AD 741766

RADC-TR-72-106
Technical Report
31 January 1972

CENTER FOR COMPUTER-BASED BEHAVIORAL STUDIES

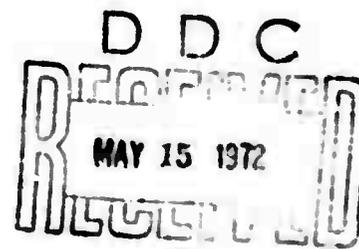The Regents of the University of California

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14. KEY WORDS	LINK A		LINK B		L'NK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Computer Simulation						
Gaming, Model						
Simulation						
Systems Analysis						
War Games						
Management Games						

DD 1473 Abstract continued from page 1

This document describes project developments covering the first
two and one-half years placing particualr emphasis on progress
covering the last six month period and on plans for project
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at hand, the document as a whole, and many of the internal sections,
are prefaced by an overview statement which reflects the general
background and rationale developed in the original proposal.

3

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
The Regents of the University of California Department of Psychology 405 Hilgard, Los Angeles, California 90024	UNCLASSIFIED
	2b. GROUP

3. REPORT TITLE

(U) Center for Computer Based Behavioral Studies (CCBS)

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Semi-annual Technical Report   7/1/71 to 1/1/72

5. AUTHOR(S) (First name, middle initial, last name)

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Robert J. Meeker
Alvin S. Cooperband

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
31 Jan 1972	60	15

8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
F30602-70-C-0016	
b. PROJECT NO	
ARPA Order 1488	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	RADC-TR-72-106

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES Monitored by Al DeLucia - RADC/IRDA Griffiss AFB NY 13440	12. SPONSORING MILITARY ACTIVITY Advanced Research Project Agency 1400 Wilson Blvd Arlington VA 22209

13. ABSTRACT

The Center for Computer-based Behavioral Studies (CCBS) on the UCLA Campus is designed and is being developed to overcome a number of the methodological limitations blocking significant research advances in, and behavioral sciences' contributions to, the study of national policies and problems. The Center is designed around a time shared computer system that will make its informational and technological resources available to behavioral scientists and policy analysts located at widely dispersed university and government research centers, offering them new and powerful research, policy planning, and educational tools. A number of these tools for studying and analyzing the behavior of indivuals, groups, and social-political units are specifically capable of narrowing the enormous gap that continues to exist between the policy analyst and the behavioral scientist. Essential to the development of these broad methodological and technological areas is an ongoing program of substantive research on bargaining and conflict resolution behavior relevant to political crisis management. As the three areas of development (laboratory gaming and simulation research, inductive data analysis, and data resources management) share a systematic base of operation, the potentials for mutual support among them will be substantially enhanced. Central to all of these activities are plans based on a number of highly integrated software systems, hardware configurations, and laboratory design and equipment requirements, stemming from ARPA-supported research and development projects conducted over the past seven years.

DD FORM 1473

CENTER FOR COMPUTER-BASED BEHAVIORAL STUDIES

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PUBLICATION REVIEW

This technical report has been reviewed and is approved.

RADC Project Engineer

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ground and rationale developed in the original proposal.)

OVERVIEW

The events of the sixties have underscored the general failure of the behavioral sciences to contribute significantly to the solution of the pressing problems of the day, or to offer guidance to the decision makers who face these problems. In the outspoken view of a national advisory committee on the behavioral sciences, there is a "lack of vital social and economic information on critical issues and lack of methods for analyzing information and relating it to policies and operations."[*]

While there is a growing recognition of the relevance of the behavioral sciences to the range of complex decisions facing the government in domestic and foreign affairs, it has not immediately produced a new wave of social science research. The university scientists of the country have moved slowly in facing these large-scale problems. Part of their reticence stems from the realization that new research directions require new methods and information resources that are beyond the capabilities of individual researchers within most university research communities.

This document describes the plans for a Center for Computer-based Behavioral Studies (CCBS) on the UCLA Campus--its design, phased development, and use. The Center is designed around a time-shared computer system that will make its informational and technological resources available to behavioral scientists located at widely dispersed university and research centers, offering them new and powerful research, policy planning, and educational tools. The Center will provide resources that will allow behavioral scientists to extend their knowledge and basic research interests to the study and analysis of national policies and problems. A number of these tools for studying and analyzing the behavior of individuals, groups, and social-political units are specifically relevant to

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[*] "Report on the Behavioral Sciences and the Federal Government," American Psychologist, 23:11 (1968), p. 803.

help bridge the enormous gap that continues to exist between the policy analyst and the behavioral scientist, who prefers to engage in those forms of research which yield more readily to reductionist theories and existing research techniques.

The broad range of needed support can be cast into three generally defined areas:

- **Laboratory Gaming and Behavioral Simulation Research**. The aim is to provide necessary laboratory techniques so that problems embedded in real-world complexity can be studied intensively and rigorously in a controlled laboratory environment. A laboratory program is designed to break through some of the methodological limitations that currently threaten the viability of laboratory simulation for use as a tool in both theory building and policy study. A variety of laboratory techniques will be developed for using the computer as an experimental tool for on-line analysis, umpiring, controlling, and recording of decision-making behavior, particularly the dynamic interaction process that takes place between players and teams of players. A primary focus of such development will be to provide support for complex, multiperson simulations.

- **Inductive Data Analysis**. The need is to develop more effective tools for exploratory and inductive analysis of data that are not well understood and that may be derived from situations that do not fit the tightly structured paradigms of traditional research designs. As the sources of data become larger, more complex, and more open-ended (whether from the growing role of induction in laboratory studies or from the increased use and availability of real-world data archives), the researcher will need new means of exploring, manipulating, and analyzing these data.

- **Data Resources Management**. The need is to develop a data resource system and associated data repository to be based on the most advanced computer analysis and data management techniques, including new procedures for information retrieval and archive maintenance. The technology we have developed for on-line data management and data analysis could provide many of the building blocks for a system to satisfy the interactive requirements and archive management for a large number of users with divergent interests. Such a system could become much more than an improved archive management capability--it could develop into a major extension of the methods of scientific communication: In addition to retrieval and analysis, many of the informal procedures surrounding the communication of ideas and data could be incorporated explicitly into the system.

Specifications for these capabilities would be established
by an assessment of the needs of behavioral scientists,
policy analysts, and planners and by pilot studies on
existing data archives.

A common requirement for each of these proposed developments is the
need for a large-scale, time-shared computer system. With the
three areas of development sharing a common and systematic base of
operation, the potentials for mutual support among them would be
materially enhanced.

As the discussion in the next section will demonstrate, the support
offered by powerful inductive analysis tools could reduce the
constraints on the experimental design and data collection in simu-
lation and gaming research; in turn, the research data collected
could serve as a generating source for guiding the on-going
development of the data analysis system. Laboratory research would
also be supported by a data resource system having ready-made, on-
line data banks available for participants in real-world simulations;
in turn, the information demands of decision makers in realistic
experimental contexts could help delineate the operational require-
ments for the form, content, and service demands of the data
resources system. Finally, and perhaps most obviously, the data
analysis system would augment the data archive management functions
with tools for analysis and evaluation. These do not, of course,
exhaust the possibilities of mutual support; others, not now
identified, will undoubtedly emerge from the demands of use where
the common base of operation makes such demands reasonable.

In the most practical terms, a pivotal consideration in the
projected success of a research center should be its actual and
perceived utility to the behavioral science community. The more
closely the support developments are related by demonstrable
usefulness to on-going research, the greater the likelihood that
the center will be genuinely useful and used. This principle,
which seems so obvious, is often lost in the process of formulating
and designing research support systems. This happens in part
because system users and system producers generally represent

distinct groups in terms of interest and/or experience; as a consequence, highly technical and readily identifiable demands of computer and software implementation tend to take precedence over the less compelling needs of application. A practical and direct remedy for this is to make sure that the developers of the requirements of the research center are also among the major users. This strategy is incorporated into the center.

The initial specifications of requirements were derived largely from our past project efforts to extend behavioral research to policy relevant areas through the use of computer capabilities. Since the technological, methodological, and data analysis specifications have all grown directly out of the practically perceived needs of a substantive research program, there is a high guarantee of utility that could not otherwise be derived. For on-going developments, this close operational association between in-house, substantive research projects and resource support programs is to be continued. For the area of data resource utilization, where the requirements are less well defined, we plan to rely more heavily upon those associations, groups, and individuals who constitute the major users of data resource systems.

PROGRESS ON PROJECT: 1 JULY 1969 THROUGH 31 DECEMBER 1971

Background and Summary

Progress during the first twelve months of the project was severely curtailed by protracted contractual negotiations; a definitive contract was not implemented until the last week of the first year. A finalized contract was established the last week of June 1970.

In sum, the project operated for the entire first year without the enablement of a finalized contract, and without authorization to acquire the central computing system and its major components of hardware and software support. Additionally, during the first half of the year nearly all planning and preliminary steps toward implementation had to be deferred until the decision on the central computer configuration was resolved. In the absence of enabling conditions--without definite selection of the central processing system and without contractual authority to purchase major equipment, to subcontract for software development, or to develop project staff--the proposed schedule of development for the first year was critically compromised.

By contrast, the project has progressed at an accelerated rate in the next year and one-half; as a result, we have been able to recoup a significant portion of the schedule slippage due to first-year delays. Phase I of the computing system is essentially complete, both with respect to hardware configuration and operating system software. Phase II hardware and software design has been developed through a detailed formulation stage; we are ready to undertake steps for implementation. Two higher-order programming languages--JOVIAL and META--have been developed; both META and JOVIAL are now being used for applications programming. We have developed a programming system that provides rapid and easy laboratory implementation of experimental research designs. In data management and analysis, we have implemented (a restricted version of) TRACE, a system that essentially provides implicit

programming capabilities in data analysis; and we have implemented a full-interactive version of IDEA, a program that provides computer assistance in the task of inductive data analysis. The permanent laboratory facilities are in the last phases of construction and will be operational in late Spring. A proposal has been submitted to interface CCBS with the ARPA network as a means of offering our capabilities to a wider community of users. In sum, the overall project development is still behind the schedule originally proposed, but considerably less so than might be expected with the first-year delays.

