerical) and (b) original maps in the form of a seven city flight map (visual spatial) were created to be the information store for the communication task. An explanation of how each was designed and created follows.

ITINERARIES: VISUAL NUMERICAL CHRONOLOGY

An itinerary was constructed in the form of a numerical

chronology using as the unfamiliar numbers the time references to a twenty-four hour clock. This was done on the assumption that normal society uses and is, therefore, familiar with the twelve-hour clock and because a post experiment debriefing of a pilot study indicated that less than one out of twenty subjects had expressed either familiarity with or a working knowledge of the twenty-four hour clock. The itineraries (see Appendix B) were constructed so that the numerical chronology would be equal for the communicants and would be isomorphic in terms of (1) number of days, (2) number of commitments, and (3) number of possible cancellations per day. Since there were four treatment conditions, the itineraries for each treatment condition remained the same except that the name of the starting location where the subject was to be on a particular day was changed in order to meet the requirements for a Latin Square design.

FLIGHT MAPS: VISUAL SPATIAL RELATIONS

In order to insure unfamiliarity with the spatial relations type of information to be communicated during the communication task, original maps were created for the subjects depicting fictional places (see Appendix B). Since the subjects were instructed that they had a corporate jet at their disposal and that they were to fly to their meeting places, the maps took the form of a flight map.

In order to insure that no contaminating variance might result by giving names of places with which a subject might be familiar (and therefore assume or expect that other places should be juxtaposed in various relationships), unfamiliar, unusual, and fictional names were

either created or selected from a book by John Ritchie (Note 2). The manner of selecting a name, if the book was used, was the following: first a name was selected beginning with the letter a, then a name was selected beginning with the letter b, etc., until a name was selected for each letter of the alphabet. If more names were needed the process was repeated. Each place on each map had four names, corresponding to one of four variations used in conjuction with a Latin Square design. Each map was isomorphic in the number of places depicted (seven). Each map had five places depicted within its region and two common places depicted in the central region. The numbers five and seven were chosen to keep the possible combinations of interconnecting flight patterns from becoming overly complicated. For example, the Western Region map consisted of five cities depicting the western region and two cities depicting the central region. The Eastern Region map consisted of five cities depicting the eastern region and the exact same two cities depicted for the cetral region as shown on the western region map. Each map was nearly equal in number of possible relationships and/or connections to other places. The Western region map depicted thirteen routes whereas the Eastern region map depicted twelve. (In production of the Eastern map, one route was inadvertently left off. It was not believed that this one oversight affected the design of the experiment.) Travel time between cities as depicted on the maps was given in familiar and easy numbers in order that unfamiliar numbers might not be a confounding variable in the depiction of the spatial relations information. See Appendix B for copies of the four maps used in the Latin Square design.

There were four pairs of itineraries to correspond to the four pairs of flight maps used during the experiment. A Latin Square design was used in the distribution of the materials to seek to insure the unfamiliarity of the information for the subjects. A pilot study indicated that information about the nature of the study was being communicated within the sample pool. Post experimental debriefings of the pilot study indicated that only the information concerning the names of the places where the subjects could meet was being given to other prospective subjects. Some of the subjects, therefore, knew beforehand where they had to meet, though they did not know the exact times. To seek to insure against this happening during the regular data gathering sessions, each map had four different names for each place depicted. The maps were then distributed to the four experimental conditions using a Latin Square design.

SUBJECTS

Subjects for this experiment consisted of an equal number of both male and female dyads fulfilling class requirements for the introductory psychology course (Psychology 1113) at the University of Oklahoma. Subjects were required to sign a sign-up sheet located in a central location within the psychology complex in order to participate in the experiment. As this experiment was one of many being conducted within the psychology department, the subjects were free to choose which experiment(s), at what time and place, they wished to participate. Ninety-five dyads were randomly assigned to one of four treatment conditions: audition only (E1); audition with a visual

spatial supplement (E2); audition with a visual numerical supplement (E3); and, audition with both spatial and numerical visual supplements (E4). Sixty-four dyads successfully completed the required communication task for a total N of 16 dyads per treatment condition.

SETTING

This study was conducted in a room 20 ft X 12 ft which had a 6 ft X 4 ft table near the west wall. Three chairs were placed at the table (one at each end of the table and one at the center). The table was divided in the center by a 4 ft (l) X 3 ft (h) X 6 in (w) triangular white pasteboard blind placed on top of the table. On either side of the blind and on the table in front of the chairs was a standard pushbutton Bell telephone. The third chair (for the experimenter) was on the side of the table and directly in front of the pasteboard blind. This allowed the experimenter to see the two subjects while at the same time the subjects were unable to see one another. To the right of the experimenter and immediately adjacent to the northwest corner of the table and touching the west wall was a metal bookcase 8 ft (h) X 6 ft (l) X 1 ft (w). The bookcase shielded from the sight of the subjects the equipment used during the course of the experiment. The two Bell telephones were connected to a Southwestern Bell teletrainer[1]. Connected to the teletrainer was a Califone Model 3420 cassette tape recorder.

INSTRUCTIONS AND PROCEDURES

When ready, the dyad was asked to enter the experimental room and

to take a seat at the table on either side of the pasteboard blind. The experimenter had the subjects fill out cards which would insure that the subjects received credit for their participation in the experiment. When these preliminary procedures were completed, the experimenter began, by means of an auditory explanation, to prepare the subjects for their part in the experiment. The instructions and procedures used by this experimenter and which the subjects were to follow, are explained in detail in Appendix C.

DEPENDENT MEASUREMENTS

TIME TO AGREEMENT

When the telephone was rung to begin the communication task a tape recorder and a stopwatch was started. As soon as the subjects agreed to a first meeting time and place, completed the "Recommeded Meeting" form, and indicated through their discussions that they were ready to go on to determine the next day's meeting time and place, a time reading was taken to the nearest second. When the subjects agreed upon the second meeting time and place and again completed the "Recommended Meeting" form, a second time to the nearest second was taken for the subjects. As soon as the subjects indicated to one another that they were through with their discussions and hung up the telephones, a final time was taken to the nearest second.

Since there were only two agreements to the communication task, the dependent measures of interest in this study were time to the first agreement and time to the second agreement. Time to overall completion of the task (because of potential "social" amenities) was

not considered as a dependent measure.

Only those subjects who successfully completed the communication task in each treatment condition were analyzed for time-to-agreement. Successful completion of the communication task required that the time and place of meeting for both days be completely accurate. Subjects who failed to complete accurately the communication task were not used in evaluating time to agreement. These subjects were used to evaluate success rate.

SUCCESS RATE

The subjects who failed to complete accurately the communication task were used to evaluate success rate. Success rate was examined by comparing the proportion of communication task failures for each treatment condition to the criterion of sixteen successes per treatment condition.

COMMUNICATOR CONFIDENCE

After the subjects had hung up their telephones, and their "Recommended Meeting" forms were collected, they were asked to complete a one item five interval post task questionnaire in the form of a Likert type scale (see Appendix C). This was done in order to measure the degree of confidence which the subjects had in their own accuracy in performing the communiction task correctly. After the subjects completed the questionnaire, the experimental procedures continued as explained in Appendix C.

SUMMARY

This chapter explained the experimental method used to seek to answer the question, "Is the efficiency of telephonic communication facilitated by providing visual supplements to the spatial and numerical information which is being discussed?" This chapter discussed the experimental conditions, task, materials, subjects, setting, instructions and procedures, and dependent measurements.

Chapter IV explains the method used to analyze the data and reports the findings. Chapter V discusses the findings and conclusions, and discusses possible future research.

CHAPTER IV

ANALYSIS OF DATA

The dependent variables analyzed in this investigation were (1) communication efficiency, comprised of (a) time to agreement and (b) success rate, and (2) communicator confidence. Time to agreement, in addition, consisted of two measures: (1) the time needed to reach a first agreement (T1) and (2) the total time needed to reach a second agreement (T2). An explanation of the method used to analyze time to agreement, success rate and communicator confidence and a report of the findings follows.

METHOD OF ANALYSIS

The .05 level of confidence was set for all tests.

COMMUNICATION EFFICIENCY

Time(s) To Agreement: T1, T2

A 2 X 2 ANOVA (numerical, without or with a visual supplement, by spatial, without or with a visual supplement) was used to examine communication efficiency in terms of (1) the time needed to reach a first agreement (T1) and (2) the total time needed to reach a second agreement. Appendix D lists the raw scores and provides a summary of the various measurements. Table I is an analysis of variance table for the T1 scores. Table II is an analysis of variance table for the T2 scores. Table III is a summary of the T1 and T2 scores. Table IV

is the Newman-Keuls table of Q for the time to reach a first agreement, T1. Table V is the Newman-Keuls table of Q for the time to reach a second agreement, T2.

Success Rate

A Chi Square was used to test for the significance of the difference between porportions with a view to success rate. Table VI is a 2 X 2 contingency table and lists the raw data scores for the Chi Square analysis of success rate.

COMMUNICATOR CONFIDENCE

A 2 X 2 ANOVA (numerical, without or with a visual supplement, by spatial, without or with a visual supplement) was used to evaluate communictor confidence. Table VII is an analysis of variance table for the communicator confidence scores. Table VIII is a summary of the communicator confidence scores. Table IX is the Newman-Keuls table of Q for the communicator confidence scores.

RESULTS: COMMUNICATION EFFICIENCY

TIME(S) TO AGREEMENT: T1, T2

The Spatial Supplement

A main effect for the visual spatial supplement for T1 is revealed in Table I, $F(1,60) = 5.42$, and the main effect for the viusal spatial supplement for the total time needed to reach a second agreement, T2, as revealed in Table II, approached significance, $F(1,60) = 3.12$, $p. < .10$. The Newman-Keuls method of multiple comparisons was used to test for a significant difference among the

group means. Inspection of Table IV reveals no significanct difference among the group means for the time needed to reach a first agreement (T1). A significant difference was approached, however, between the means for groups 2 and 3, Q = 3.45, p. < .10. Inspection of Table V reveals no significant difference among the group means for the time needed to reach a second agreement (T2). Again, however, a significant difference was approached between the means for groups 2 and 3, Q = 3.37, p < .10.

The Numerical Supplement

An examination of Table I and Table II shows that there were no effects involving the visual numerical supplement. An examination of the means in Table III reveals that, if anything, the addition of a numerical supplement increased the time needed to reach an agreement.

SUCCESS RATE

An examination of Table VI reveals that the frequency of failure to reach an N = 16 was almost equal for the four experimental conditions. A Chi Square analysis produced a $X^2 = 0.03$. A $X^2 = 3.84$ (df = 1) was required to reach significance at the .05 level of confidence.

RESULTS: COMMUNICATOR CONFIDENCE

An examination of Table VII indicates a signficant F for communicator confidence, F (3, 60) = 4.62, p. < .01. Table VII also shows a significant main effect for the numerical visual supplement, F (1, 124) = 12.12, p. <. 01. The Newman-Keuls method of multiple

comparisons was used to test for a significant difference among the group means. Table IX shows a significant difference between the means for groups 1 and 4, $Q = 3.78$, $p. < .05$; and 2 and 4, $Q = 4.92$, $p. < .01$.

POST HOC DATA ANALYSES

This researcher observed that the subjects who had both the spatial and numerical information visually supplemented (E4) appeared not to use the telephone to talk with one another in the performance of their communication task. It appeared that these subjects were performing the communication task on their own and then confirming what they had done with the other subject. If the subjects having all the information visually supplemented were performing the communication task on their own, then it should be demonstrable that their performance, or resolution times, should not differ from a separate group of subjects who had to perform the same communication task but without the benefit of talking to another. In order to test this possibility, single subjects were randomly selected to perform the same communication task as the subjects having all of the informaion supplemented (E4), but without the benefit of talking to another subject (E5). Appendix E lists the raw scores and provides a summary of the various measurements taken. Table X reports the results of Student's *t* statistic used to compare the T1 and T2 times for these two groups. No significant differences are revealed. Table XI reports the results of a Student *t* statistic used to compare communicator confidence for these two groups. No significant

difference is revealed. Twelve failures were observed for the singles group. A Chi Square was performed to test for the success rate between the two groups. A significant Chi Square was obtained, X^2 (df = 1) = 5.00, p. < .05.

