CONTINUITY AND CHANGE IN COMPUTER-ASSISTED SURVEYS: The Development of Berkeley SRC CATI

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As evidenced by this ASA panel and similar sessions at other conferences (1), computer-assisted methods for data collection have indeed "arrived" as a new field within the survey profession. Based on a 1979 review in Survey Research (2), it is clear that most survey organizations in the country are now in at least the planning stage of developing, adapting, or extending a system for computer-assisted telephone interviewing (or CATI).

This paper presents a summary of one such developmental effort at the Berkeley Survey Research Center (3), and a comparison of its features with those of other CATI systems, including the UCLA programs which provided early CATI experience for virtually all academic and governmental survey organizations in the United States (4). The paper emphasizes the major design objectives and architectural features which distinguish the Berkeley system from other approaches, and reviews both the current and developing capabilities associated with those features.

BASIC PRINCIPLES AND ADVANTAGES OF CATI

In discussing the rationale and design objectives for the Berkeley system, we have assumed that the reader is at least somewhat familiar with the general logic of computer-assisted telephone interviewing (or CATI). In order to describe the Berkeley system in a somewhat comparative fashion, however, we have provided a short summary of the (general) procedures and/or functions which may be included in any CATI system, and the potential advantages associated with computer control of the survey process.

Exhibit 1 presents a simplified list of the general activities or research functions that may be incorporated in any approach to CATI. Each of these types of activity has been implemented in a number of ways in the different CATI systems developed to date, and several activities have been omitted by some systems (to be handled either manually or by other computer programs), but every computer-assisted telephone survey involves each of these activities.

Advantages. Although the potential advantages associated with CATI systems have been discussed extensively elsewhere (5), it may be helpful to begin by briefly reviewing five areas in which CATI methods offer the promise of improvements in data quality, data collection efficiency, or new survey capabilities:

First (and perhaps most importantly), question branching is controlled by the CATI program rather than by the interviewer. This feature eliminates an important form of interviewer error in conventional surveys and permits interview schedules, data structures, and surveys designs of unusual complexity (including randomization of question sequences).

Second, the wording of questions may be automatically modified based on answers already received. For example, questions may be personalized by inserting the respondent's name (or the names of other household members) at appropriate points.

EXHIBIT 1: RESEARCH ACTIVITIES IN CATI SURVEYS

Preparation of Interviewer's Instrument -- i.e., the drafting of full specifications for question content, question sequence or branching, and interviewer instructions, and their entry in machine-readable form.

Conversion and Checking of Interviewer's Instrument -- i.e., the transformation of the entire instrument into a computer-resident format which maximizes the efficiency of interviewing, and the checking of all specifications for logical errors.

Creation of Sample File and Scheduling Instructions -- i.e., the development of a data set which contains a record for each sample household with its telephone number and other case-identifying information, data from previous interviews with the same household, random numbers to control its assignment to a (randomly selected) question sequence, and/or scheduling information to be used in determining the time for specific calls (such as the appropriate search pattern and/or time zone).

Actual Interviewing -- i.e., includes repeated dialing using assigned search patterns to establish contact with eligible respondents, production interviewing, and the routing of questionable or difficult cases to supervisors for special handling.

Interviewer Supervision -- i.e., the resolution of cases where interviewer attempts have been unsuccessful (through reassignment to language or refusal specialists, or final non-interview classification), routine monitoring and checking of interviewer performance, and provision of assistance to interviewers on request;

Specifications of Coding Procedures -- i.e., the preparation of instructions to both coders and/or the computer for the sometimes complex set of editing, data reduction, and/or cleaning procedures which take place after each interview is complete.

Conversion and Checking of Coder's Instrument -- i.e., a process which may resemble the translation of the interviewer's instrument (above) if the instructions for editing and coding are stored in the same machine-readable format.

Production Coding of Completed Interviews -- i.e., includes the creation of coded values for responses to open-ended questions and "other" responses, as well as the resolution of any inconsistencies or discrepancies between the recorded responses and the logic of the coder's instrument.

Certification of Completed (Coded) Cases -- i.e., the final checking for errors in the coded data and the transfer of satisfactory cases to an output file for data analysis.

(*) Note: After this paper was started, William Nicholls left the Berkeley Center to accept a position as Project Director for CATI at the U. S. Bureau of the Census. He remains an active contributor to the research group affiliated with the Berkeley CATI system, but the perspectives expressed in this paper are those of the Berkeley project and not necessarily those of the Bureau.

Third, close supervision of interviewers (and greater standardization of field practices) is possible both by telephone monitoring of the interview and by viewing TV monitors which reproduce the contents of each interviewer's screen.

Fourth, computer control can provide accurate and efficient management of production survey activities, including sample selection and control, optimum scheduling of calls, automatic maintenance of callback standards, and generation of frequent reports on sampling and field work performance.

Fifth, since data collection and basic data entry are carried out concurrently, and since coding for each case may be completed within hours of interviewing, some CATI systems can produce a cleaned data file for analysis very quickly after the completion of field work (or, in large studies, while the field work continues).

It should be recognized that these potential advantages are not all realized in every CATI system. Rather, each system's specific advantages (and limitations) will depend on its basic design and stage of development.