Computer Laboratory Developments

The principal goal of the project is to broaden and expand the capabilities of behavioral research, particularly in areas of potential policy relevance. The principal means of accomplishing this goal is to develop new behavioral research methodologies through the use of on-line, data acquisition tools, particularly for computer-administered experiments and simulations and for interactive forms of data and text analysis. The goals of the project, then, are predicated on the development of a large-scale time-sharing computing system.

Computer Hardware

The hardware configuration of the CCBS central system computer is designed to support high-speed interaction with many concurrent users who, in the three primary applications of the system, may be any mix of experimental subjects, data analysts, and development programmers. The different applications (and associated different types of users) require different interactive service needs, which, in sum, present a need for greater than normal communications processing. The basic hardware configuration is especially designed to meet these requirements.

Beyond the basic configuration, the major extension of computer
hardware is to meet extended data management requirements,
especially as these relate to the management of data bases of
archive proportions. (This aspect of the project is identified
in the original proposal as Phase II development.) There are
two major facets in extended data management capabilities:
First, a need to provide greater data storage capacity in the
system, and, second, a need to provide improved means of access-
ing when it resides outside the normal bounds of direct address-
ability (i.e. core memory). The first of these requirements can
be met with the acquisition of standard data storage devices (in
our system, additional disc storage is the most appropriate);
there is, by contrast, no standard hardware available for meeting
the second requirement; we have, then, proposed to develop the
hardware and associated software necessary to support virtual
memory programming.

A summary of the computer system hardware is given below:

CCBS computer system hardware, basic configuration:

   Processor: DEC PDP-10/PDP-15 dual processor--both processor
           interface to PDP-10 core (262,144 words of 36-bit,
           1.5 μ sec. memory) with 4192 words of 18-bit, 0.8 μ
           sec. memory on the PDP-15; interprocessor memory
           interface, DA15-C, developed by DEC (detailed
           description in Appendix B, Technical Report 12/31/70);
           and high speed communications interface, developed by
           DEC (detailed description in Appendix C, Technical
           Report 12/31/70).

Auxillary storage devices on the PDP-10:

·Drum: 2 swapping drums. DEC RM10B (storage capacity
of 345,600 words each, mean access time of 5.3 µ sec.,
and transfer rate of 4.1 µ sec. per word).

·Disc: 4 disc-pack drives. DEC RP03 (storage capacity
of 5.2 million words per pack, mean access time of
62.5 µ sec., and transfer rate of 15 µ sec. per word).

·DECTAPE: 6 drives, DEC TU56 (storage capacity of
367 thousand characters per tape, mean access time
of 10 seconds, and transfer rate of 15,000 character
per second).

·Tape: 2 drives--one 7-track industry standard,
DEC TU20B (45 in./sec., density to 800 bpi.)
One 9-track USASI standard, DEC TU30A (45 in./sec.,
density at 800 bpi.)

·Card: card punch, DEC CP10A (200 cards per minute)
card reader DEC CR10A (1,000 cards per minute).

Auxillary storage devices on the PDP-15:

·Disc: 1 fixed head track, DEC RS09 (storage capacity
of 262,144 18-bit words, mean access time of 16.7 µ sec.,
and transfer rate of 16 µ sec. per word.)

Printer Plotter: Gould, model 55-5032-100--text and graphics:
96 printable characters; print rate: up to 1000 lines
per minute for a 132-character line across an 11-inch.
page, processor-limited.
Plot rate: up to 8 inches per second for 11-inch wide
plots, processor-limited.

Communication terminals:

·High-speed terminals: 24, Computek Model 400/15:
storage tube: text/graphics display, keyboard and light-
pen* input: 96 printable characters; transmission rate:

_____
*Light-pens for the Computek terminals have been developed jointly
by Computek and CCRS in response to CCRS needs; development is the
first light-pen capability for a remotely located storage-tube
display terminal.

7300/360 baud.

- Hard copy terminals: 5, Texas Instrument Model 733;
95 printable characters; transmission rate: 300/150/110
baud.

The system described above is complete--all components have been
acquired and are operational; this reflects the following assumption-
made in the current reporting period:

- Acquisition and interface of the printer-plotter.
- Integration of the high speed communications
interface.
- Acquisition and interface of hard copy terminals.

Two major modifications to the hardware system are planned in the
areas of data storage and data management:

Extended data storage capacity--Disc storage will be augmented in
two ways: public disc storage will be increased by the addition
of two additional disc drives (RKE RP03) which offers double the
storage capacity of the RP02), permitting some of the existing,
smaller-capacity RP02 drives to be allocated for use with
private disc packs. A modification to the disc controller is
required to permit it to handle both RP02s and RP03s.

Extended data management--the hardware necessary to support virtual
memory programming is being developed by CCNS; the design con-
cept has been implemented by software simulation (the SMART
system described below); a design study of the virtual memory
hardware has been completed, and detailed documentation is being
written in preparation for hardware acquisition.

Accomplishments during the current reporting period relating to
system modifications:

Design study of virtual memory hardware.

Computer Software

Software developments are oriented toward on-line data acquisition
techniques (currently planned computer-administered experiments
and simulation) and interactive forms of data analysis. There
are two major lines of development: General support and applications
support--general support programming provides the software environ-
ment for application support programming which, in turn, provides
the software-implemented methodology for the end-users in the
system. Within the general support effort there are two areas of
concentration: Operating system and higher-order languages. Within
the applications support effort there are also two areas of concen-
tration: Laboratory research and data analysis.

Operating System Improvements

CCBS requirements for a time-sharing system are somewhat atypical--
in particular CCBS users are typically not all one class, are not
usually programmers, and are often not independently related to a
given object program. In some respect each of the differences
are at variance with assumptions that are built into standard time-
sharing systems; they are specifically at variance with the time-
sharing system supplied with the DEC PDP-10 computer. It has been
necessary, then, to modify the operating system to CCBS needs. While
none of the modifications are in the class of major technical
innovations, and while none by itself constitutes a major revision,
they are, on the other hand, non-trivial changes and represent, in
sum, a significant programming effort. These modifications are
listed and briefly described below:

Terminal interactions--all terminal interactions in the delivered
                        DEC system assume continuous-scroll output;
                        to match the display characteristics of the
                        Computek terminals, terminal output had to
                        be "paged".

Disc and tape access-- access to peripheral storage in the delivered
                        DEC system is assumed to be a user responsibility
                        with only minimal provision for system protection
                        and assistance. To accommodate naive users,
                        peripheral storage access procedures have been
                        modified.

Device assignment--   in the delivered DEC system, the assignment
of access devices for private data storage
are assumed to be a user responsibility;
again, to accommodate naive users the operat-
ing system has been modified to provide new
procedures, better protection, and greater
assistance in device assignment. These
improvements are generally applicable to all
PDP-10 systems; documentation is contained
in TM-13 attached to this report.

(In addition to modifications of the operating system monitor, the
manufacturer-supplied general utility programs also required
extensive modification and augmentation.)

Terminal support--   the Computek terminals which serve as the
primary interactive devices for the system
are considerably more versatile than the
normal devices upon which DEC utility programs
are predicated; to fully utilize the versatility
of the Computek terminals, the DEC utility
programs had to be revised.

Text Editor--   two editors were delivered with the hardware;
neither was considered adequate for the broad
class of users in CCBS; a new text editor has
been implemented; this editor is generally
applicable for all PDP-10 systems; documenta-
tion is contained in TM-10, TXTED: A Simple
Content Editor, attached to this report.

Beyond these modifications, a major revision of the operating system
is planned. This revision is required for the development of an
extended data management capability (i.e. the software side of
developing virtual memory capability). As mentioned previously,
the virtual memory design has already been simulated in a software
version. The emulation of virtual memory hardware is part of the

SMART system, but, in addition to emulating the virtual memory hardware, SMART also performs elaborate core management services; it is these core management services that constitute the planned operating system revisions. They will be incorporated into the time-sharing monitor after the virtual memory hardware is acquired. The core management concepts of the SMART system are described in P-4 SMART: A Multiple High Segment Executive System, attached to this report.

Accomplishments during the reporting period which relate to operating system and utility program improvements, are the following:

- Completion and documentation of the device assignment subsystem.
- Programming of text editor.
- Completion and documentation of SMART system.

Higher-order Language Developments.

The CCBS research program imposes requirements on the type of higher-order programming languages that are needed to support the development of application systems. In particular, the computer-administered experimentation implies a need for programming forms that facilitate real-time process control, and interactive data analysis implies a need for programming forms that facilitate general data manipulation and management. When the PDP-10 computer was acquired, the higher-order languages available on the machine were evaluated for CCBS applications and were judged to be in-adequate; a higher-order language development was required. A modified JOVIAL and META were selected for implementation--JOVIAL because it had a history of performance in both command-and-control systems and data management, and META because it had proven utility both as an interface between JOVIAL and intermediate language forms (of the type contemplated in CCBS applications), and as a powerful, character-string manipulator (to aid in restructuring data bases).

Both JOVIAL and META are now operational in the CCBS system.
Since both are programs of general utility for all PDP-10 systems,
general releases are planned when the compilers have been shaken
down and thoroughly documented.