Table XII reports the findings of Student's t statistic used to determine if learning had an efficiency effect for the subjects once they had arrived at a first agreement. This research did not focus on learning or on a learning effect. But one might wondered whether learning had an influence on the time required to arrive at a second agreement once the first agreement was reached, thus affecting communication efficiency. To examine this possibility, the time required to reach the first agreement (T1) was subtracted from the total time needed to reach a second agreement (T2), and this mean time (T2-T1) was compared to the mean time required to reach a first agreement (T1) for that group. Table XII shows that if there was any learning during the time in which it took the subjects to reach a first agreement, this learning did not affect or influence the time required to reach a second agreement.

The results reported in this chapter are discussed in detail in Chapter V. Chater V also relates these findings to the generalizations of previous investigators and indicates possible avenues for future research.

TABLE I

ANALYSIS OF VARIANCE TABLE FOR

TIME TO FIRST AGREEMENT: T1

SOURCE	DF	SS	MS	REQUIRED#	F
BETWEEN	3	851589.8	283863.27	2.76	2.25+
SPATIAL	1	683722.0	683722.00	4.00	5.42*
NUMERICAL	1	159699.8	159699.80	4.00	1.27
SPAT X NUM	1	8168.0	8168.00	4.00	0.06
WITHIN	60	7565698.5	126094.98		

\# At the .05 level of confidence.
* Significant beyond the .05 level of confidence.
\+ Significant beyond the .10 level of confidence.

TABLE II

ANALYSIS OF VARIANCE TABLE FOR

TIME TO SECOND AGREEMENT: T2

SOURCE	DF	SS	MS	REQUIRED#	F
BETWEEN	3	2204585.7	734861.9	2.76	2.32+
SPATIAL	1	988533.1	988533.1	4.00	3.12+
NUMERICAL	1	816312.5	816312.5	4.00	2.58
SPAT X NUM	1	399740.1	399740.1	4.00	0.06
WITHIN	60	18986628.0	316443.8		

\# At the .05 level of confidence.
\+ Significant beyond the .10 level of confidence.

TABLE III

MEAN SCORES:

TIME TO FIRST AGREEMENT (T1) AND TIME TO SECOND AGREEMENT (T2)

	T1				T2			
	E1	E2	E3	E4	E1	E2	E3	E4
$\bar{X}^*$	611.8	382.5	689.1	505.0	1088.1	681.4	1155.9	1065.4
EX	9789	6120	11026	8080	17409	10903	18494	10746
N	16	16	16	16	16	16	16	16
$\bar{X}^+$	10.2	6.4	11.5	8.4	18.1	11.4	19.3	17.8

* = Mean in seconds
+ = Mean in minutes

KEY: AUDITION

E1: Only;
E2: With a spatial supplement;
E3: With a numerical supplement;
E4: With combined visual supplements.

TABLE IV

NEWMAN-KEULS METHOD OF MULTIPLE COMPARISONS

TABLE OF Q FOR TIME TO FIRST AGREEMENT (T1)*

	E3	E1	E4	E2
E3		0.87	1.84	3.45
E1			1.20	2.58
E4				1.37
E2				

* required for significance at the .05 level of confidence = 3.74.

KEY: AUDITION

E1: Only,
E2: With a spatial supplement
E3: With a numerical supplement
E4: With combined visual supplements.

MEAN =

E1: 611.8
E2: 382.5
E3: 689.1
E4: 505.0

$s_{\bar{X}}$ = 88.77

TABLE V

NEWMAN-KEULS METHOD OF MULTIPLE COMPARISONS

TABLE OF Q FOR TIME TO SECOND AGREEMENT (T2)*

	E3	E1	E4	E2
E3		0.48	0.64	3.37
E1			0.16	2.89
E4				2.73
E2				

* required for significance at the .05 level of confidence = 3.74.

KEY: AUDITION

E1: Only,
E2: With a spatial supplement
E3: With a numerical supplement
E4: With combined visual supplements.

MEAN =

E1: 1088.1
E2: 681.4
E3: 1155.9
E4: 1065.4

$s_{\bar{X}}$ = 140.63

TABLE VI

CONTINGENCY TABLE

FOR

CHI SQUARE ANALYSIS OF SUCCESS RATE*

		SPATIAL 0	SPATIAL 1
NUMERICAL	0	E1: 9	E2: 8
	1	E3: 7	E4: 7

* Frequency = number of failures to reach a criterion for N = 16.

$X^2 = 0.03$

KEY: AUDITION

E1: Only;
E2: With a spatial supplement;
E3: With a numerical supplement;
E4: With combined visual supplements.

TABLE VII

ANALYSIS OF VARIANCE TABLE

FOR

COMMUNICATOR CONFIDENCE

SOURCE	DF	SS	MS	REQUIRED#	F
BETWEEN	3	9.1562	3.052	2.70	4.62**
SPATIAL	1	0.0312	0.031	3.94	0.05
NUMERICAL	1	8.0000	8.000	3.94	12.12**
SPAT X NUM	1	1.1250	1.125	3.94	1.70
WITHIN	124	82.0600	0.660		

\# At the .05 level of confidence.
** Significant beyond the .01 level of confidence.

TABLE VIII

COMMUNICATOR CONFIDENCE

Raw Scores With Summaries*

	E1	E2	E3	E4
Score	fr	fr	fr	fr
1	0	0	0	0
2	1	0	1	3
3	7	5	13	11
4	12	14	10	15
5	12	13	8	3
$\overline{X}$	4.09	4.25	3.78	3.56
EX	131	136	121	114
EX^2	559	594	481	426
N	32	32	32	32

* Maximum score possible = 5.
Minimum score possible = 1.

KEY: AUDITION

E1: Only;
E2: With a spatial supplement;
E3: With a numerical supplement;
E4: With combined visual supplements.

TABLE IX

NEWMAN-KEULS METHOD OF MULTIPLE COMPARISONS

TABLE OF Q FOR COMMUNICATOR CONFIDENCE

	E4	E3	E1	E2
E4		1.57	3.78*	4.92**
E3			2.21	3.35
E1				1.14
E2				

* significant beyond the .05 level of confidence.
** significant beyond the .01 level of confidence.

KEY: AUDITION

E1: Only,
E2: With a spatial supplement
E3: With a numerical supplement
E4: With combined visual supplements.

MEAN =

E1: 4.09
E2: 4.25
E3: 3.78
E4: 3.56

$s_{\bar{x}} = 0.14$

TABLE X

TIME TO AGREEMENT: T1, T2

DYADS WITH COMPLETE VISUAL SUPPLEMENTS (E4)

COMPARED TO

SINGLES WITH COMPLETE VISUAL SUPPLEMENTS (E5)

	T1		T2				t value	
	E4	E5	E4	E5	alpha	Required	T1	T2
$\bar{X}^*$	505	668	1065	1103	.05	+/-2.042	-1.49	0.20
EX	8080	10689	17046	17648				
N	16	16	16	16				
$\bar{X}^+$	8.4	11.1	17.8	18.4				

* = Mean in seconds
\+ = Mean in minutes

TABLE XI

COMMUNICATOR CONFIDENCE

DYADS WITH COMPLETE VISUAL SUPPLEMENTS (E4)

COMPARED TO

SINGLES WITH COMPLETE VISUAL SUPPLEMENTS (E5)

	E4	E5	Alpha	Required	t
EX	114	62	.05	+/- 2.021	-1.21
EX^2	426	254			
N	32	16			
$\overline{X}$	3.56	3.88			

TABLE XII

POST HOC ANALYIS OF MEANS

FOR

TIME TO FIRST AGREEMENT (T1)

COMPARED TO

TIME FROM FIRST TO SECOND AGREEMENT (T2 -T1)

	$\bar{X}$						
COND	T1	T2 - T1	HYP	ALPHA	REQUIRED	t VALUE	DECISION
E1	611.8	476.2	H_o	.05	+/-2.042	1.19	ns
E2	382.5	298.9	H_o	.05	+/-2.042	1.39	ns
E3	689.1	466.8	H_o	.05	+/-2.042	1.41	ns
E4	505.0	560.4	H_o	.05	+/-2.042	-0.50	ns

KEY: AUDITION

E1: Only;
E2: With a spatial supplement;
E3: With a numerical supplement;
E4: With combined visual supplements.

CHAPTER V

SUMMARY AND CONCLUSIONS

This investigation sought to provide an empirical basis by which to begin to answer the general question, Does the visual availability of information benefit the attainment of communication goals? To begin to answer this quesion, a more specific question was asked, namely, Can information be classified according to communication modality and, if so, what kinds of information, visually supplemented to auditory discourse, facilitate communication efficiency? The specific question raised in this study, for which an empirical answer was sought, was, Is the efficiency of telephonic communication facilitated by providing visual supplements of the spatial and numerical information being discussed? Another objective in seeking to answer the questions above was to provide evidence that could be used in answering Henneman's (1952) question: "Do the eyes or ears afford the more efficient sensory channel through which to present information?" (p. 161). The findings of this investigation also could be viewed as providing data for theorizing about the modal specificity of certain types of information (see Freides, 1974). Birch (1963) and Gibson (1969) have argued that information processing is amodal, whereas Freides (1974) has suggested that certain sensory modalities may be more "adept" at certain types of information processing. The following, therefore, is a discussion of the findings reported in the

previous chapter, and is followed by a discussion of the post hoc considerations which were raised. The conclusions derived from the data and how these conclusions relate to the observations of earlier writers is then discussed. This is followed by a discussion of the the limitations of this investigation. Finally, this chapter concludes by relating the findings and conclusions of this investigation to the knowledge that still needs to be explored in order that human communication behavior might more fully be understood.

DISCUSSION

The hypotheses of this investigation stated that a combined visual and auditory communication of unfamiliar spatial and/or numerical information would be more efficient (in terms of the time needed to reach agreement and success rate) and would produce higher confidence scores than the communication of that same information through audition only. The findings of this investigation, as reported in the previous chapter, warrant the following summary for communication efficiency and communicator confidence.

THE SPATIAL SUPPLEMENT

A main effect for the spatial supplement indicates that compared to a numerical supplement, having a spatial supplement increases communication efficiency when measured by the need to reach an agreement. The following summarizes the specific conclusions for the spatial supplement.

1. The Spatial Supplement Only Compared to Audition Only

   Compared to audition only, having only the spatial relations information visually supplemented had no effect either on the time needed to reach an agreement, success rate or communicator confidence.

2. The Spatial Supplement Only Compared to the Numerical Supplement Only

   Having only the spatial relations information visually supplemented had no effect either on the time needed to reach an agreement, success rate, or communicator confidence.

3. The Spatial Supplement Only Compared to Combined Supplements

   Having the spatial relations information visually supplemented had no effect either on the time needed to reach an agreement or on success rate. Communicator confidence ratings, however, were significantly increased.

THE NUMERICAL SUPPLEMENT

No significant main effect was revealed for the numerical supplement affecting the time needed to reach an agreement. A significant main effect was revealed for the communicator confidence scores. This effect, however, was in the opposite direction to that predicted. Having a numerical supplement had the effect of significantly lowering communicator confidence ratings. The following summarizes the specific conclusions regarding the numerical supplement.

4. The Numerical Supplement Only Compared to Audition Only

   Compared to audition only, having only the numerical chronology type of information visually supplemented had no effect either on the time needed to reach an agreement, success rate or communicator confidence.

5. The Numerical Supplement Only Compared to Combined Supplements

Having the numerical chronology type of information visually supplemented had no effect either on the time needed to reach an agreement, success rate, or communicator confidence ratings.