Accomplishments during the reporting period which relate to higher-
order language developments are the following:

> •Delivery of a useable JOVIAL compiler
> •Completion of META compiler

Laboratory Software

On-line computer-administered experimentation is, for many
behavioral researchers, a relatively unfamiliar method of investiga-
tion. They have had little or no experience with the process
control programming even if they have used computers extensively
for data reduction and analysis. They would, then, have difficulty
using the laboratory without a considerable degree of assistance;
the problem is analogous to using a computer without the assistance
of high-order languages; the analogous need is to provide a
"research-design compiler". CCBS has developed this sort of software
support in the form of a system of programs called LIS: Laboratory
Implementation System. A more extended description of the general
rationale of LIS is contained in P-1, LIS: An Implementation
System for Computer-based Experiments, attached to this report.
The total Laboratory Implementation System is composed of three
programs described below:

> •LIS--the central and major program in the system: designed
> to operate in four modes: Implementation--used for
> gathering and operationalizing specifications; Debug--
> used for checking experimentation logic; Simulation--
> used for viewing the experiment from a selected subject-
> role; and Run--used for running experiments. The program
> handles all routing of information, evaluation of
> responses, presentation of displays, recording of data,

and logic contingencies necessary for implementation of experiments. A prototype program has been operational for two months; shake down experience has substantiated the design concepts--for a broad set of applications we can produce a meaningful implementation in a matter of days.

-DGP--Display Generation Program. This program is used for preparing displays to be used in experiments or for educational purposes. The procedures for preparing displays are conversational; the user language has been designed for a non-programmer, with operating instructions incorporated directly into the program. This program is now operational.

-EDTAB--Table Editing Program. LIS operates interpretively on a set of tables whose entries contain values defining a given experiment. The initial setting of these values into the tables is the most exacting and time-consuming procedure in the process of implementing an experiment; for any given experiment, this is a one-time task almost exclusively clerical in character. As a practical expedient we have committed this task to a stand-alone program that can be used by a clerk-typist; this frees professional personnel from the most time-consuming aspect of the implementation process. This program is now operational.

Accomplishments during the reporting period which relate to laboratory support software development:

-Completion of display generation program.
-Completion of table editing program.
-Completion of the LIS prototype, implementation tests, and major improvements in interaction network logic.

Data Management and Analysis

CCBS efforts in this area are focused on forms of interactive
data analysis that will allow a substantive expert (the researcher,
the policy-maker, the policy-analyst, the decision-maker, etc.)
to exercise his judgment in the course of the analytic process.
The principal efforts in this direction are the TRACE and IDEA
developments.

TRACE--This is a highly general system of programs that
produce the equivalent of an implicit programming
system. Implicit programming is tantamount to
"natural-interaction"--the user does not need to be
explicitly concerned with data management; all data
management is accomplished without direct specification.
Functionally, this transforms the user into a data
analyst technician without having to know or exercise
data analysis computing techniques. The support that
enables this sort of functional transformation is
extensive and complex. TRACE is composed of three major
components: a compiler that interacts with the user, a
data-base management component that builds and updates
the primary data structures; and a manipulative component
that acts on the data structure to produce the desired
results. (A description of the TRACE system is contained
in P-2, TRACE: An Implicit Programming System for
Inductive Data Analysis, attached to this report.)

The CCBS virtual memory developments affords a direct
extension of the TRACE concept; virtual memory extends
the implicit programming capabilities to large data
systems that exceed core memory limitations.

IDEA--The IDEA program offers an inductive aid to a researcher for discovering and summarizing potentially interesting data models in the form of restricted tree structures for a multivariate data base. It permits the investigator to collaborate with an open-ended library of programmed heuristics on the process of uncovering and representing the structure of his data.

The interactive aspect of IDEA is essential since the number of potential decision trees for any interesting set of data is too large to permit exhaustive search for the best partitions, and the character of the data may be inconsistent with exhaustive search even if it were computationally possible. The program is thus designed to employ heuristics and to permit the investigator to monitor the process and to intercede when slavish application would produce artifactual results.

A fully interactive version of IDEA is available on the CCMS system. It is continuously being modified with user experience and additional capabilities. A revised version of "A Users Guide to IDEA in the CCMS System" has been completed. (CCMS-TM-24).

Accomplishments during this reporting period in the area of interactive data analysis:

> ·Completion and documentation of IDEA.
> ·Completion of prototype version of TRACE interpreter; coding of TRACE compiler.

Laboratory Facilities

Housing for the CCBS computer-based laboratory is being developed on the U.C.L.A. campus. A facility of approximately 6,000 square feet will provide space for the computer, laboratory, and staff offices. This facility is now in the final phases of construction; following construction, the laboratory will be outfitted for operations. In addition to the computer and interaction terminals, the laboratory requires other equipment (for monitoring, recording, stimulus presentation, and information exchange) in order to provide adequate facilities for a wide range of behavioral investigation. Specifications have been made for integrating a closed-circuit T.V. system, an audio monitoring/recording system, and a general control system into the computer-based laboratory.

Video System

The video system will consist of a closed circuit television camera and monitor in each of the 24 experimental cubicles, video recorders, mixers, patch panels, special effects generators, and other equipment. The video system will provide for remote visual observation of subjects, recording of subjects' gross behavior, and presentation of training and stimulus information.

Audio System

In addition to the audio channel of the video system, independent audio capabilities are required, consisting of a speaker in each experimental cubicle connected through a patch panel to a central public-address type system.

Acquisition and installation of laboratory equipment will be made in the Spring. The laboratory will be fully operational in Summer 1972.

Accomplishments during this reporting period in the area of physical laboratory developments:

> ·Design study leading to specification of
> laboratory equipment.
> ·Completion of phase I of laboratory building.

Simulation Research and Methodology Development

Laboratory simulation exercises are being conducted at a number of centers for the study of international relations, for evaluation of political-military strategy for crises and long range planning, and for study of other allied topics. One of two divergent approaches are characteristically used in these gaming efforts. In policy-oriented gaming, where credibility and realism are emphasized, data are not systematically recorded and analyzed, methodologies employed are typically unevaluated, and experimental control is deemed unnecessary except for constraining player departures from realism or the gamer's intended focus. In research-oriented gaming, where theoretical and methodological issues are of primary concern, superficial representation of reality and the use of unskilled players have led to extensive criticism and charges of triviality. In either case, because these games are administered, played, and observed manually[*], they are severely limited in the amount and subtlety of monitoring and control, in the level of detail and volume of data that can be gathered, and in the role played by the analysis of these data. Furthermore, where the complexity of situations being studied does not readily yield to the control sought in the standard application of the laboratory experiment--a situation characteristic of almost all laboratory gaming--these limitations in data acquisition critically curtail the value of these exercises for evaluation or research purposes. Consequently, whether policy- or research-oriented, such games are unable to deal with a number of important questions, some of which are so fundamental as to bear on the validity of the games themselves.

Our research plan attempts to join the assets in both approaches and to reduce a number of the limitations associated with each.

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[*] In almost all so-called man-machine exercises, the computer serves as little more than a rapid desk calculator rather than as an on-line tool to improve the data collection and dissemination processes.

In particular, an attempt is being made to realize jointly the objectives of the theory-oriented researcher, and the more stringent demands for credibility and relevance of the policy-oriented practitioner, through our newly-developed on-line capabilities. Furthermore, through a strategy of overlapping data linkages with non-simulation approaches, we hope to increase the generalizability and utility of simulation studies and data.

In our program of research, we continue efforts that are directed toward a number of related goals: 1) Determination and study of issues which are simultaneously important issues in U.S. foreign policy and which are amenable to theoretical and research analysis that may be applied in a simulation setting, 2) development of computer and associated simulation methodologies for laboratory exercises, 3) development of computer simulation submodels of international processes based on the theory and data generated in the laboratory simulation studies and from real world data bank studies, 4) experimental and para-laboratory studies of human behavior in situational conflict, and 5) incorporation of real world data and on-line data and management techniques to help specify variables and control activities in the simulation setting. Project activities during the past six months have been undertaken and are described in all of the above-listed areas except under items "3" and "5". The latter will be initiated when the TRACE-III system is operational.

Scenario Topics, Conceptual Issues, and Scenario Developments

Proposed and developed simulation scenarios will continue to focus on some of the central issues of American foreign policy today--the factors influencing the degree, form and effectiveness of U.S.-U.S.S.R. involvement in local conflict.

A key problem of the United States foreign policy in the next decade will be the extent to which the United States can, in future crises, take actions that are commensurate with its conventional and nuclear power, its economic strength, its scientific

and technological status, and its interests in the outcome of the
crisis. We are concerned with studying the factors which permit
or constrain the United States and the Soviet Union from taking
action in a set of representative crisis situations.

While pursuing the detailed development of particular scenarios
we are attempting to set forth a conceptual framework that
raises ques'ions about the dynamics of great power involvement.
Most particularly we are concerned with the dynamics of con-
frontation and commitment processes in these circumstances. The
evolving framework and hypotheses of interest are being used to
shape scenarios and the simulation format as much as possible
without compromising their policy-validity and their utility for
policy analysis.

Confrontation Theory: A Theoretical Framework

In exploring the field of deterrence theory as it relates to
U.S. involved crises in the third-world area, we began by review-
ing case studies of what has happened in earlier crises (Korea,
Quemoy, Vietnam). This led us to the formulation of a number of
general questions designed to help us explore the conditions of
successful and unsuccessful deterrence and led to the development
of a new conceptualization of "Confrontation Theory: Introduction"
by Professor David Wilkinson and other members of the simulation
project staff. In summary, confrontation theory includes
initiation theory (accounting for an Act -- or its
omission), response theory (explaining a Counteract -- or a
failure to Counteract), and outcome theory (explaining the result
of a confrontation). This effort was reported in the last
technical report and in a document cited in that report. Laboratory
studies based on this framework will not be initiated until the
move to the laboratory facility is completed.

The Role of Commitment Processes in Defining Foreign Policy

This effort began as an attempt to develop a conceptual framework
for describing and explaining changes in military "commitments"
exhibited in data from earlier simulation runs. Beginning with the
data obtained from the 1973 Mid-East exercises, we have focused on

the significance of commitments in the relationship between the
principal belligerents, Israel and Egypt and their patron superpowers,
USA and USSR.

To what extent, for example, do the major-minor power partners
agree or differ in their understanding of the nature and strength
of the commitment? Are there any misreadings of degree or kind
of superpower commitments by adversaries as a result of implicit-
ness of commitments? How does Israel's acquisition (in the
game) of nuclear capability change the nature, strength and
communication of these commitments?

In attempting to answer these types of questions we have developed
and administered scales and associated structured interviews
with game participants and other interviewees. The scales aimed
at determining the strength or willingness of the superpowers to
honor defensive commitments against threats to their local allies.

The most recent work has shifted its earlier focus away from
these empirical pursuits to the development of a theoretical-
empirical framework for studying the behavior associated with
military "commitments". This effort has resulted in the formula-
tion of two sets of hypotheses which have both generality and
relevance to many third world area conflicts and which nevertheless
are capable of being operationalized and evaluated for their
significance in a variety of particular real world settings. A
further treatment of these hypotheses and associated explanations
are in preparation for publication. The hypotheses are presented
here with a brief introduction to illustrate their form and content.

Hypotheses on Commitment Credibility. "Credibility of
commitment" refers to others' perceptions of the committor's
intentions to defend its client or ally with a military response
strong enough to raise the attacker's costs to unacceptably high
levels. A credible commitment thus entails an expected military
response strong enough to deter a would-be challenger. What
constitutes a "strong enough" response will, of course, vary
depending on the conflict situation and the particular challenger.

Given the importance of deterrence in nuclear strategy, there is considerable attention in current literature to what makes a commitment credible. W. W. Kaufmann, Herman Kahn, Bruce Russett, Thomas Schilling, Charles Wolf, Jr., among others, have all addressed themselves to this question. Below is a restatement or reformulation of propositions suggested by their works and by independent study of the various U.S. military commitments in the postwar period.

It is hypothesized that a defender's (D_1) threat to defend a client (D_2) tends to be more credible to a challenger (C).

1. The greater C's estimates of the superiority of D_1's local military forces over his own.

2. The greater C's estimates of the superiority of D_1's strategic military forces over his own.

3. The greater C's perception that D_1's governmental stability is at stake in the successful defense of D_2.

4. The greater C's perception that D_1's other or future military commitments is at stake in the successful defense of D_2.

5. The more unambiguous C's perceptions of D_1's public declarations to defend D_2.

6. The stronger C's perception of D_1's actions taken in support of his threats.

7. The greater C's perception of the reliability of D_1's fulfillment of comparable commitment promises in the past.

8. The greater C's perceptions of D_1's possible losses of some economic value in D_2 if D_2 were defeated.

9. The less C's perception of D_1's possible losses of some economic value in C (and C's allies) if he enters war against C.

10. The greater C's perceptions of D_1's possible losses of some military value if D_2 should be defeated.

11. The more "total" C's perception of D_1's assessment of his objectives against D_2.

12. The greater C's perception of the public support in D_2's country for military resistance against C.

Hypotheses on factors enhancing the defender's willingness to increase the credibility of his commitment.

The "Credibility" of a defender's commitment refers to the challenger's (and other actors') perceptions of the defender's intentions to use military force in defense of the client against a challenger's attack. Most of the deterrence literature has been concerned with explaining what makes commitments credible in the eyes of other actors. There is another aspect of this problem however--an aspect concerned with explaining those conditions which tend to make a potential defender more willing to increase the credibility of his commitment in order to deter the challenger from attacking the client. It is the defender's willingness to increase his commitment credibility which is of interest in this set of hypotheses.

The defender is in a situation, then, in which he perceives his commitment as not being fully credible to the challenger. There are essentially two reasons why his commitment may not be credible. His capabilities may not be perceived as strong enough to defend the client; or he may be perceived as not having very strong intentions (for a variety of reasons discussed in the first set of hypotheses. These two reasons are often intertwined, and it is not important to distinguish them here for theoretical purposes. A defender may perceive that it is a matter of enhancing his credibility through increasing his military capability or through increasing his resolve or both. The following propositions are sufficiently general so that they apply to both circumstances.

Many of the propositions are reformulations of those in the previous section with the same independent variables seen to enhance a commitment's crediblity as well as the defender's willingness to strengthen it.

It is hypothesized that a defender (D_1) will act to increase
the credibility of his commitment to defend the client (D_2):

1. The greater D_1's perception that his governmental stability
   is at stake in the successful defense of D_2.

2. The greater D_1's perception that the credibility of his
   other military commitments is at stake in the successful
   defense of D_2.

3. The greater D_1's perception of the possible losses of some
   economic value in D_2 if D_2 were defeated.

4. The less D_1's perception of possible losses of some
   economic value in C (and in C's allies) if D_1 should go
   to war against C.

5. The greater D_1's perception of his possible military losses
   if D_2 should be defeated.

6. The more "total" D_1's perception of C's objectives against
   D_2.

7. The greater D_1's perception of the public support in D_2's
   country for military resistance against C.

8. The less D_1's perception of the probability that D_2 might
   force him into a war against C through the initiation of an
   attack against C.

Each of the variables specified in the hypotheses have been
operationalized at two or more distinct levels in the form of
paragraphs designed for modular incorporation into a Mid East
scenario. This procedure will permit assessment of the impact
of these variables both separately and in various combinations.
Associated instruction, background materials, and questionnaires
have been prepared from the perspective of U.S. and Soviet
decision-making teams and pilot runs on these materials have been
initiated. The general method used for conducting these paper
and pencil scenquest exercises is described on pages 37 and 38.

A Book on Scenario Design and Construction for International
Relations Simulation Exercises.

Although simulation games are finding wider usage (in universities
and military colleges, as well as in military exercises), practically
nothing has been written on how to prepare good scenarios, nor have
any systematic procedures been developed to assist the scenario
designer in organizing information, materials and concepts. Scenario
design remains an art in which only few practitioners achieve
products of high quality. As a consequence, most scenarios are
designed on a hit-or-miss basis and are excessively costly; the
implications for playability, representativeness, and relevance
to theory and policy concerns are left to intuitive decision.

The purpose of the planned book will be to provide general and
specific guidance on scenario development for study of inter-
national crises so as to contribute to an improved quality and
economy of gaming. The book also will serve as a manual on how
to conduct simulations, of procedures, record keeping, control
problems, role playing, debriefing, etc.

During the course of our discussions on this effort, we have been
led to place increased emphasis on the value of constructing a
simulation exercise as an important teaching and learning device.
In order to construct a simulation, the student and designer
must go through a detailed and exhaustive series of steps which
require that he make every explicit assumptions about the nature
of the international system. He must translate these assumptions
into the construction of an alternative world description, and a
crisis scenario, in ways that are logical and internally consistent.
He must clearly sort out the presumed role of the many variables
he has identified, and he must be clear about the purposes and
expectations he is associating with the exercise he is creating.
This is precisely the intellectual process the authors of the
book have found themselves immersed in, and it became increasingly
clear as work progressed that readers of the book should be given
a similar opportunity to go through this process, since it is of

great value as an aid to clear thinking about one's own views of
the international relations process that enter into the scenario
construction. Accordingly, many of the chapters in the book will
go well beyond their original conceptual structure. In addition
to providing instructions to the reader on how to proceed in the
construction of a simulation exercise, and examples of exercise
materials, we will attempt to explicate the step-by-step intellectual
process which led us to make certain choices and assumptions,
and we will provide the framework for the reader to move through
a similar process on his own. We anticipate that this will require
substantially more effort than we had originally assumed, but we
believe it will be well worth it.

The planned book at present is divided into four main sections.
An introductory section will deal with the purpose of simulation
exercises, and their role in the study of international relations.
Another section will address the problem of how to create alterna-
tive world descriptions from a set of variables based on theoretical
and policy considerations. Another section will deal with
scenario construction and examples describing and illustrating how
it will be possible for each investigator to construct, from a wide
variety of simulation possibilities, scenarios that are tailored
to his needs. Characterizations of a variety of national regime
types will further increase the uniqueness of focus that may be
achieved. A final section will deal with the problems of
setting up and playing an international relations game.

In the context of exploring the usefulness of various conceptual
frameworks for structuring the background and play of international
simulation exercises, an Alternative Regime-Types approach with
2, 3 and n-state games was developed (CCBS TM-21). In this paper
the relationship between alternative future worlds and alternative
regime-types is spelled out and assumptions grounding the
alternative regime-type method are noted. The regime-type
process model is described in static and later in dynamic form.
On this basis, two-by-two international relations worlds are
constructed and illustrated by reference to Sino-Soviet relations.

Three state worlds are described next, with the United States
added as a third state, and suggestions are presented as to how
n-state worlds can be built. Throughout, suggestions are made as
to the interrelationship between gaming and this approach; and
the idea is set forth of integrating the two.

In addition to the regime-type paper, three draft chapters have
been completed on this project prior to this reporting period, two
on scenarios, and one on alternative worlds.

A 1976 Mid-East Scenario for a One-Team Simulation Exercise (CCBS-TM-28).

This scenario explores deterrence and commitment considerations
that would motivate an American decision to give large-scale
direct military assistance to Israel under conditions of in-
creasing levels of Arab-Soviet endangerment of Israel.

The game is organized around a pre-game scenario setting the
stage for future developments in the Middle East. It incorporates
a bias; i.e., it assumes that the steps taken by the Soviet
Union in the Middle East since 1955 are following a pattern toward
the exercise of greater influence in the area. It assumes that
the Soviet Union wants to reopen the Suez Canal to facilitate its
shipping, and is linking up its policy activities in this area
with those being undertaken in the Indian Ocean area. The game
will require large-scale direct Soviet military assistance to the
Arab nations for the announced purpose of forcing Israel back to
her pre-1967 boundaries and implementing the UN resolutions of
November 22, 1967, which were supported by the United States. The
essentials of this scenario were developed from materials in the
New York Times for June 5 and June 28, 1970, by C. L. Sulzberger
and George Ball.