COMBINED SUPPLEMENTS

Having combined supplements significantly decreased communicator confidence, but had no effect on success rate or the time needed to reach an agreement. The following summarizes the conclusions for having combined supplements.

6. Combined Spatial and Numerical Supplements Compared to Audition Only

Compared to audition only, having both the spatial relations and numerical chronology type of information visually supplemented had no effect either on the time needed to reach an agreement, or on success rate. Communicator confidence ratings, however, were significantly lowered.

POST HOC QUESTION

The findings of this investigation showed that having the spatial relations type of information visually supplemented significantly increased communication efficiency when measured by the time needed to reach an agreement. A post hoc question arose as to why the subjects who had both the spatial relations and numerical chronology type of information visually supplemented had a less efficient mean time to agreement than those subjects who had only the spatial relations information visually supplemented. Looked at from one viewpoint, the subjects having both the spatial relations and the numerical chronology types of information visually supplemented had an identical

communication task as those having only the spatial relations or numerical chronology type of information visually supplemented, except for an additional visual supplement. When this additional visual supplement was added, the mean time to agreement was increased as compared to those having only the visual spatial supplement.

Two possible explanations may account for this finding. First, the numerical supplement may have attenuated the time needed to reach an agreement. Second, the communicants may have undertaken to resolve the communication task on their own, independently of the other subject, while at the same time giving only the appearance of talking with the other subject by having the other subject confirm what they had resolved. If this second observation is tenable, then it should be true that a group of individuals having all the information and working independently on the same communication task, instead of in dyads, should not differ in their completion times from the group of dyads having all of the information visually supplemented and able to talk with one another.

To test this possibility, a separate group of sixteen subjects was examined in accordance with all the experimental procedures for those given all of the visual supplements, except that the instructions were altered to take into account the fact that the subjects would not be talking to to one another. The data from this inquiry reveal that the group of subjects who undertook the communication task alone, did not differ from the group of dyads having the total information store visually supplemented. This was true for both the time needed to reach an agreement and for

communicator confidence. However, the failure rate was significantly increased, or almost doubled (12 as compared to 7). It is possible, therefore, that the individuals of a dyad, having all of the information store visually supplemented, may not have relied or depended upon one another during the communication task. It may be that the subjects simply resolved the communication task independently and only sought confirmation from the other. If this did happen, then no dependent, interactive and mutual exchanging of the information occurred. Thus, time to agreement, (more quickly achieved by those having the spatial relations information visually supplemented and in which dependent interaction was required), may have been attenuated. Another possible explanation for the above is that having two types of information visually supplemented may involve a different type of communication task from having only one type of information visually supplemented, thus the attenuation.

Since the subjects who had all of the information visually supplemented did not differ in the mean time it took them to reach an agreement when compared to subjects working alone, it is possible that only those communicative situations in which the communicants must rely on one another for the necessary information, will the mean time to agreement be lowered.

CONCLUSIONS

The findings of this inquiry can now be related to the generalizations of Day and Beach (1950), Freides (1974), Hartman

(1961), Henneman (1952), Menne and Menne (1972), and Taub and Kline (1976). The generalizations of these researchers focused primarily on communication efficiency. In this investigation communication efficiency was measured in terms of time to agreement and success rate in completing a communication task. Conclusions that can be drawn concerning success rate are first discussed followed by the conclusions that can be drawn concerning the time needed to reach an agreement and communicator confidence. These conclusions are discussed in terms of the effect of (1) the spatial supplement, (2) the numerical supplement, and (3) combined spatial and numerical supplements.

Success Rate

The number which failed to complete accurately the communication task was nearly equal for each experimental condition (9,8,7,7). No significant difference was found for success rate. While it was expected that those having a visual supplement would make fewer errors than those not having a visual supplement, this expectation clearly was not supported by the data. Perhaps the reason why no difference in success rate occurred can be explained by a randomly and normally distributed variable classified as inattentiveness, or non-attention to detail. Many of the failures occurred when one of the subjects did not take into account that for the second agreement the starting location was different from that of the first. This error affected both the times and places which the subjects could meet. Another error ocurred when one of the subjects had to rely on the information

of the other subject who had misinterpreted his information in some way. These types of error appear to have been randomly and normally distributed.

The Visual Spatial Supplement Only

Freides (1974) generalized that "vision best suits a spatial task . . . auditory coding bests suits a temporal task" (pp. 295-296). Henneman (1952) stated that "vision is . . . particularly well adapted to the presentation of spatial relations data" (p. 162) and that "non-language visual displays . . . can be interpreted more rapidly than the same information could be presented in words" (p. 163). Taub and Kline (1976) believed that, "performance for visual stimuli may be improved if spatial cues are provided" (p. 84). This research has shown that visually supplementing spatial relations information, in the form of a map, significantly decreased the time needed to reach an agreement. This finding supports the proposition that certain types of information are particularly suited for vision and affect communication efficiency. These data provide support for the generalizations of Freides (1974), Henneman (1952), and Taub and Kline (1976).

The evidence produced in this study also support the proposition that certain sensory modalities may be applied more adeptly to certain types of information processing tasks as claimed by Freides (1974, see Appendix A). The data from this study show that having the spatial relations type of information visually supplemented was more efficient than having either no supplements or having the numerical chronology

type of information visually supplemented.

Confidence that the communication task was achieved correctly was not significantly different from audition only, but was significantly higher when compared to having both types of information visually supplemented.

The Numerical Supplement Only

Day and Beach stated that "a combined visual and auditory presentation of material leads to more efficient comprehension than the presentation of either auditory or visual material alone" (p. 8). This research has shown that visually supplementing the numerical chronology type of information, in the form of an itinerary, had no effect on the time needed to reach an agreement. If anything, having the numerical chronology type of information visually supplemented attenuated communication efficiency.

Though visual material alone or comprehension was not a design of this experiment, the findings from this undertaking suggest that the generalization of Day and Beach (1950) should be viewed with caution. The data from this inquiry suggest that whether a combined visual and auditory presentation of material is more efficient depends upon the type of material being visually supplemented. For an auditory task requiring the discussion of unfamiliar numerical chronology type of information, communication efficiency may be attenuated if the unfamiliar numerical chronology type of information is visually supplemented during the course of the communication task.

The subjects who had only the numerical chronology type of

information visually supplemented had to communicate, auditorily, the spatial relations type of information. The data show that having the spatial relations type of information visually supplemented facilitates communication efficiency, and that visually supplementing the numerical chronology type of information attenuates communication efficiency. One could ask, therefore, whether the attenuation was caused by having to talk about the spatial relations type of information without the benefit of seeing it, or by having to talk about the numbers. Difficulty in communicating the spatial relations type of information does not appear to be the source of the attenuation. The subjects who had no visual supplements were able to communicate both the numerical chronology and spatial relations type of information more quickly, but not significantly so, than those having only the numerical chronology type of information visually supplemented. Visually supplementing the numerical chronology type of information, therefore, appears to have produced the attenuation.

Again, confidence that one has correctly achieved the communication task appears to be related to the type of information being communicated and visually supplemented. When the numerical chronology type of information was visually supplemented, the mean communicator confidence score was lowered.

Combined Visual Spatial and Visual Numerical Supplements

Menne and Menne (1972) generalized, "when stimuli are complex, the input may cause an overload on the attention span, resulting in the S's selective focusing attention on that modality most effective

for him in the given situation" (p.172). The data from this research indicate that this generalization needs to be reconsidered. If an "overload" did occur among the subjects having both types of information visually supplemented, then, according to Menne and Menne, the subjects should have focused their attention on that modality most effective for them in the given situation. The data obtained from this study support the proposition that the visual modality is the more efficient modality for communicating spatial relations type of information. The data also show that the auditory modality was more efficient for communicating the numerical chronology type of information. According to Menne and Menne, the subjects should have focused their attention on that modality most effective for them in the given situation. Had the subjects done this, they then would have ignored the visual numerical chronology supplement and would have communicated this information auditorily. The mean time to agreement for these subjects would then be similar to those subjects having only the visual spatial supplement. As it was, the mean time to agreement for those having both types of information visually supplemented was higher compared to those having only the spatial supplement and was not significantly different from those having the numerical chronology type of information visually supplemented.

Confidence, however, that the communication task was correctly performed, was significantly affected by the type and amount of information visually supplemented. A significant lower confidence mean was revealed when compared to audition only. A significant lower confidence mean was also revealed when compared to those having only

the spatial relations type of information visually supplemented. Why confidence should be lowered when all of the available information is provided presents an interesting question. This may be explained, perhaps, by noting that when the subjects had all of the information available to them, they may have recognized that in the final analysis they were solely responsible for any outcome. If a mistake was made, it could not reflect, or be attributed to, the other participant. No excuse could be offered for not being aware of something, since all of the information was available to that individual. These people, therefore, may not have trusted too highly their own judgments, especially as compared to trusting another's judgments when that person had the necessary and otherwise unavailable information. When the subjects did not have all of the available information and had to rely on one another, the subjects may have felt more assurance in the accuracy of the outcome because they had to believe and trust in the other person's handling of that information. There was no signficant difference in confidence, however, when dyads having two visual supplements were compared to single individuals having all the information visually supplemented. This finding supports the idea that when a person must rely and trust only in himself, his confidence may be diminished. When a person, however, is placed in a position which requires that trust and reliance must be placed in another, confidence, by comparison, appears to be enhanced.

The findings of this study favor a proposition that having all of the (total) information available, or visually supplemented, may significantly attenuate communicator confidence when measured

immediately after completing a communication task. The findings also support the conclusion that time to agreement and communicator confidence should be viewed as a function three variables: (1) type of information being communicated (i.e., spatial, numerical, etc.), (2) modality of communication (i.e., audition only or a combination of both), and (3) amount of the total information store available to the communicants (i.e., 1/2, 3/4 or all, etc.).

LIMITATIONS OF THE INVESTIGATION

Henneman (1952) stated that "the visual sense is perhaps the only efficient medium by which information conveyed in mathematical equations and graphic functions can be intelligibly received" (p. 162). This investigation used numbers in the form of a numerical (twenty-four hour clock) chronology. No support can be provided for Henneman's proposition from the findings of this research. The findings of this investigation suggest that numbers, when used nominally, or as names, may be a temporal, or auditory, type of information. Numbers may be auditory in the sense that they may reference either discrete concepts or a linear function. If the concept of time represents a linear function, as it does, then the concept of time is temporal and not visual. Numbers in the form of mathematical equations, as Henneman suggests, may be a visual type of information. The design of this experiment did not address numerical information in the form of mathematical equations.

FUTURE DIRECTIONS

This research demonstrated that visually supplementing spatial relations type of information to telephonic discourse enhanced communication efficiency. This study also showed that visually supplementing either too much information, or the wrong kind of information had a debilitating effect upon communication efficiency and significantly lowered communicator confidence. Future research, therefore, should seek to delineate and to catalogue the type of information which actually may be visual in nature, though such information may have an auditory language counterpart.

Exactly how many visual supplements may be too much also needs clarification. Visually supplementing more than one type of information, as in this investigaton, resulted in a situation that tended to negate the efficiency effect of having the spatial relations type of information visually supplemeted. It may be that supplementing two or three types of what may be classified as a visual type of information may not produce a debilitating effect upon either communication efficiency or communicator confidence, but may rather enhance both. Future research, therefore, should seek to clarify this issue.

It has been suggested that the efficiency effect for those having the spatial relations information visually supplemented may have been the result of aligning type of information with the appropriate modality (i.e., the spatial relations information was seen by the eyes while the numerical chronology type of information, not being a visual, but

temporal, type of information, was heard by the ears). It is also possible that the efficiency effect for those having the spatial relations type of information visually supplemented may have been a function of the organizing characteristics of the numerical chronology type of information. The communicants may have felt constrained to communicate with each other according to this (numerical) chronological order. Thus the task actually may have structured or organized the information for the communicants and, thereby, may have facilitated the interactive exchange of the information. Future research should clarify the effect of structuring or organizing characteristics on communication efficiency.