The game scenario introduces at reasonable intervals a series of
Arab-Soviet actions which progressively threaten Israel's
security and, ultimately, its survival as a state. Control
presents to the U.S. team at each interval a description of the

situation created by a new Arab-Soviet action. An Israeli request for a specific amount of U.S. military assistance is then made, and the U.S. team is required to decide on a reply from a range of alternatives, to give an explanation and rationale for the decision, and to make an estimate of the effects that their decision will have, i.e., what the next Arab-Soviet action will probably be. The game scenario is designed to progressively sharpen a conflict in goals for the U.S. team -- on the one hand there is concern for the viability of Israel as a nation, and on the other the concern not to become involved in overt hostilities with the Soviets in the Middle East. The U.S. team, then, will presumably be faced with a dilemma -- two mutually exclusive strategies, each with potentially good and bad consequences. The scenario is designed to examine the behavior of U.S players who cannot escape between the horns of this dilemma (i.e., finding an easy "solution"); but it does not prevent players from temporizing or trying to compromise. The question of substantive interest, then is whether players will accept the consequences of one of the pure strategies (commitment or non-involvement) or be drawn to compromise alternatives (some level of partial commitment with attendant partial involvement) which are psychologically attractive, but may be strategically poor in a series of escalation moves.

Pilot runs of the game have been conducted successfully in a manual semicomputer mode, and programming the simulation for computer administration has been completed with a revised version of the pre-game scenario and game moves. Laboratory runs on the computer will be initiated after the move to the new laboratory is completed.

Content Analysis of Completed Mid-East 1973 Simulation Exercises.

In our earlier simulation series, we focused on achieving a laboratory simulation that avoids or minimizes the use of procedures that trivialize or simplify issues so that the simulation activities and results would not be viewed as superficial by

policy experts. With this goal, a series of four manual simulation exercises were run using a Mid-East crisis scenario that explored the political-military implication of nuclear acquisition by Israel. The four runs differed primarily in terms of the levels of sophistication of the participants. In these runs, four teams (three members each) represented Egypt, Israel, the United States and the Soviet Union.

The data generated in our simulation exercises for our content analysis included team communiques, public "messages" to international "press services", "speeches" in the United Nations, game moves and national team position papers (an evaluation of the situation of related objectives and contingencies prepared at the beginning of each session).

An approximate total of 24,000 words were encoded, half of which were manually tagged (in distinct thematic units of actor-action-target) and used in the program output. The scenario, encoded in about 4,000 words, itself was similarly analyzed to assess the degree and direction of the scenario writer's bias. These data for the four exercises and for each team were analyzed and aggregated to test a number of hypotheses.

The primary research tool used in these investigations is the General Inquirer computer program for content analysis, as modified by Oli Holsti while at Stanford University. At its core, the Stanford General Inquirer utilizes a 3700 word dictionary-- a listing and "definition" of the most frequently occurring words generally found in political documents. Each word in the dictionary is scaled along three basic semantic dimensions -- evaluative (good-bad), potency (weak-strong) and activity (active-passive). The use of this particular dictionary reflects the basic assumption that when decision makers perceive any object of meaning, including themselves, the most relevant discriminations made are based on these three dimensions.

The output of the Stanford General Inquirer allows an investigator to draw conclusions regarding a nation's perception of the qualities and performance of any national actor and of a nation's **actions** toward any other particular national actor (included in the set of documents under analysis). Thus, one may examine how national actors (perceivers) evaluate any other nation -- along the three semantic differentials.

The purpose of the policy-oriented scenario was to examine the possible political and military consequences of a nuclear-armed Israel within a Middle East crisis situation. Nevertheless, the content analysis of the simulation data generated in the study of a specific problem also afforded an opportunity to test a number of broad hypotheses related to international relations theory in general. These hypotheses and corollaries were developed in three main areas:

1. Perceptions within and between alliance members.

   Hy: A nation's evaluation of the qualities of its ally is more positive than the evaluation of the quality of its opponents.

   Hy: A nation tends to perceive its own action toward an ally in more positive terms than it perceives its own actions toward an opponent.

   Hy: A nation tends to perceive the action of its ally toward itself as more positive than it perceives the action of its ally toward an opponent.

Statistical tests confirm all three hypotheses. When the first two hypotheses are tested for each specific configurations of super power and local power for the two alliances (U.S.-Israel and U.S.S.R.-U.A.R.), eight additional predictions are generated, and four of these are confirmed by statistical tests. Two of the four derived predictions from the third hypothesis for the super power-

low power configurations are statistically significant.

2. Perception as a function of the national actor's power status.

   Hy: A super power opponent is evaluated more positively than a local power opponent regardless of the perceiver's power status.

   Hy: A nation perceives its own actions toward a super power opponent in more positive terms than it perceives its own actions toward its local opponent. (These two hypotheses were derived from Herman Kahn's "basic rules" applied to the particular Middle East subsystem represented in our simulation). Statistical tests confirm both of these hypotheses.

3. "The tendency for decision makers to see other states as more hostile than they themselves are" - Jervis.

   Hy: Every nation (X) perceives every other nation (Y) as more threatening than the other nation (Y) perceives itself.

   Hy: Every nation (X) perceives any other nation (Y) as more threatening (or hostile) than it (X) perceives itself.

   Hy: Nations perceive the actions of other nations toward themselves as more threatening (or hostile) than other nations perceive these same actions.

   Statistical tests confirm all three hypotheses.

4. Dynamics of misperception in crises or differential threat perception.

   Hy: A local power (X) perceives its own actions toward its local opponent in more positive terms than it (X)

perceives the actions of its local opponent toward
itself.

Hy: A super power tends to perceive the action of its
local ally toward its local opponent in more positive
terms than the super power perceives the actions of
its local opponent toward its local ally. Statistical
tests confirm both hypotheses.

These illustrative results, while hardly counter intuitive, are
nevertheless an important confirmation that perceptions expressed
in the messages and documents generated in the simulated exercise
and analyzed by content analysis techniques confirm to general
hypotheses about national actors in the international system.
Perhaps of even more importance is the fact that these results were
obtained in a policy-oriented exercise not designed to test the
hypotheses. They thus lend greater credibility to the interpreta-
bility of simulation results. A complete report on the tests of
the hypotheses is being prepared for publication.

Computer Methodology Developments

The most important development in this area is that associated
with the computer-based laboratory implementation system (LIS)
reported on pages 13 and 14 of this report. Three other
significant developments are associated with the work on the two
Mid-East exercises described in the preceding pages.

One-Team Simulation Exercises

The purpose in developing a one-team simulation is to create an
international relations game which requires only limited personnel
for administration, and affords greater control for research
purposes. It is an effort to provide a simulation format that
offers greater efficiency, control, and standardization; this is
the rationale for reducing the response roles to a single
team, the U.S., while all other nation roles in the game are

simulated. Not only can a number of U.S. teams be run simultaneously, but the physical presence of a number of teams adds to the credibility that these other teams are being played "live" rather than being simulated by the experimenter.

The computer programming for this activity has been implemented in relations to the simulation exercise described on pages 27 and 28. Laboratory runs will be initiated using this computer-administered format when we move into the laboratory facility.

Interactive Automatic Theme Encoding of Messages and Documents for Content Analysis.

Progress in the area of automated language analysis has continued in recent years, with major attention turned away from such unmanageable tasks as fully automatic high quality language translation to the development of more sophisticated syntactic and lexical techniques for other applications. These techniques may be employed to meet the need for more efficient analysis of verbal interaction data that are collected in experimental gaming, social interaction, and simulation studies or for analysis of documents. For the most part, such data are either superficially analyzed by such computer programs as the General Inquirer, or great sums of time and money are spent in having them more deeply analyzed by trained coders. For instance, when thematic analysis distinctions are required for the computerized content analysis previously described, this was all done manually.

Operational translation-oriented parsing systems (parsing program, grammar, and dictionary) such as the Harvard Syntactic Analyzer and RAND's PARSE have been shown to correctly analyze about 50% of the sentences encountered in ordinary newspaper text; the remainder are multiply parsed (about 30%), not parsed at all (about 15%), or parsed incorrectly (about 5%). There is good reason to think that for the task of theme encoding the corresponding performance figures can be improved significantly, making such a system a practically useful tool in message and document analysis.

The problems of automatic parsing for theme encoding can be reduced to tractable proportions by some combination of the following approaches: 1) The scope of the burdens of grammatical analysis is narrowed by the character of the theme encoding task. Theme analysis of the Stanford type (recognizing actor/action/target, and associated modifiers of each) is different from and simpler than grammatical analysis for mechanical translation. 2) The language of the message composer may be contrained to accommodate the theme encoding system. The composer may be required either (a) to use a habitable English subset, or (b) to provide ancillary cues with messages in unrestricted English. Either alternative, if used, would be implemented with interactive training and refresher aids. 3) Interactive man/machine resolution of theme encoding problems can be introduced at several points in the evolving system. The computer will generate aid requests diagnostic of such a problem to a human analyst who will then supply additional data or decisions as require¹.

The grammatical requirements of automated thematic analysis, the consequent extent and kinds of language restrictions on message composers, and the tactics of man/machine integration in overall system design will be the subject of investigation to determine a configuration that least restricts and interrupts the message composer while achieving acceptable levels of performance in theme encoding.

This effort has begun with the development of a thematic parser of the augmented transition-network type.[1] This relatively new class of syntactic processors offers great logical power and efficient performance while retaining a perspicuous structure that

[1] See William A. Woods, Augmented Transition Networks for Natural Language Analysis, Report No. CS-1, Aiken Computation Laboratory, Harvard University, December 1969. We wish to acknowledge here our considerable debt to Mr. Ronald Kaplan of Harvard University whose BBNLISP transition-network grammar of English serves as a model for our initial implementation.

aids, rather than impedes, grammatical "tuning" for specific applications. In addition, the augmented transition-network model lends itself comfortably to operation in an interactive environment.

Having settled on a suitable model for grammatical analysis, it then became possible to specify the remaining main components of TES. These include: a grammatical dictionary and a companion set of look-up and maintenance procedures, a theme-encoding procedure, and an interactive communications processor.