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FOOTNOTES

1. A Southwestern Bell teletrainer is a devise that allows two telephones to be connectd directly to simulate a telephone link without actually using normal telephone lines. The telephones are connected to a small box-like device which in turn connects to a standard 110v - 125v wall socket. Once the telephones are connected and the power turned on, simulated dial tones and telephone rings can be produced by means of switches on the box-like mechanism. Also, earphones or a tape recorder can be connected to the box-like mechanism to allow the listening to or the recording of the telephone conversations.

2. The only question that was not immediately answered to the subjects satisfaction at this time was the predictable question, "How well did we do -- Did we get them all right?" To this, the general answer was, "I cannot at this time answer THAT question for you. However, as soon as the experiment is completed I will post on the sign-up board all possible meeting times and places. At THAT time I will be happy to review with you, if you wish and if you have forgotten, exactly how well you did. Do you understand WHY I cannot at this time tell you how well you did?" When the subjects understood why, they were quite satisfied with this response.

APPENDIX A

GENERALIZATIONS AND HYPOTHESES

(Derived From The Literature)

DAY & BEACH (1950)

A. A combined visual and auditory presentation of material leads to more efficient comprehension than the presentation of either auditory or visual material alone . . . .

B. Meaninful material is more efficiently presented aurally, whereas meaningless unfamiliar material is more efficiently presented visually . . . .

C. Unusually difficult material is more effectively received with a visual presentation, whereas particularly easy material is better understood with an auditory presentation.

D. The relative effectiveness of the visual presentation increases with increasing difficulty of the material . . . .

E. Such organized and related material as prose or factual information is better understood with an auditory presentation.

F. Material such as code that is comparatively discrete and unrelated is more effectively received with a visual presentation . . . .

G. The less referability afforded by a visual presentation system the less is its advantage over an auditory presentation.

H. The most significant advantage of a visual type presentation system is the relative referability, or opportunity for reviewing the material that it affords.

FREIDES (1974)

I. With complex information (spatial or temporal patterns) specific modalities are adept with certain kinds of information.

J. Vision best suits a spatial task ... auditory coding best suits a temporal task.

K. Evidence suggest modalities are different processing systems.

L. Modality plays a nonspecific role with simple information but a selective role with more complex information, actually requiring translation to the adept modality for the most proficient processing to occur.

HARTMAN (1961)

M. Comparison of pictorial verbal presentations with single channel presentations strongly indicate advantage for the combination of channels.

HENNEMAN (1952)

N. Vision is ... particularly well adapted to the presentation of spatial relations data . . . .

O. The visual sense is perhaps the only efficient medium by which information conveyed in mathematical equations and graphic functions can be itelligibly received.

P. Aurally presented stimuli have poor referability.

Q. Most forms of visual presentation afford good referability because of 'storage' characteristics inherent in the display.

R. Non-language visual displays such as pictures, symbols, or instrument dials can be interpreted more rapidly than the same information could be presented in words.

LARSON (1973)

S. No one has yet undertaken an examination of the relationship between preferred sensory input channel and appropriate levels of vocabulary, abstraction, organization, etc., in discourse.

McHENRY (1974)

T. Visual input might complement the auditory input and result in increased comprehension of the total content of the presentation.

MENNE & MEENE (1972)

U. When stimuli are complex, the input may cause an overload on the attention span, resulting in the S's selective focusing attention on that modalilty most effective for him in the given situation.

MOWBRAY & GEBHARD (1961)

V. For prose material that is unusually complicated or difficult . . . a visual method of presentation is to be preferred.

TAUB & KLINE (1976)

W. Performance for visual stimuli may be improved if spatial cues are provided . . . and may be optimal only with simultaneous presentations.

APPENDIX B

SAMPLES OF THE

ITINERARIES AND REGIONAL FLIGHT MAPS

SUPPLEMENTED TO THE TELEPHONIC DISCOURSE

ITINERARY

for

WESTERN REGION VICE PRESIDENT

OCTOBER 26: President cannot meet this day.

OCTOBER 27: HUGGMUGGER (or FERRARI or ADRIA or CHISLEU)

0710 - 0820	Breakfast: Chamber of Commerce	(can be cancelled)
0820 - 0935	Inspection	
0935 - 1150	Management meeting	(can be cancelled)
1150 - 1305	Lunch: Lion's club	
1305 - 1635	Inspection	
1635 - 1800	Tour of city	(can be cancelled)

OCTOBER 28: President cannot meet this day.

OCTOBER 29: APPHIA (or ELIADA or FORTUNATUS or GEDALIAH)

0800 - 0905	Management meeting	(can be cancelled)
0905 - 1135	Inspection	
1135 - 1305	Lunch: Lion's club	(can be cancelled)
1305 - 1450	Inspection	
1450 - 1800	Tour of city	(can be cancelled)

OCTOBER 30: President cannot meet this day.

ITINERARY

for

EASTERN REGION VICE PRESIDENT

OCTOBER 26: President cannot meet this day.

OCTOBER 27: GUNZUI (or QUARTERNION or REZIA or SHASHAI)

0800 - 0910	Tour of city	(can be cancelled)
0910 - 1240	Chamber of commerce	(can be cancelled)
1240 - 1335	Lunch: Lion's Club	(can be cancelled)
1335 - 1455	Management meeting	
1455 - 1720	Inspection	
1720 - 2030	Reception/Dinner: Elk's Club	

OCTOBER 28: President cannot meet this day.

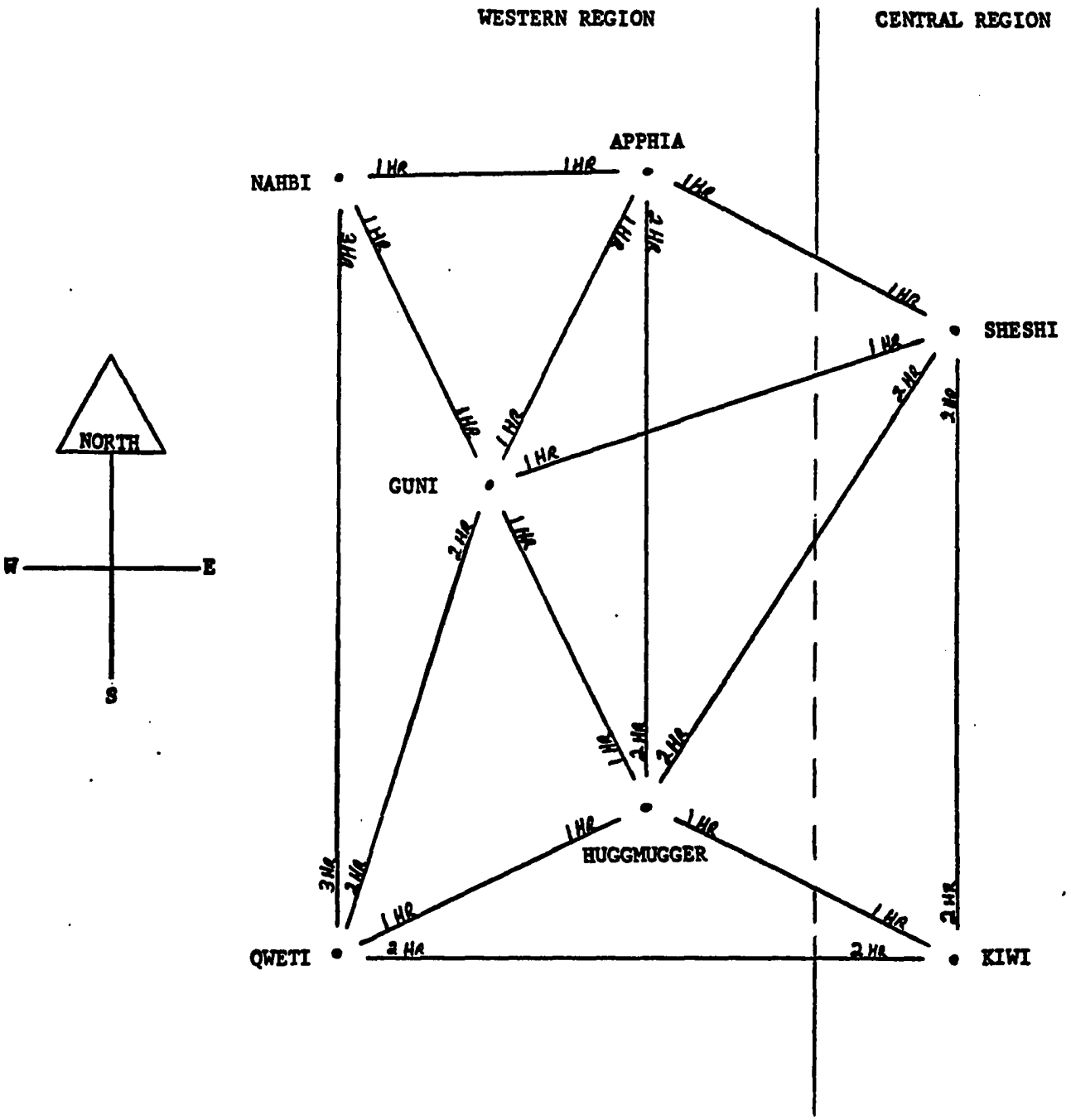
OCTOBER 29: FAGUCI (or HABAZINIA or ISHMERAI or JAHDAI)

0800 - 0925	Management meeting	(can be cancelled)
0925 - 1150	Inspection	
1150 - 1350	Lunch: Elk's Club	(can be cancelled)
1350 - 1535	Inspection	
1535 - 1800	Tour of city	(can be cancelled)

OCTOBER 30: President cannot meet this day.