In our initial implementation of TES, the grammatical dictionary will be no larger than is required to support meaningful system debugging, testing, and tuning. This will permit relatively rapid evolution of the central processing modules while avoiding the expensive nuisance of revising all entries in a full-scale dictionary to reflect each change in the grammar. The relatively small initial dictionary also permits us to postpone certain basic systems programming tasks involved in the implementation of an efficient search procedure for a large dictionary until the over-all implementation has reached a reasonably mature stability.

The theme-encoding procedure itself is logically simple when compared to the grammatical analyzer. It scans the sentence structure produced by the grammatical analyzer and assigns thematic tags in a fairly straightforward fashion to the words and phrases of the original text. This implies that the grammatical analyzer will carry the major burden of thematic analysis--a decision which is consonant with the power of the grammatical analyzer. The theme-encoding procedure may thus be viewed as an output transducer whose principal task is the deletion of structure required in the grammatical analysis but valueless in subsequent operations.

The interactive communications processor occupies a central role in TES, both in the developmental and mature stages of the system's evolution. This processor accepts intervention requests from other system components as well as from the user. In handling such requests, and their replies, the interactive processor is able to shape its own behavior in accordance with its knowledge of the state of the overall system. Initial performance of TES will provide estimates for the determination of initial system requirements. The development of interactive and fully-automatic system components will proceed jointly. To the greatest extent possible, especially in the area of dictionary development, existing programs and data will be adapted to our purposes.

A general document describing the grammar-parser has been written by Gary Martins (CCBS TM-18) August, 1971.

The overall progress of the project has been encouraging. Programming of the grammatical analyzer--by far the largest single component of TES--is now about 85-90% complete, and should be completed shortly. Development of the experimental dictionary has begun and is expected to proceed smoothly.

Direct Validity Tests of the Stanford General Inquirer.

The problem of assessing the validity of computer content analysis methods is not fundamentally different from that of assessing the validity of any measuring instrument. Does it measure what it purports to measure?

Attempts to establish validity are of two kinds. Construct (direct) validity is afforded by determining how well estimates using the instrument compare with alternative means of measuring the same phenomena. Thus a new IQ test might be compared with other measures or teachers' ratings of intelligence. Predictive validity attempts to assess an instrument by inferring its validity indirectly by examining its hypothesized relationships with other variables. A good measure will normally exhibit both forms of

validity. It is thus surprising that although the Stanford
General Inquirer has been extensively used in the analysis of
political documents, there is not a single published report that
indicates whether the inferences based on the three semantic
differential scales used to describe national actors and their
behavior conforms to similar characterizations obtained by other
means. Instead, validity of these scales has been inferred in-
directly from hypothesized relationships of the semantic
differential categories to other variables. Since reported
relationships are not impressively high nor uniformly obtained,
there is an obvious need for some simple, direct assessments of
validity of the Stanford General Inquirer. A series of simple
experimental tests are planned to get at the validity of the
techniques by systematically exposing errors which may occur at
various stages in the content analysis procedures.

Initially, global assessment of validity will be made. Subjects
will be presented with paper-and-pencil descriptions of situations
involving a number of nations in well-defined conflicts or crises.
Nation descriptions will be systematically differentiated in
terms of attributes and behavior that would presumably lead to
differential characterization along the evaluative, potency and
activity dimensions. Subjects will then be asked to assume
the roles of statesmen and/or advisors to one of these different
nations and to compose a variety of messages consistent with the
information provided. Validity will be assessed by determining
how successfully the Stanford General Inquirer will be able to
reconstruct actor action and target characterizations consistent
with the specific information sets provided subjects. Beyond this
general comparison the analysis will also attempt to determine
whether the content analysis is done equally well for the three
different scales; for actor, action and target units and whether
different kinds of messages will be better or poorer vehicles
for assessing scale information. Still at a general level, but
viewing the messages from the standpoint of the recipient or
policy analyst, to what extent will "natural" readings of the
messages be consistent with the set of implications drawn forth

by the computer analysis. To be sure, these are basic, general questions, but there is no information available of even this elementary kind.

At a more analytical level, to what extent does the semantic differential signification of a given sign depend on linquistic context? Are there general contextual determinants that can be identified, corrected, weighted, ignored? Are there more useful or appropriate grammatical parsings?

The potential questions are, of course, endless and a strategy of evaluation must be designed that is both economical and which moves rapidly to detect the major contributions to validity and error variance.

The analyses are still at the planning stage, but it is quite clear that they can be undertaken with minimal cost and effort. At the same time it is expected they would serve two major purposes of considerable importance: 1) The results would provide a much needed and long-overdue direct assessment of the validity of the content analysis procedures, and 2) the approach would initiate a more differentiated response to the detection and analysis of the various stages in content analysis at which error may occur. The identification of these points in the analysis process where validity is lost would also provide specific requirements for the preceding project on computer interactive theme encoding of verbal documents.

Thematic and instructional material for the first phase of this study has been prepared for pilot studies and experimentation.

Sequential Coding: A Suggested Modification to the Stanford Syntactic Codes.

As a by-product of the two preceding efforts, an improved method for content coding has been conceptualized and described in the

last technical report. It utilizes interactions of the three
individual Stanford codes (agent, action, target) together with
operators (modifiers) to form <u>sequences of codes</u>. This method
affords a more precise characterization of content relationships
between sentence constituents than is possible with the use of
the Stanford individual codes. That is to say, the sequential
coding is closer to the natural reading of sentence content than
that permitted by the Stanford coding.

The sequential coding system is based on a very simple grammatical
structure using only three grammatical categories: predicates,
operators, and individual names. With minor exceptions,
predicates are two-place relations, the first place correspond-
ing to the coding category "agent", the second place corresponding
to the coding category "target", and the predicate itself correspond-
ing to the coding category "action"; predicates include all
ordinary verbs and common nouns. Operators are of two kinds:
logical operators, constituted by the logical connections and
quantifiers together with their time, quality or type, purpose
or cause, source, and destination; modality operators include
all ordinary adverbs and adjectives. Individual names are names
of individual objects of interest, such as nation names, descriptions
of nations, cities, geographical regions, political regions, etc.
By allowing predicates to enter into the first or second place
of other predicates (i.e., to occur within other agents and
targets), we are able to uniformly represent the content structure
of a great variety of English sentences using only three
grammatical categories, and to encode this structure by iteration
of agent, action, target, and modality codes into suitable
sequences. A paper describing the method was produced by
Peter Tripodes.

A second document entitled, An Automatic Coder Utilizing Sequential
Codes has also been written by Peter Tripodes (CCBS TM-26)
which describes a procedure for automatically encoding text by
the various labels indicating actions and characteristics of
national actors, as used in the Stanford version of the General

Inquirer. This procedure effects an automatic approximation to the man-executed operation of affixing these labels to appropriate words of the text.

An important feature of this procedure is its simplicity, which is made possible by the employment of sequential codes for representing multiple roles of words in sentences as described in the first paper. By these means we are able to duplicate the effect of some complex judgments made by the human coder with a minimum of devices.

The procedure is carried out in two steps: the first step affixes sequential codes to appropriate words of the text; the second step converts each sequential code to a single code, thereby converting the output into the standard form used by the human coder operating with the Stanford version of the General Inquirer.

Experimental and Para-laboratory Research Studies of Human Behavior in Situational Conflict.

The simulation approach, because of its complexity, particularly needs to be closely interrelated at many levels with other techniques of investigation to clarify its findings, to serve as a direct source of hypotheses, and as a simple setting for developing and testing new methods. It is necessary, then, that the research program continue to range widely in its approaches to problems from paper-and-pencil situations to computer-based experimentation and that data from these studies be more closely linked. While these studies are only a small part of the total effort, we believe it is particularly important to continue two lines of investigation in support of the simulation activities: 1) our earlier program of experimental studies in the new computer laboratory, and 2) SCENQUEST studies.

While no new experimental studies are being undertaken until the laboratory is available, results of earlier studies continue to be

analyzed and written up.

SCENQUEST - A Scenario Questionnaire Technique for Studying
In-process Phenomena in Conflict Resolution.

Many in-process phenomena cannot be studied easily in simulation
exercises because they occur rarely, or follow unique patterns
of antecedent events, or require more extensive subjective
analysis than can be easily obtained during the exercise. The
SCENQUEST approach, based on a combination of standard techniques,
affords the laboratory investigator a convenient, low-cost means
of collecting data on a wide variety of situations that require
control and standardization of antecedent events. An example of
such a situation is a player's sudden shift to aggressive moves
in a condition that had been stable and characterized by coopera-
tion, and where no outside triggering event could be detected.

In the SCENQUEST approach, the experimental subject is given a
specific opening or ongoing situation or game. The synopsis is
in dramatic, real-life terms or in bare-bone, analytical ones,
and may concern situations as complex as those presented in
simulation scenarios or as simple as those in a prisoner's
dilemma experiment. The synopsis may give a summary history
of the events and decisions made by both parties up to a given
point. The subject reads the scenario from the point of view of
one party in the situation; he is then asked to respond as if he
were in the situation with the history as it is given and in the
designated party's place. He then records his response on a
questionnaire form. This procedure contrasts with role-playing
where a person is asked to adopt another's attitudes, opinions, etc.
The respondent here is situation-playing.

Determinants of Size of Conflict. An ongoing SCENQUEST study explores
a number of determinants of the perceived size of conflict at the
opening phase of an experimental bargaining situation. Variables
identified for analysis include size of stake in the bargaining,
divisibility of issues into separable bargaining units, amount of

opportunity for exchange of bargaining offers within a negotiation encounter, number of negotiation encounters, and degree of inequality of trial outcomes (relatively equal to vs. highly unequal potential division). Game materials, instructions and recording forms were developed for these variations in a 2^5 experimental design. A set of 57 dependent measures and 26 derived measures were used to assess the effects of the independent variables on earning goals, strategic and tactical planning and on self and other bargainer perceptions. Data collection for 480 subjects were completed. The results appear to be unusually promising in separating out factors that contribute to a global, effective orientation to negotiation versus a strategic orientation to the variety of negotiation situations presented. Preliminary findings were reported in the last technical report. During the past reporting period the first of two write-ups of the analyses of these results has been completed. (CCBS TM-25)

1. Incentive Effects. A paper on "The Effects of Size of Payoff and Real Versus Imaginary Rewards on Pre-Bargaining Perceptions" was submitted for presentation at the American Psychological Association Meetings at Hawaii. This paper investigates the effect of real vs. imaginary and $2 vs. $20 payoffs on the large set of pre-negotiation perceptions described.

Previous bargaining experiments manipulating payoff type (real vs. imaginary) and quantity have yielded conflicting results. In general, these studies have failed to distinguish effects at different stages of bargaining and to collect data that permit discrimination among contending explanations. Results indicate that the two incentive variable effects are less similar than assumed. The quantity variation primarily affects strategic stance; the real-imaginary variation primarily influences the "maximizing-difference" orientation. Most importantly, both effects are salient prior to the start of bargaining.

These and other related findings on incentive help to clarify the important differences in orientation that result from incentive manipulations and indicate that its effect on behavior is more complex than that suggested by a characterization of consequences that derive from a simple "more-or-less" incentive conception.

2.   The second report will include an analysis of two additional variables, unequal trial outcomes and potential for equalizing overall bargaining outcomes. Where subjects believed they were to bargain for real money stakes, characterization of themselves and of their adversaries on semantic differential items differed significantly as a function of the variable "inequality of trial outcome". Where trial outcome differences would be large, subjects rated themselves and their adversary significantly lower on all five items associated with the evaluative factor--i.e., as less trustworthy less peaceful, less moral, less fair, and less generous -- than where relatively equal division of outcomes could be achieved through negotiation. Subjects also rated themselves higher on two of five dynamism factor items, more active and more unyielding, and also, more competitive, when trial outcome inequality was large than when it was small. The number of trials (1 or 10) was important in determining whether inequality of trial outcome could be equalized. (Equality could be achieved in the ten-trial condition if subjects agreed to "take turns" in opting for the larger outcome; of course, this was not possible in the one-trial condition.) Subjects characterized themselves as more competitive in the one-trial than in the ten-trial conditions when playing for real money.

In contrast to these findings, it is of interest that in response to questions regarding tactics and strategy, the subject took into account more closely the actual strategic contingencies of the situation, determined by the combination of both the trial and the inequality of trial outcome variables. Thus, when required to set an earnings goal, to estimate the proportion of outcome that he expected the other bargainer and he would earn,

and to specify the contracts he would propose, the subject's
response was a function of both the trial variable -- S intended
to bargain "harder" in the one-trial condition than in the ten-
trial condition -- and of the asymmetry variable -- S intended to
bargain "harder" when asymmetry was high -- so long as the outcome
at stake was real money.

When the subject was to bargain for imaginary money, however,
his strategic plans were primarily based on his "affective"
orientation to the situation, rather than on the strategic
contingencies.

These partial findings suggest some important empirical bases
for the separation of effective and strategic influences in
negotiation processes. A paper summarizing these findings is
planned for the next reporting period.

A second SCENQUEST study has been incorporated as part of the
Los Angeles Metropolitan Area Survey conducted by the U.C.L.A.
Survey Research Center. At the closing phase of a structured
interview, the respondent is told the following:

Here is a final set of questions I think you will enjoy. I am
going to describe a situation to you, and I want you to imagine
what you would do in this situation. Here it is.

You have been looking at used cars for a number of weeks and have
finally found one that is axactly what you want. The car dealer,
[Mr._____, a_____] happens to live in your
neighborhood, and you have chatted with him a number of times at
the neighborhood food market. After some bargaining over the
selling price [with Mr._____, a _____],
an oral agreement is finally reached which includes the cost of
repainting the car with a special two-tone color of your choosing.
You make a sizeable cash down payment and state that you will
return in two days with the remainder of the money. You obtain

the additional amount as a personal bank loan, and two days later return to pick up the car. When he looks at your check, Mr. _____ tells you that there seems to be a misunderstanding, that you forgot to include the sales tax and excise tax. You tell him that you understood that the agreed price included all taxes, and you are somewhat upset. You check your receipt and find that it is not clear as to whether the additional taxes were included in the amount that you thought was the total price. You don't want to pay any more, in fact, you cannot really afford to pay any more. The car has already cost you more than you intended to spend.

At this point the respondent completes some ratings of himself as a customer in the situation and of the car dealer. The respondent is then told this additional information.

He says he is sorry about the mistake, but he cannot return your deposit as he has already spent much of it on the special paint job that you requested. You suspect, however, that you might be able to convince the dealer to give up some or all of the additional money for taxes if you try. At this point the respondent is asked to indicate which of a number of responses (influence tactics) he might choose, how effective he believes his response would be, and how he responds to the dealer's counter offer.

Two independent variables are studied. 1) The effect of same versus different ethnicity of salesman and respondent. (The scenario describes the salesman as "Mr. Brown, a Negro", "Mr. Goldstein, a Jewish salesman", "Mr. Lopez, a Mexican-American") 2) The effect of a firm or a flexible concession. (The counter-offer that the car salesman makes to the respondent meets him half way or remains unaltered.) The survey sample will systematically sample respondents from each of these ethnic groups.

The data should reveal a great deal about the perceptions of the sample to the situation and variables manipulated. Relatively no data of this kind has been systematically collected. Furthermore, if this technique of using experimentally mainpulated

variables in surveys proves of value, it will open up a relatively untapped domain for data collection and hypothesis testing to augment those collected in the laboratory. The data collection has been completed and after the data have been cleaned up by the Survey Center, they will be made available to us for analysis during the next reporting period.

3. A Scenquest study of misperception or bias of participants versus observers under varied conditions of incentive and ability to influence outcomes.

A popular social psychology theory during the 1960's was dissonance theory, which assumes that man's aim, in making social perceptions, is to rationalize his "driven" behaviors and to perceive himself as acting consistently. Biases in social perceptions were assumed to result from this tendency to reduce dissonance, a motivation aroused when the individual perceives himself as acting inconsistently. The 1970's ushered in attribution "theory", which makes different assumptions from those of dissonance theory. This new approach assumes that man seeks only to perceive his social environment accurately. Biases in social perception are assumed to stem from the fact that man must make situational inferences on the basis of limited information. Thus, biased social perceptions are considered by attribution theorists to be errors in information selection and processing rather than "need-oriented perceptions."

Much of the controversy between theorists of the two schools has centered around frequent differences which occur between the social perceptions of participant actors vs. uninvolved observers of action in the same situation. Dissonance theorists assume that actors are seeking to reduce the dissonance produced by their own behavioral inconsistencies, and to justify their behavior, by their social perceptions. Since neutral observers have no action of their own to justify, they experience no dissonance, and make more "objective" perceptions. Attribution theorists on the other hand assume that different historical information, causal information, and information on consequences is typically available to

actors vs. observers, and that inferences based on these different sources of information lead to different social perceptions, even in the same situation.

The present study proposes a third model of social perception processes. Our instrumental learning model considers human cognizing--including the processes of making social perceptions--to be itself a form of behavior. As such, social perceptions are assumed to be controlled both by environmental stimuli which signify to the perceiver the types of outcomes likely to follow certain courses of action, and by the reinforcing consequences of the perceptions made. We hypothesize that, where an individual's future outcomes are a salient concern to him in perceiving his situation, the individual's discrimination as to whether or not he has power to affect his outcomes is an important determinant of whether he has an incentive to make a strictly accuracy-oriented perceptual response (as predicted by attribution theory) vs. whether he "rationalizes" in perceiving the situation (as hypothesized by dissonance theory.) It is assumed that accuracy-oriented perceptions have instrumental value to the individual whose behavioral choices affect his outcomes, whereas they have little value to the powerless person. The powerless person may then "rationalize" his situation in order to feel better about it.

We assume, then, that differences between actors' and observers' social perceptions are complexly determined by the outcomes which they hope to attain from the situation, by their abilities to affect those outcomes, and by the need of actors to justify certain actions they may take in order to achieve the outcomes they desire. A suggested study to test the importance of these variables is being designed. Identical information about a bargaining situation will be presented to actors and observers in different conditions. Patterns of social perceptions as a function of the above-mentioned variables will be investigated.

The approach suggested in this study not only attempts to test
when the assumptions of each of these social psychological
approaches most accurately describe social perception processes,
but also draws from and suggests extensions of mass society
theory, a theory of major importance in the field of sociology.
For example, the proposal suggests that the powerless or alienated
individual not only learns less about his situation but also
distorts it in a particular direction. If confirmed, the approach
will offer some fresh interpretation of bargainer misperceptions
associated with his relative power to influence his outcomes.

FUTURE PLANS

This section reviews our plans to accomplish the program of re-
search, as discussed in the project's original proposal, within
the funding schedules negotiated as terms of the basic contract.
As reflected in our previous management and fund status reports,
we have discussed a potential need for revision of these terms;
because of delays associated with equipment arrival and facilities
completion, many of the project developments will come to greatest
fruition in the last phase of the contract. At this time it is
apparent that the project will realize its goals more adequately
if the contract completion date is extended for one year so as to
take maximum research use of supporting facilities that have been
developed. Based on the proposed one year extension date of the
contract, the projected plans for the Center focusing primarily on
the next reporting period are the following:

Central Computing System -- Hardware

The computer hardware to support Phase I operations is complete
with the minor exception of a light-pen capability for all terminals.
The light-pen required redesign; that redesign is now complete
and evaluated operationally; it has been transmitted to the manu-
facturer for production and subsequent field installation.

Work on Phase II began with the design study of virtual memory
hardware; the design is complete; fabrication and integration of
the hardware is planned during the next six months. The hardwa
necessary for archive storage will also be acquired before the
end of the fiscal year. A third component of Phase II capability
concerns remote user support; specifications for hardware acquisition
in this area have been deferred to insure compatibility and
maximum performance in the context of the ARPA network; these
requirements will be determined in coordination with our entry into
the network.