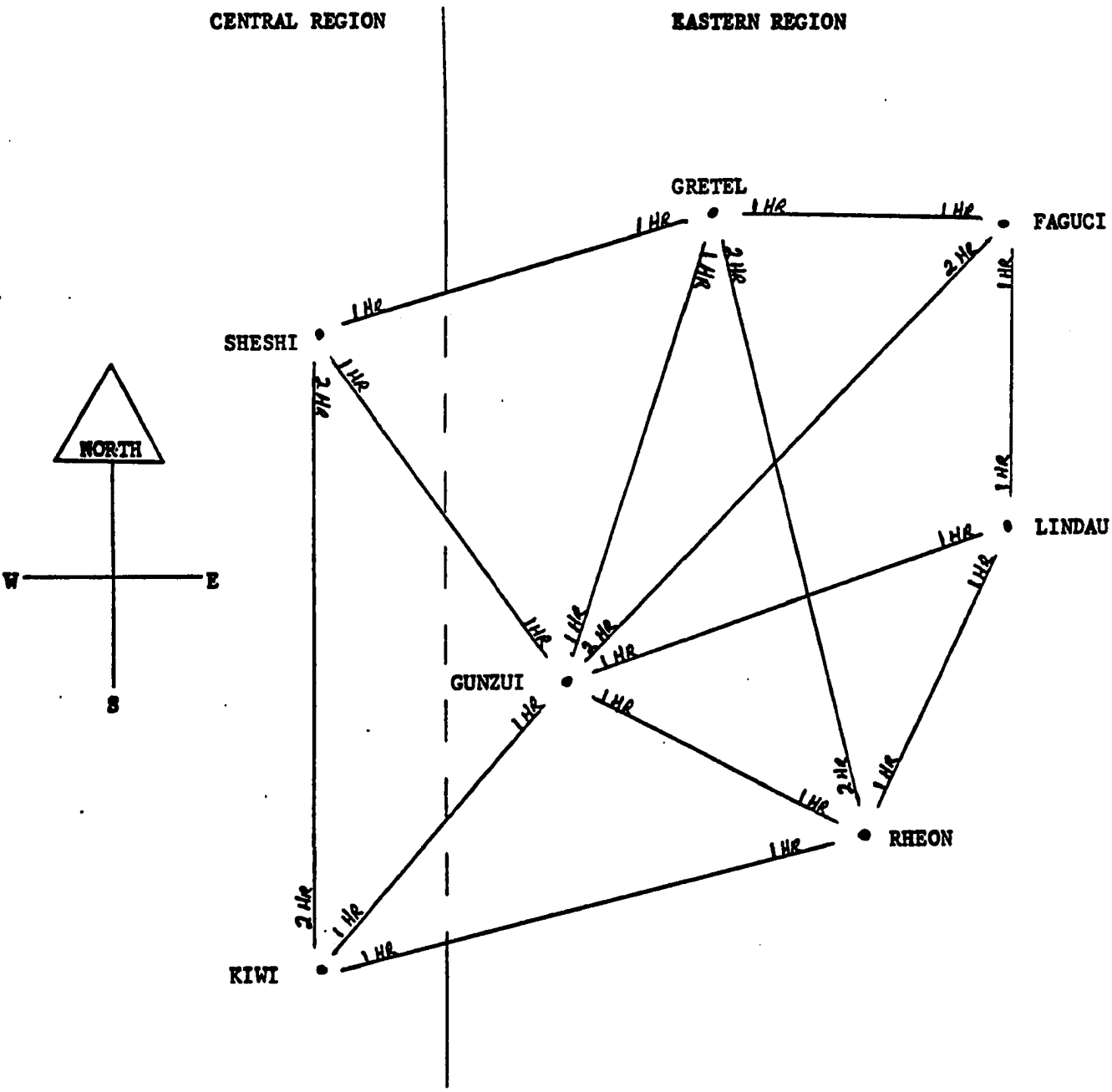
REGIONAL FLIGHT MAP

Plant Sites & Flight Times MAP #1



REGIONAL FLIGHT MAP

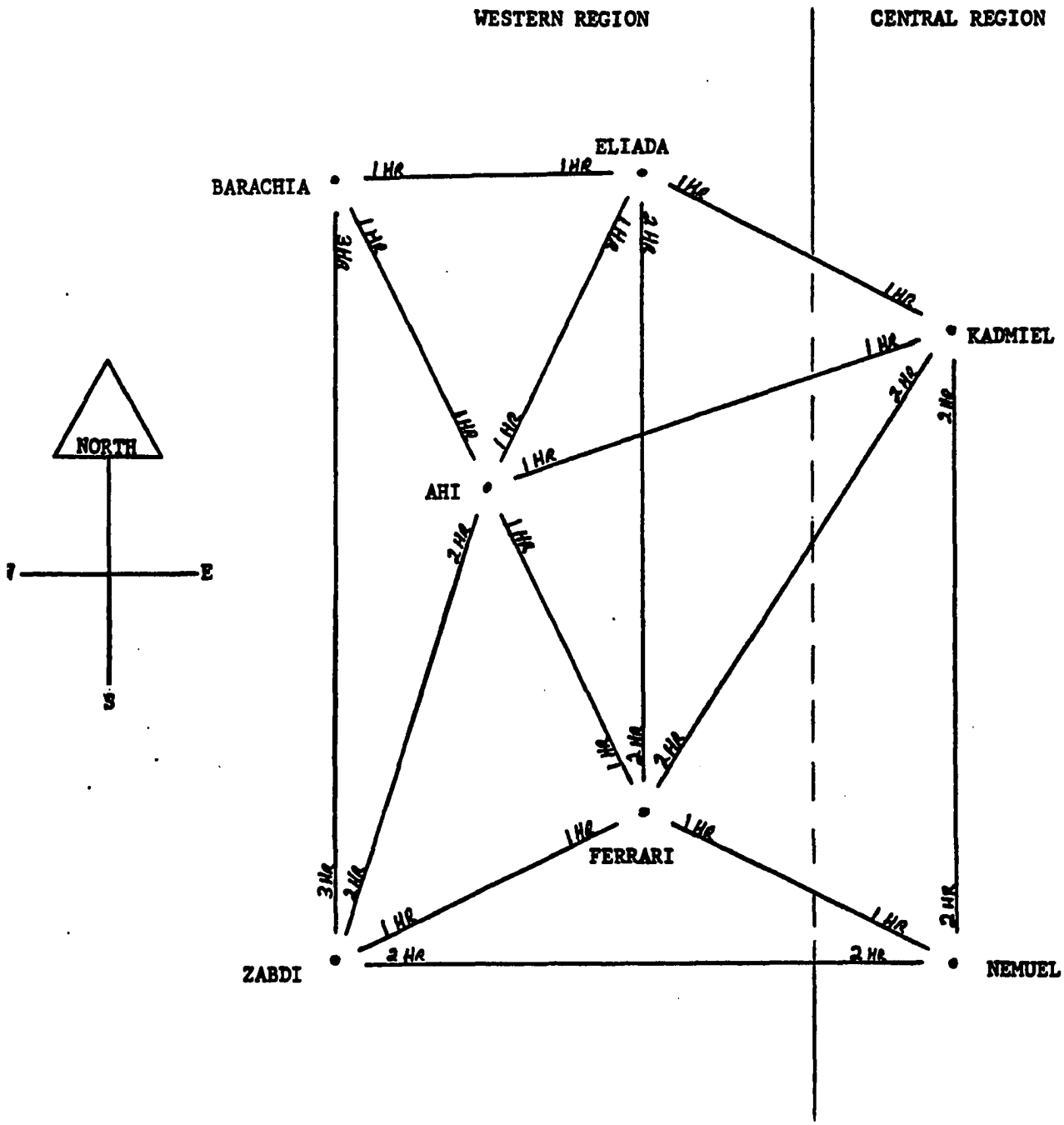
Plant Sites & Flight Times MAP #1



REGIONAL FLIGHT MAP

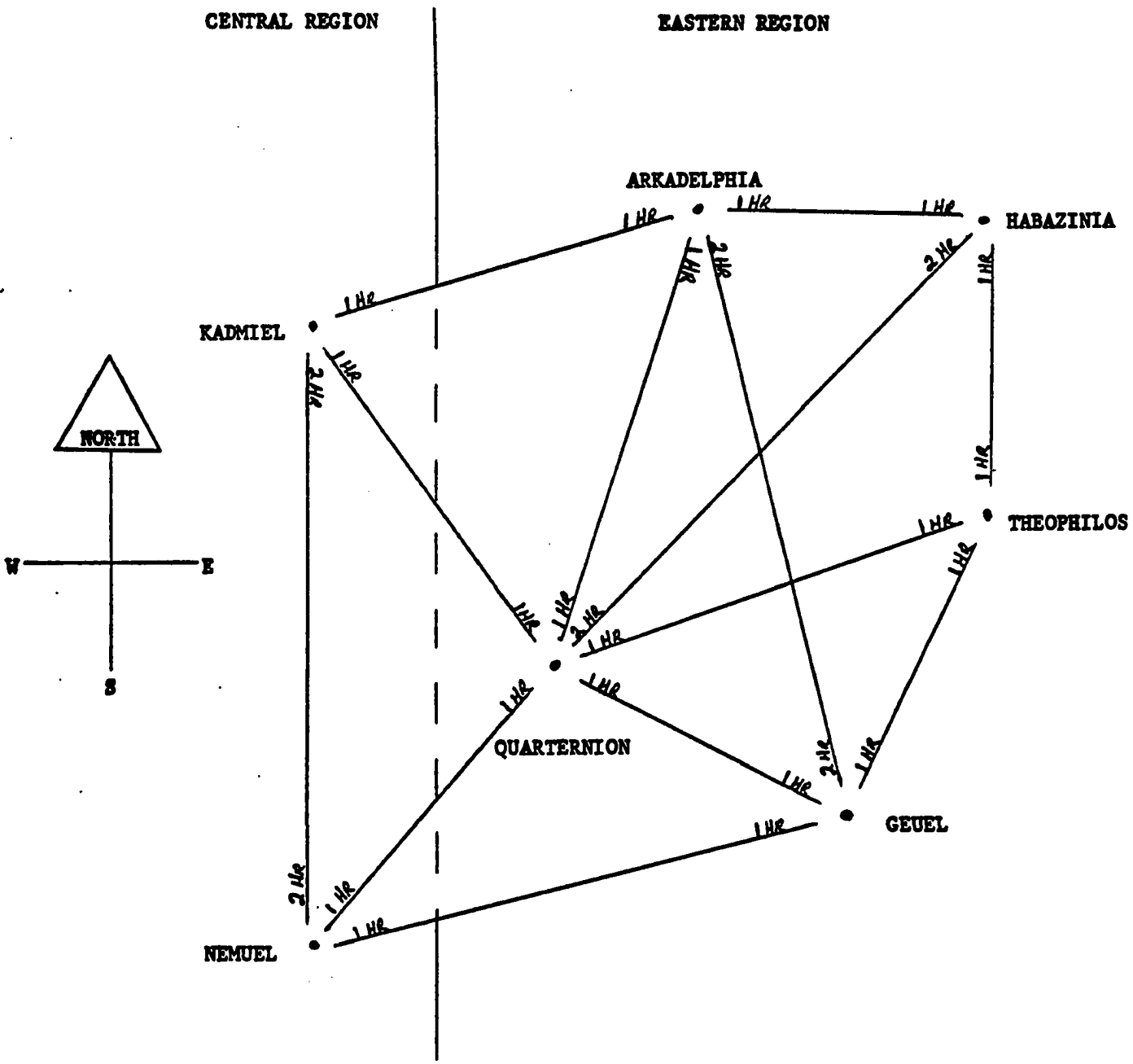
Plant Sites & Flight Times

MAP #2



REGIONAL FLIGHT MAP

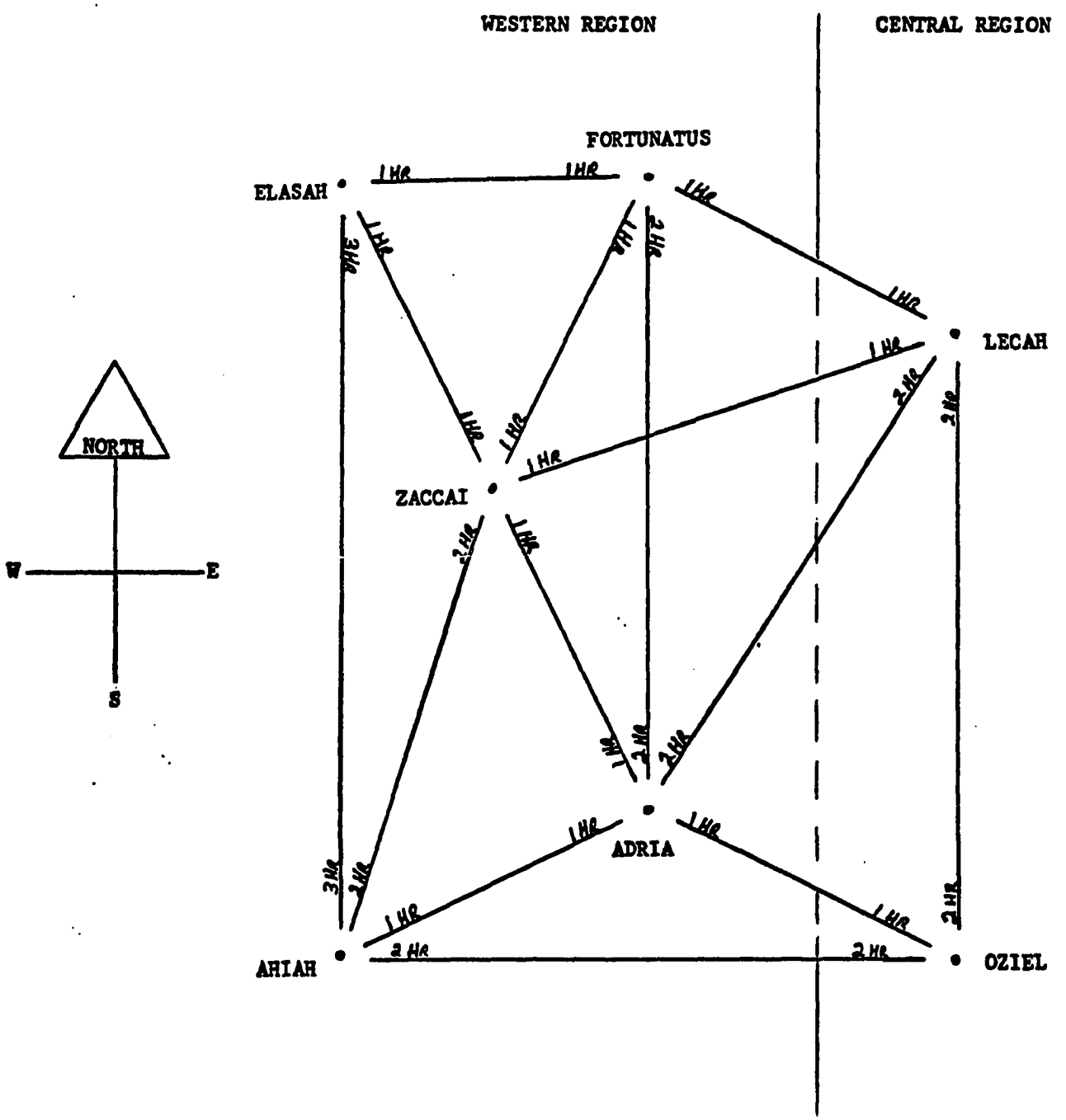
Plant Sites & Flight Times MAP #2



REGIONAL FLIGHT MAP

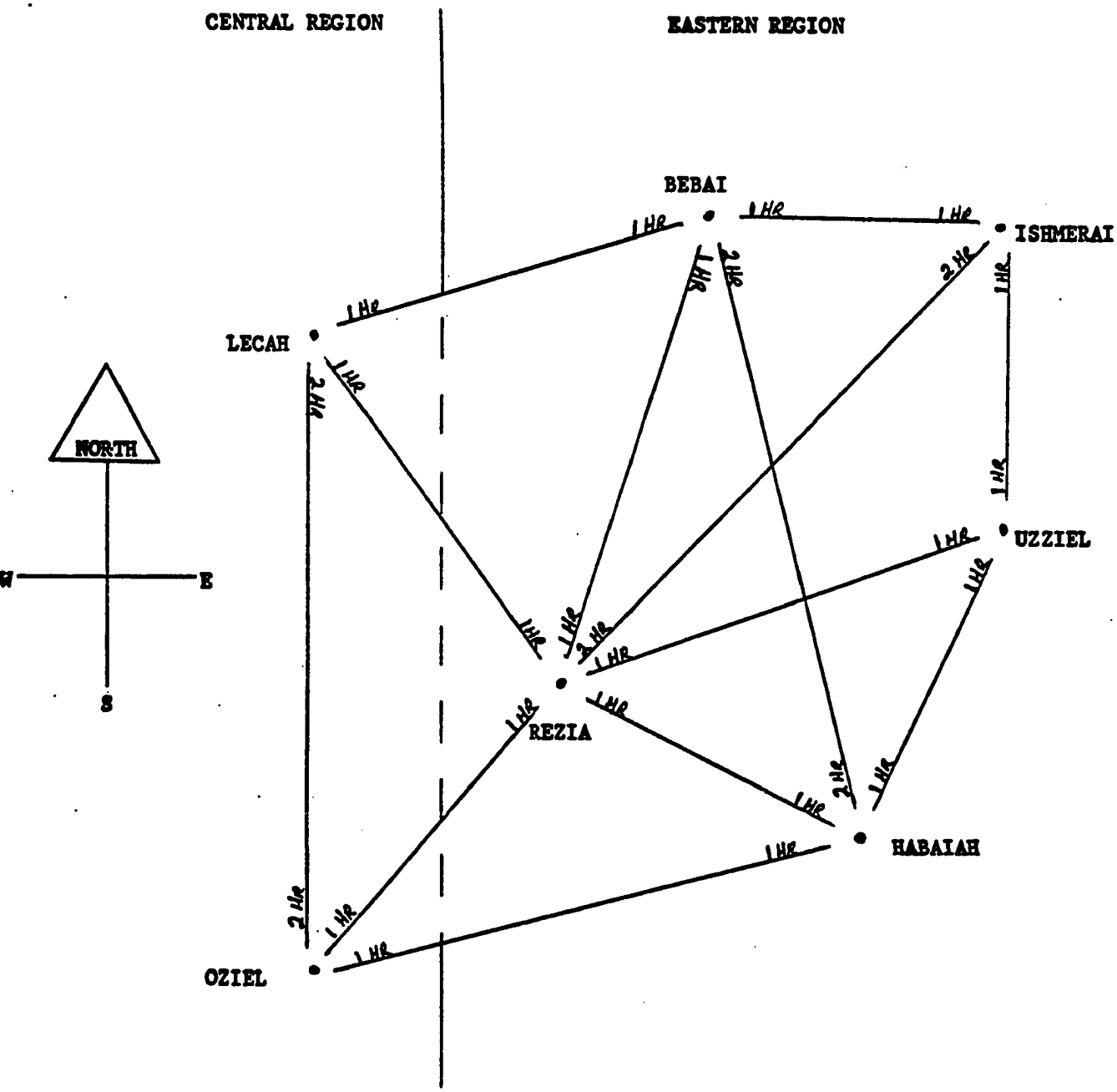
Plant Sites & Flight Times

MAP #3



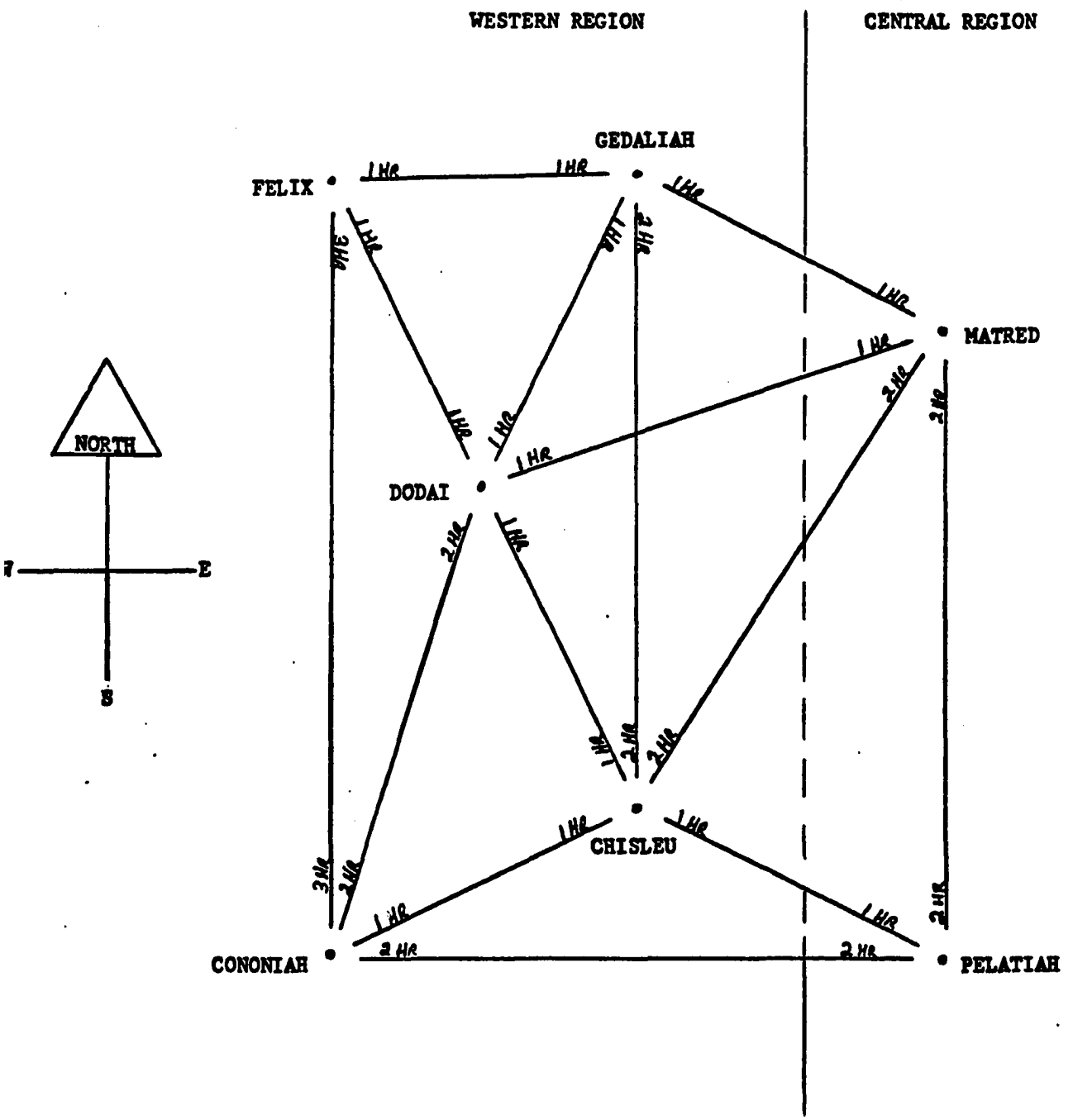
REGIONAL FLIGHT MAP

Plant Sites & Flight Times MAP #3



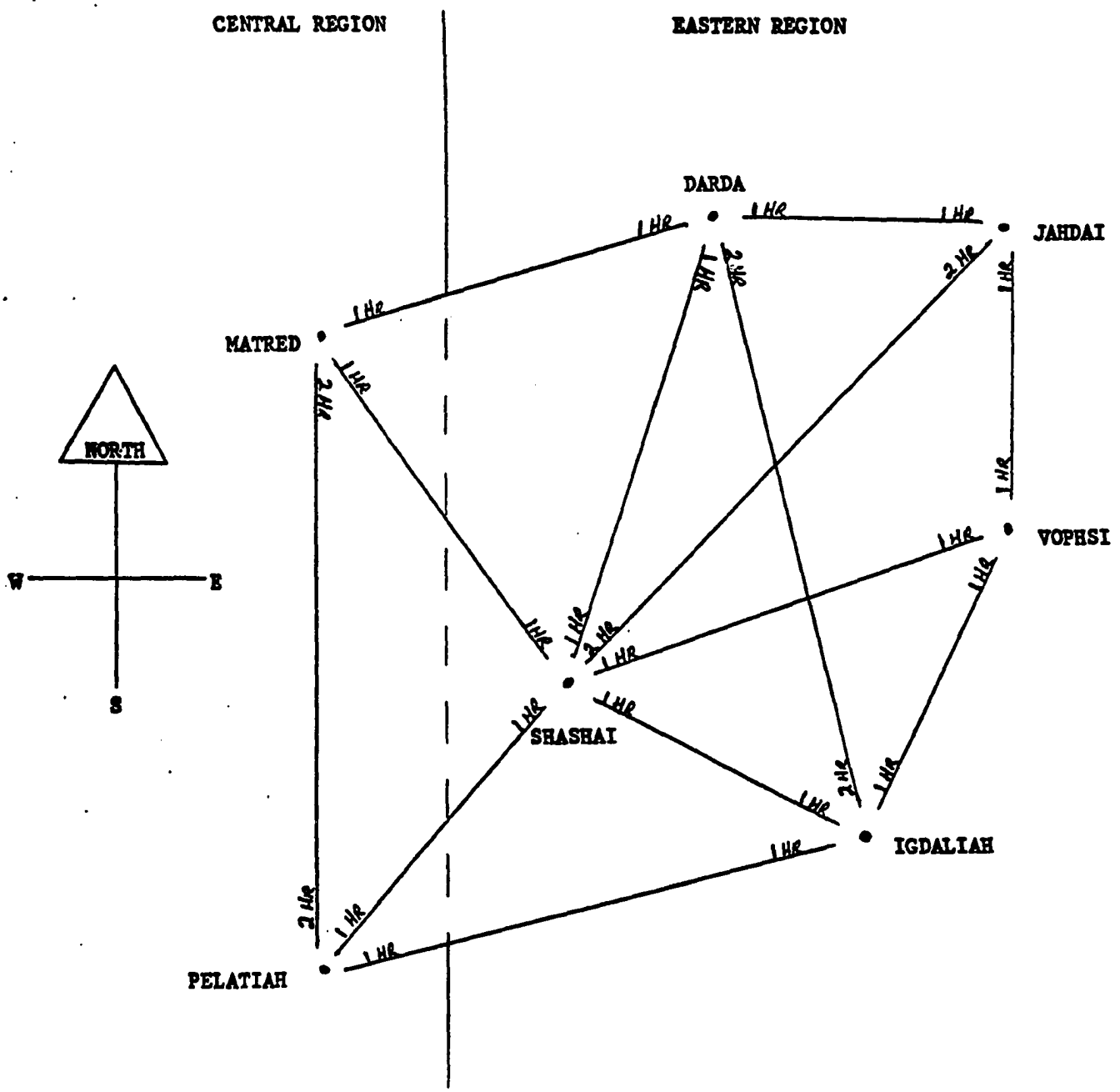
REGIONAL FLIGHT MAP

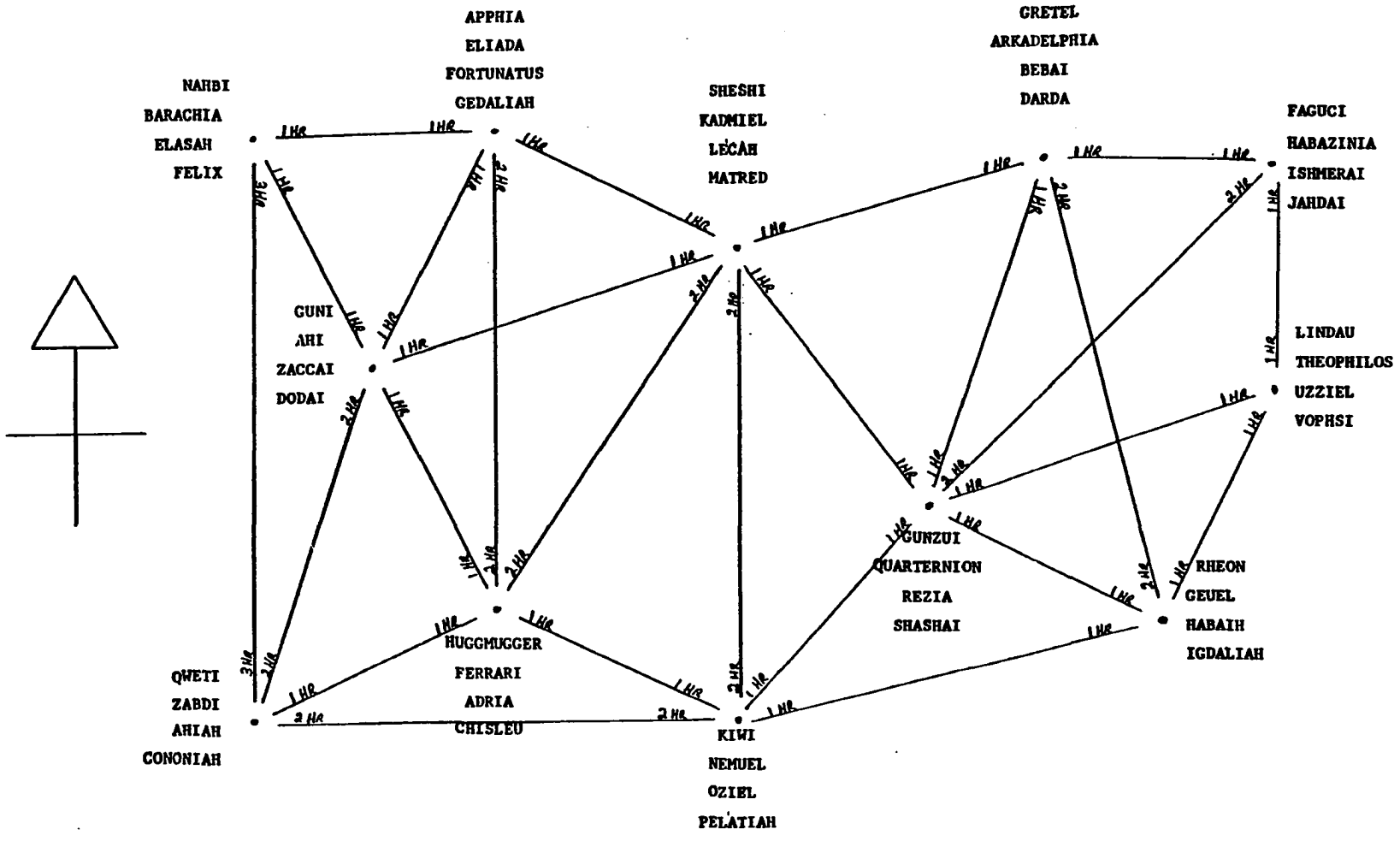
Plant Sites & Flight Times MAP #4



REGIONAL FLIGHT MAP

Plant Sites & Flight Times MAP #4




NAHBI
BARACHIA
ELASAH
FELIX
APPHIA
ELIADA
FORTUNATUS
GEDALIAH
SHESHI
KADMIEL
LECAH
MATRED
GRETEL
ARKADELPHIA
BEBAI
DARDA
FAGUCI
HABAZINIA
ISHMERAI
JAHDAI
GUNI
AHI
ZACCAI
DODAI
LINDAU
THEOPHILOS
UZZIEL
VOPHSI
GUNZUI
QUARTERNION
REZIA
SHASHAI
RHEON
GEUEL
HABAIH
IGDALIAH
QWETI
ZABDI
AHIAH
CONONIAH
HUGGMUGGER
FERRARI
ADRIA
CHISLEU
KIWI
NEMUEL
OZIEL
PELATIAH
1 HR
2 HR
3 HR

APPENDIX C

AN EXPLANATION OF THE INSTRUCTIONS AND PROCEDURES USED TO PREPARE THE SUBJECTS FOR THE EXPERIMENT

The experimenter used the following instructions and procedures to prepare the subjects for their part in experiment.

INSTRUCTIONS AND PROCEDURES

As each subject reported for the experiment, the subject was required to wait outside the experimental room until the dyad was complete. If for some reason one member of the dyad failed to show for the experiment the other member was given credit, thanked for coming, and then dismissed. Nothing more was said. At all times the potential subject remained outside the experimental room. When a dyad was complete, it was allowed to enter the room and instructed to take a seat on either side of the table in front of one of the telephones. Seating placement was random. The experimenter then introduced himself and the participants to one another.

Once the subjects were introduced, they were asked to fill out an experimental credit record card; following this the subjects were given the following, enclosed in an 8 1/2" X 11" plastic handout:

PREFACE

You are about to engage in a communication task.

This communication task requires the sharing of unfamiliar numerical and spatial information.

This experiment is designed to provide insight into human communication behavior. Specifically, this experiment focuses on the effects unfamiliar numerical and spatial information have on a communication task consisting of auditory or telephonic discourse.

Your response to the task in no way will affect your grade in class; so please, approach the communication task you are about to engage in as you would if you were really confronted with the task to be described to you in a moment.

As other members of your class will be participating in this experiment I would ask you please not to discuss your participation in this experiment with them at this time.

I thank you for your participation in this experiment.

When the subjects finished reading the handout it was collected by the experimenter and then, as casually and informally as possible, the experimener spoke to them the following, orally:

In order for you to do the task you are about to engage in, I would like for you to try to imagine that each of you has just been hired as a vice president for a large corporation--a very large corporation, having a number of production regions. Each of you has been newly hired for a separate region; the region and the company with its various personnel are all new to you.

Having become settled in your regional headquarters, Home Office has scheduled an inspection/tour for each of you for the production plants and cities within each of your regions.

> While you are visiting and inspecting the production plants within your regions, you each receive the following message from the president of the company; the message says in essence that the president wants to meet with the two of you twice. He wants to meet with the two of you face-to-face in one of your regions on October 27 for a minimum of one hour and again with the two of you on October 29, face-to-face, for a minimum of one hour in the other's region. You are to telephone the other vice president, review your itineraries, agree where and at what times these meetings can be arranged between the hours of 9 a.m. and 6 p.m. and inform the president. The president will fly in to meet with the two of you at the agreed upon places and times.

The following example was then given to illustrate the nature of the above communication task

> Suppose that both of you happen to be officers in one of the fraternities (or sororities) on campus; and suppose also that you are having a national convention in two days. When you get back to your fraternity/sorority today you receive the following message from national headquarters: "there is a problem with your state charter concerning Article 5 Section B. Please contact the officers of the OSU chapter, compare your's and their's and the national constitution on this article and section and bring both of yours in line with the national constitution by the time the national convention starts. We suggest that you telephone the officers of the other chapter, work out the details by tomorrow and give us a call back by tomorrow night."

The subjects were then asked if they understood the gist of the communication task. If one of the subjects was uncertain or unclear as to what was being asked, the above oral instructions was repeated until the subjects agreed that they understood the general nature of the communication task.

When the subjects agreed that they understood the general nature of the communication task, the following written instructions was

distributed to each subject in the form of an 8 1/2" X 11" handout enclosed in plastic, and was read, orally, to them by the experimenter:

SCENARIO