Central Computing System -- Software
Phase I software is complete; work in this area will be confined to maintenance and selective upgrading.

Phase II software development is, of course, dependent on the delivery of virtual memory hardware; with the design of that hardware now finalized, formulation of the software design can begin; this design and its implementation is scheduled to be co-incident with hardware fabrication and delivery.

Higher-order Language
The JOVIAL compiler has been delivered and is being used in applications programming; the compiler will be extended, upgraded, and maintained under contract for the next eighteen months. The principle extensions will be the development of a JOVIAL language debugger and the inclusion of virtual storage capability (to take full advantage, at the programming level, of virtual memory hardware developments). The META compiler will be extended and upgraded with special emphasis on increasing its capabilities to reformat data bases.

Laboratory Facilities
The permanent laboratory will be ready for operations by the end of this fiscal year. Equipment to outfit the laboratory has been specified and the major portion will be acquired during the next six months; selected portions of the equipment will not be acquired until requirements can be more usefully defined in the context of operations.

Laboratory Software
A prototype of the laboratory programming system is operational and is being empirically tested; the results thus far have sub-stantiated the basic design concept; the development strategy is

an incremental one which means that, beyond the basic capability,
needs are being defined by operational demand; this process of up-
grading will be continual, but the activity will be greatest when
the system is initially exercised in the context of operations,
i.e. during the next six- to twelve-month period.

Data Analysis/Management System

Separate components of the TRACE system are essentially complete--
SMART has been checked out; an initial version of the TRACE
interpreter is operational; and the TRACE compiler is in the check-
out phase. Integration of the components and system check-out
is planned during the next six months. Subsequent to the system
check-out, the SMART function will be replaced by the implementation
of virtual memory hardware, and the SMART compiler will be more
effectively interfaced with user language requirements.

A book on Scenario Design and Construction for International Relations Simulation Exercises.

A chapter on a descriptive taxonomy for writing scenarios for
alternative world futures is scheduled for completion in the next
reporting period.

Formulation of a Set of Simulation-Testable Propositions in Confrontation and Commitment Theory

With the completion of papers in both of these areas, plans
for testing subsets of variables are being evaluated for simulation
testing. Laboratory implementation awaits completion of the
laboratory facility. The data collection phase of a scenquest
study on the evaluation of variables influencing credibility of
commitment will be initiated during the next reporting period.

A Mid-East Scenario for 1974 for a One-Team Simulation Exercise

The one-team simulation has been programmed for computer administra-
tion. The simulation has been programmed as a two role game -- one
being the Subject role and the other being the Control or experimenter

role. The experimenter controls the content of the situation displays to be presented to the player in each cycle of the simulation; the Subject makes the required type of responses for each cycle; and then the experimenter constructs the situation for the next cycle. Shake-down runs have been made; preliminary data have been used to revise and expand the scenario and associated techniques for on-line elicitation of decisions and responses. A series of experimental runs awaits the completion of the laboratory facility.

Computer-Assisted Interactive Theme-Encoding of Texts for Content Analysis.

Primary efforts have gone into the new augmented recursive transition-network model for the sentence-analysis component of the theme-encoding system. An initial running version of this component of the system is expected to be in operation by the end of the next reporting period. Plans to incorporate a number of interactive subsystems to facilitate timely and convenient human assistance in the theme-encoding process will be based on the early runs with the initial version.

Direct Validity Tests of the Stanford General Inquirer

With the availability of the General Inquirer IV and the Stanford Dictionary experimental validity studies of the kind described will be initiated during the next reporting period and analyzable results will be available at approximately the end of the next reporting period.

Experimentation

Analyses of data from earlier computer laboratory-based experiments will continue and results will be reported. Preliminary plans for experiments are formulated in anticipation of the development of permanent laboratory facilities. These will be used as test cases for the "entry" module of the laboratory software system.

SCENQUEST - Scenario Questionnaire Studies

1) Bargaining data from the U.C.L.A. Survey Research Center has been collected. Analysis of results will be initiated when these cleaned data are made available during the next reporting period.

2) Additional write-ups of the Size of Conflict study are being prepared.

3) Data collection on bargainer misperception and bias under varied conditions of incentive and ability to influence outcomes will be completed.

Professional and Project-Related Activities

Alvin Cooperband attended the 1971 ACM National Conference, Chicago, Illinois, to present papers entitled: "TRACE III: An Implicit Programming System for Inductive Data Analysis", and "LIS: An Implementation System for Designing a Computer-based Experiment", August 3-5.

Gerald Shure attended the US/ONR Decision Making Research Conference, Monterey, California, October 3-5.

Gerald Shure attended the National Gaming Council Conference, Ann Arbor, Michigan, October 6-9.

Gerald Shure met with Dr. Dana Main, University of Michigan on Data Generation Simulation for Psychological Research, and with Dr. Raymond Tanter on CASCOM and CASIS. October 7-8.

Gerald Shure met with Professor Philip Stone, Harvard University, and with Dr. Namenwirth of University of Connecticut to discuss content analysis and CCBS use of the latest General Inquirer programs, October 16-17.

Pete Baker attended the 1971 DECUS Fall Symposium, San Francisco, California, to present a paper entitled: "PDP-10/50 Monitor Cataloguer", November 11-13.

William Moore attended the 1971 DECUS Fall Symposium, San Francisco, California, to present a paper entitled: "SMART: A Multiple-High-Segment Executive System", November 13.

Gerald Shure attended the Peace Research Society Conference, Ann Arbor, Michigan, November 15-16.

Gerald Shure and Al Delucia (contract monitor, RADC) met with Dr. George Lawrence and Col. Austin Kibbler of ARPA, Human Resources Research Office, to discuss future project plans, November 17.

Gerald Shure met with Henry F. De Francisco, Information Science Center, Defense Intelligence School, Anacostia to discuss use of content analysis in center curriculum. November 18.

Gerald Shure and Al DeLucia met at Industrial College of the Armed Forces with Capt. Al Wilhite, Director, Simulation and Computers; and Colonel George Draper. November 18.

Gerald Shure briefed Colonel Thane Minor and senior staff members at SAGA, JCS on the use of CCBS gaming, research data analysis capabilities, particularly through the ARPA network. November 18.

Gerald Shure participated as a member of the international Relations Committee of the American Psychological Association, Division 9, November 18.

Gerald Shure met with Dr. Davis Bobrow and Carl Weick, University of Minnesota, to discuss project developments in the area of international forecasting and computer-aided observational methodology, November 20-24.

Stuart Shaffer was elected first president of the Southern California PDP-10 Users Group.

Stuart Shaffer was appointed to the Arrangements Committee of the USA-Japan Computer Conference to be held in Tokyo, October 1972.

Stuart Shaffer continued to serve as a member of the National Council of the Association for Computing Machinery.

Visitors to CCBS

Dr. Davis Bobrow, University of Minnesota, to discuss international forecasting research, July 22-23.

Donald A. Cole, Informatic, Inc., Hawaii, visited the project at the request of Rome Air Development Center, primarily to discuss CCBS data management developments and their potential application to intelligence systems, August 13.

Pat Langendorf, Sam DiCarlo, and Bob Roberts were briefed on project developments, particularly in the area of automated text analysis, September 13-15.

Dr. Philip Stone, Harvard University, to discuss research on automatic theme encoding and its interface with CCBS content analysis programs, October 29.

Dr. George Lawrence, Deputy Director, Human Resources Research Office, ARPA, to review project developments and discuss technical aspects of CCBS joining the ARPA computing network, December 18.

Project Documentation (July - December 1971)

CCBS-P-3   PDP-10/50 Monitor Cataloguer, Baker, P.S. Also
             published in DECUS Proceedings, Fall 1971, 5-9.

CCBS-P-4   SMART: A Multiple-High-Segment Executive System,
             Moore, W. H. Jr., and Cooperband, A.S. Also published
             in DECUS Proceedings, Fall 1971, 1-4.

CCBS-TM-16   Laboratory Implementation System (LIS): Program
             Description, Meeker, R. J., Rogers, M. S., and Adams, P.D.

CCBS-TM-17   Multiple Virtual Segmentation on the PDP-10 Computer,
             Cooperband, A. S., and Gallenson, L.

CCBS-TM-18   An Experimental Automatic Theme-Encoding System for
             Content Analysis, Martins, G.R.

CCBS-TM-19   Internal Teletype Assignment Command, Baker, P.S.

CCBS-TM-20   Proposal to Interface CCBS to the ARPA Network via
             PDP-15 Peripheral Processor, Shure, G.H., Cooperband, A.S.,
             and Meeker, R.J.

CCBS-TM-21   Alternative Regime Types: An Approach to Structuring
             the Background and Playing of Political Games, Robinson, T.W.

CCBS-TM-22   CHECK: A Source File Preprocessor, Fisher, W.H.

CCBS-TM-23   Group Judgment Technology, Shure, G.H., and Dalkey, N.

CCBS-TM-24   An Illustrative Example of An Idea Analysis Conducted
             on a Hard Copy Terminal, Rogers, M.S., and Shure, G.H.

CCBS-TM-25   The Effects of Size of Payoff and Real Versus Imaginary
             Rewards on Pre-Bargaining Perceptions, Lanto, S. and
             Shure, G.H. December 1971. Submitted for presentation
             to the American Psychological Association Meeting, 1972.

CCBS-TM-26   An Automatic Coder Utilizing Sequential Codes,
             Tripodes, P. December 1971.

CCBS-TM-27   Survey Materials for a Scenquest Bargaining Study: The
             Effects of Same Versus Different Ethnicity of Bargainers
             on Influence Tactics, Shure, G.H. December 1971.

CCBS-TM-28   A Middle East Nuclear Proliferation Scenario 1976.
             Revision of 1973 Middle East Scenario. H. A. DeWeerd.