You and the other person have just been hired as vice presidents for a large corporation

You have been assigned to separate regions and have responsibility for regional production.

Your geographical regions, the productions plants within them, and the managers and various personnel are all new to you.

Having become settled in your regional headquarters, Home Office has scheduled an inspection/tour of all the production plants and cities in each of your regions for October 26 through October 30.

As vice presidents each of you has a corporate jet at your disposal

In preparation for your inspection/tour Home Office has prepared and supplied each of you with an itinerary and regional flight map.

At this point the experimenter gave to the person sitting to the left a copy of the Western Region itinerary and flight map and the person to the right a copy of the Eastern Region itinerary and flight map. In distributing these, the experimenter brought to the subjects attention that on October 27 and 29 they were scheduled to be at the city/production plant listed for that day. When the subjects agreed that they understood the itinerary and that they had a copy of a flight map that depicted only their region, the experimenter continued

to read:

It is now October 26 and you are at your first stop on your inspection/tour. While touring this plant you and the other vice president each receive the following message from the president of the company:

PRESIDENT'S INSTRUCTIONS

1. You are to telephone the other vice president, review your itineraries, and schedule as many meetings when the three of you can meet together on October 27 and again on October 29 as possible.

2. There must be AT LEAST two meetings one meeting must be on the 27th in one of your regions and the other meeting must be on the 29th in the other's region.

3. The president will adjust his schedule to meet with the two of you at the places and times that are workable for you and the other vice president. You are not, therefore, to concern yourself with the president's itinerary or schedule.

CRITERIA TO BE USED

4. The president wants you to use and to meet the following criteria when setting up your potential meeting times and places:

    a. There must be AT LEAST TWO meetings one in each of your regions.

    b. Set up as many potential meetings in each of your regions as possible.

    c. Make each potential meeting AT LEAST ONE HOUR in length.

    d. Maximize the length of all potential meetings and determine the EXACT amount of time that you can meet. (for example, 1 hr. and 25 min.; 2 hr. and 50 min; etc.).

    e. You are not to cancel anything on your itineraries unless potential cancellation has already been built into your itineraries.

f. You are not to be late to any meeting if it is non-cancelable.

g. Any travelling that you do must be done the same day as the meeting.

h. Any travelling that you do must be done between the hours of 8 a.m. and 10 p.m..

i. A meeting may not begin before 9 a.m. nor go past 6 p.m.

At this point the experimenter asked the subjects if they clearly understood what was being asked of them and if they understood the criteria which they were to abide by. If not, any or all of the SCENARIO was repeated until the subjects agreed that they understood the nature of the communication task and the restrictions. The experimenter then said that it was not necessary to try to remember or memorize all the instructions or criteria as they would be allowed to keep these instructions with them throughout the course of the experiment and refer to and to discuss them as often as necessary. The experimenter then asked the subjects to turn their handouts over, and he continued to read:

TASK INSTRUCTIONS

You may keep the TASK INSTRUCTIONS and SCENARIO with you throughout the experiment and refer to and discuss them as needed.

INSTRUCTIONS

1. Refer to the PRESIDENT'S INSTRUCTIONS in the SCENARIO on the reverse side of this handout as often as necessary to confirm that you are doing what has been asked of you.

2. Determine the places and times that you can meet as quickly as possible, being as accurate as possible.

USE THE FOLLOWING PROCEDURE IN SETTING UP YOUR MEETING

a. Set up your FIRST meeting on the 27th in one of your regions; THEN

b. Set up the NEXT meeting on the 29th in the other's region; THEN

c. Determine whatever other potential meetings are allowed by the two itineraries.

3. Record your agreed upon meeting times and places on the slip of paper titled, "Recommended Meeting."

At this point the subjects attention was directed by the experimenter to the slips of paper immediately in front of the subjects near the telephones, consisting of the following information of 5 1/2" X 4 1/4" paper:

RECOMMENDED MEETING

DATE _____

PLACE _____

TIME _____

LENGTH OF MEETING _____ HR. _____ MIN.

SIGNED _____

The subjects were informed how and when to fill out the paper titled "Recommended Meeting." When the subjects understood what they were to do, the experimenter continued to read:

RESTRICTIONS

1. You MUST follow the CRITERIA TO BE USED in the SCENARIO on the reverse side of this handout in setting up your meeting times and places.

2. You may not use paper, pencil or pen except to record your "Recommended Meetings."

3. You may not convert the twenty-four hour clock as given on your itinerary to standard time. You MUST communicate according to the times given on your itineraries.

4. Calculation of travel time must follow flight map routes as depicted on your regional flight maps.

5. You may not meet in the Central Region.

CONSIDERATIONS

A. It may or it may not be necessary that one person do all or most of the travelling on a given day in order for a meeting to be arranged.

B. In calculating your meeting time do not concern yourself with the time it takes you to get to and from your plane or for you to take off and to land. For your purposes these considerations have been built into the travel time as depicted on your regional flight map. FOR EXAMPLE, your flight map would depict a total travel time of two hours between Oklahoma City and Dallas if we consider that it takes 30 minutes to get to Will Rogers World Airport, another 45 minutes to fly to Dallas and another 45 minutes to to get to your meeting once you arrive in Dallas. Again, for example, If you complete a meeting, let us say, at 9:30 a.m., and you happen to have free time from 9:30 a.m. until 12 noon, and let us say also, that it takes one hour to travel to a particular plant site, then, in view of these considerations, if you were to arrange for a meeting at this plant site during this time, you should consider yourselves as having only 30 minutes to meet. If you left at 9:30 a.m. you would arrive at the plant site and be ready for

> your meeting at 10:30 a.m.. At 11:00 a.m., however, you must stop the meeting in order for you to fly back to where you were in order that you might keep your 12 noon appointment.

At this point in the experiment the experimenter then asked the subjects if there were any questions. All questions were answered to the subjects satisfaction before continuing. When there were no more questions, the experimenter continued:

> You are under no time restrictions whatsoever. You may take as long as you wish. I only ask that you do the task as quickly as possible, being as accurate as possible.
>
> If there are no questions, I will ring the telephones for you.

At this point the experimenter reached over to the bookshelf and, using the Southwestern Bell teletrainer, demonstrated a telephone ring. He then continued:

> this will simulate for you that you have, coincidently, called each other at the same time. You may then pick up the telephones and begin your communication task.

When there were no more questions the experimenter reached over to the teletrainer and first, unknown to the subjects, started the cassette tape recorder; then he simulated the telephone ring using the teletrainer. Before, however, starting the tape recorder and simulating the telephone ring the following variations occured, depending upon the treatment condition:

AUDITION WITH VISUAL SPATIAL SUPPLEMENT: E2

Just prior to starting the tape recorder and ringing the telephones the subjects were told, "we are seeking in the course of

these experiments to gain insight into the role and function of a video telephone which, as you can surmize, will probably be the future of telecommunications technology. Since the university has neither the money nor the equipment for us actually to use video telephones we must simulate them. Therefore, I am placing in front of you a copy of the other's MAP. When you have made telephonic contact with one another, you may reach forward and turn the handout around. By this method we hope to simulate a video telepohonic picture of the other's MAP. When there were no more questions the experimenter then started the tape recorder and rang the telephones. And, if a subject failed to turn the MAP around in order to simulate a video picture, the experimenter did it.

AUDITON WITH VISUAL NUMERICAL SUPPLEMENT: E3

The exact same procedure and discussion was followed in E3 as in E2 except the word ITINERARY was substituted for the words FLIGHT MAP.

AUDITION WITH VISUAL SPATIAL AND VISUAL NUMERICAL SUPPLEMENT: E4

The exact same procedure and discussion was followed in E4 as in E2 except the words AND ITINERARY were added immediately following the words FLIGHT MAP.

At the end of the experiment, after the subjects had hung up their telephones and submitted their "Recommended Meeting" forms to the experimenter, the following was given to them on an 8 1/2" X 5 1/2" paper to fill out.

POST TASK QUESTIONNAIRE

1. Name _____

2. How confident do you feel that you have recommended ALL the possible meeting places and times allowed by the two itineraries and regional flight maps?

Not too confident	Not very confident	Confident	Very confident	Absolute confidence

After the subjects completed the POST TASK QUESTIONNAIRE they were then given the following handout to read:

POST EXPERIMENT COMMENTS

As pointed out in the Preface, this experiment was designed to provide insight into human communication behavior. This experiment focused on the effects unfamiliar numerical and spatial information have on a communication task consisting of auditory or telephonic discourse.

We are investigating what effect (if any) unfamiliar numerical and spatial information have on a communication task. During the experiment you had to communicate both numerical and spatial information with which you were unfamiliar.

The subjects were then asked if they had any questions. When all questions were answered to the subjects satisfaction[2], the subjects were thanked for their participation and excused.

APPENDIX D

TIME(S) TO AGREEMENT

Raw Data Scores: In Seconds

KEY:

T1: Time to first agreement.
T2: Time to second agreement (includes time to first agreement).
T2-T1 Time to second agreement FROM the first agreement.
T(tot) Total time to complete the task.

E1: AUDITION ONLY

DYAD	T1	T2	T2-T1	T(tot)
1.	190	320	130	431
2.	1245	1995	750	2025
3.	448	757	309	845
4.	438	709	271	775
5.	248	510	262	705
6.	535	770	235	1285
7.	489	1153	664	1645
8.	796	1272	476	1317
9.	379	757	378	889
10.	884	1735	851	1834
11.	439	819	380	1310
12.	350	579	229	830
13.	1430	2118	688	2178
14.	465	878	413	1220
15.	514	870	356	1160
16.	939	2167	1228	2270
EX =	9789	17409	7620	20719
EX^2 =	7846499	24257421	4882222	31479261
$\overline{X}$ =	611.81	1088.06	476.25	1294.94

APPENDIX D

TIME(S) TO AGREEMENT

Raw Data Scores: In Seconds

KEY:

T1. Time to first agreement.
T2. Time to second agreement (includes time to first agreement).
T2-T1 Time to second agreement FROM the first agreement.
T(tot) Total time to complete the task.

E2: AUDITON WITH A VISUAL SPATIAL SUPPLEMENT

DYAD	T1	T2	T2-T1	T(tot)
1.	500	659	159	1028
2.	549	980	431	1464
3.	260	630	370	940
4.	278	575	297	583
5.	162	310	148	441
6.	278	515	237	578
7.	230	608	378	856
8.	620	928	308	1177
9.	252	684	432	870
10.	258	702	444	1230
11.	374	614	240	868
12.	322	408	86	689
13.	645	1180	535	1725
14.	286	495	209	662
15.	320	517	197	885
16.	786	1098	312	1388
EX =	6120	10903	4783	15384
EX^2 =	2828758	8328817	1809671	16691782
$\overline{X}$ =	382.5	681.44	298.94	961.5

APPENDIX D

TIME(S) TO AGREEMENT

Raw Data Scores: In Seconds

KEY:

T1. Time to first agreement.
T2. Time to second agreement (includes time to first agreement).
T2-T1 Time to second agreement FROM the first agreement.
T(tot) Total time to complete the task.

E3: AUDITION WITH A VISUAL NUMERICAL SUPPLEMENT

DYAD	T1	T2	T2-T1	T(tot)
1.	1010	1140	130	1738
2.	208	410	202	798
3.	273	935	662	935
4.	421	700	279	942
5.	358	595	237	645
6.	260	505	245	680
7.	574	1659	1085	1940
8.	859	1359	500	1435
9.	622	1198	576	1585
10.	2172	2638	466	2671
11.	410	757	347	885
12.	995	1346	351	2105
13.	640	1100	460	1433
14.	1525	2890	1365	2905
15.	545	824	279	925
16.	154	438	284	513
EX =	11026	18494	7468	22135
EX^2 =	11896814	29252070	5143072	38592311
$\bar{X}$ =	689.12	1155.88	466.75	1383.44

APPENDIX D

TIME(S) TO AGREEMENT

Raw Data Scores: In Seconds

KEY:

T1. Time to first agreement.
T2. Time to second agreement (includes time to first agreement).
T2-T1 Time to second agreement FROM the first agreement.
T(tot) Total time to complete the task.

E4: AUDITION WITH A VISUAL SPATIAL AND VISUAL NUMERICAL SUPPLEMENT

DYAD	T1	T2	T2-T1	T(tot)
1.	186	620	434	690
2.	297	610	313	924
3.	372	623	251	782
4.	624	1015	391	1106
5.	292	588	296	875
6.	260	834	574	1323
7.	296	657	361	918
8.	326	678	352	999
9.	760	1636	876	1666
10.	395	653	258	735
11.	880	2635	1755	2658
12.	676	1316	640	1921
13.	512	1185	673	2378
14.	960	1725	765	1962
15	419	809	390	1334
16.	825	1462	673	1503
EX =	8080	17046	8966	21774
EX^2 =	5002252	23057248	7093112	35135194
$\bar{X}$ =	505	1065.38	560.38	1360.88

APPENDIX E

E5: RAW DATA SCORES FOR SINGLE SUBJECTS

(Having Complete Visual Supplements But No Audition)

KEY:

T1. Time to first agreement.
T2. Time to second agreement (includes time to first agreement).
T2-T1. Time to second agreement FROM the first agreement.
T(tot) Total time to complete the task.

SUBJECT	T1	T2	T2-T1	T(tot)
1.	1094	1710	616	1715
2.	272	470	198	599
3.	593	1580	987	1620
4.	695	1040	345	1185
5.	495	1192	697	1192
6.	1462	1507	45	2450
7.	399	623	224	635
8.	263	1168	905	1385
9.	356	659	303	3226
10.	719	748	29	765
11.	973	1570	597	1573
12.	1185	1771	586	2900
13.	217	364	147	950
14.	514	736	222	870
15	629	881	252	900
16	823	1629	806	1648
EX =	10689	17648	7097	23588
EX^2 =	9095239	22866386	4449301	44013524
$\bar{X}$(in seconds)	668.06	1103	443.56	1474.25
$\bar{X}$ (in minutes)	11.13	18.38	7.39	24.57