DISTINGUISHING FEATURES OF THE BERKELEY SYSTEM*

As discussed above, several different CATI systems have now been developed, or are being developed, by a variety of public and private survey organizations. Most were designed to accomodate the specific types of surveys undertaken by the unit involved and to make most efficient use of available computing hardware and personnel. As a result of these all too familiar constraints, existing CATI systems vary greatly in their capabilities, hardware requirements, staffing needs, and potential exportability.

Berkeley SRC CATI is no different in this respect, for it was primarily designed to meet the needs of an academic survey research organization which undertakes a wide variety of small- to medium-sized surveys and methodological studies -- but whose volume of production survey activities is not large enough to devote major resources to either computer hardware or programming. After our experience with a modified version of the original UCLA CATI programs in the large scale California Disability Survey (7), the Berkeley group decided to develop a completely new CATI system based on general objectives in the following four areas:

- Instrument Development and Modification;
- Flexible Interview Commands and Strict Enforcement of Instrument Logic;
- Integration of Interviewing, Coding and Study Documentation;
- Operating System Characteristics

These general objectives led to a number of specific features or capabilities in the Berkeley CATI system which, together, distinguish it from other systems. The rationale for these objectives and capabilities are discussed in the following four sections.

Instrument Construction. We believe that a CATI system should place the burden of defining the logic of the data collection process on the study director (or designer), rather than attempting to simplify (or standardize) important methodological decisions by imbedding them in the system's programs. In return for this burden, however, we have given the designer as much flexibility as possible in specifying the content of each survey's questions, logic, sampling procedures, calling routines, and survey outcomes. (The instrument set-up procedure should however also be simple enough for CATI to be operated with minimal assistance of trained programmers and computer operations staff.)

Although the Berkeley system is an entirely new set of programs and departs from other systems in the way it handles both instruments and data, it is a direct descendant of the UCLA CATI effort in one respect. In the original UCLA system, study designers or project directors wrote all specifications for a computer controlled study in a single machine-readable file of instructions. In a format which is based on the UCLA approach, the Berkeley CATI system requires the study director to define all questions, answer categories, branching commands, and related instruction in an "instrument" written in the QISB language (8). Although a complete description of that language is impossible in this setting, a short summary of the relationship between designer instructions and interviewer behavior may be helpful.

An instrument written in QISB can be seen as a generalized version of a traditional interview schedule, but it may also contain computer instructions for scheduling telephone calls and interviewer assignments, arranging call backs, documenting final field outcomes, and specifying the structure of the resulting data set. A QISB instrument is therefore both a document which can be presented as a cohesive printed record of the steps to be followed in data collection and a comprehensive computer program which is converted (by another program) into a form which can be efficiently used for computer-controlled production interviewing and coding.

In QISB, survey questions (and their associated interviewer entries) may take one of several forms. The simplest of these (for precoded questions) is illustrated in the following example:

```
>Q8< Do you think of yourself as a Republican,
     Democrat, independent, or something else?

     <1> Republican  [goto Q10]
     <2> Democrat    [goto Q11]
     <3> Independent
     <4> Other [specify]

     <8> Can't say, refused

===>
```

As in the original UCLA system, such a question would appear on the interviewer's screen in the same format as shown above, except that the instructions to the computer (i.e. the "specify" and "goto" commands in brackets) would not be shown. The interviewer would then ask the question and record the respondent's answer by entering the proper numeric code -- which would immediately appear on the screen after the arrow. The respondent's answer is then automatically recorded and the next appropriate question displayed on the CRT -- unless the response is not one of those specified as legitimate. If that happens (e.g., if the interviewer enters something other than a 1, 2, 3, 4, or 8 in this example), a "try again" message appears, and the question remains on the screen until a valid code is entered or the interviewer escapes from the normal question sequence. Finally, if the respondent provides an "other" answer which cannot be assigned to any existing code (and the interviewer enters code 4), the [specify] command in the instrument causes CATI to respond with a prompt:

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specify===>
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*Note: The following discussion presents only the general principles or highlights of the Berkeley system. Those who are interested in specific capabilities or technical features are encouraged to read An Overview of Berkeley SRC CATI (6). Those familiar with that Overview may also be interested in the more specialized user documentation described in that report.

In such a case, the interviewer would simply type in the respondent's answer as unformatted text, using more than one line if necessary and terminating with three slashes, i.e., "///".

The QISB language also provides support for other question formats and for a variety of commands which determine the sequence of questions to be asked. These additional features (which are described at length in the Overview) include QISB language support for:

-- asking questions which specify a range (or several ranges) of valid codes, such as <1-29>, in addition to (or instead of) a list of specific codes;

-- asking open-ended questions which produce textual responses of variable length (which are handled by interviewers in the same fashion as an "other specify" code);

-- asking questions with fixed length text which can be used to modify (or to fill in) the wording of subsequent questions;

-- creating new variables from existing ones through arithmetic and logical commands;

-- testing for specific answers to prior questions in order to branch directly to different questions as a function of those answers; and

-- creating simple "rosters" to permit cycling through a series of questions about (for example) multiple persons in a household.

We should note at this point that other CATI systems permit designers to enter all questions and other study specifications through a conversational program (9) instead of requiring them to be written in a "programming language" (like QISB). Interactive programs of this sort may in principle be equivalent to the QISB approach, provided that they perform the same general functions as the QISB translator in keeping track of the logic specified by the person entering or correcting the instrument -- and that they provide the designer with a full and integrated printed record of the instrument's logic and question content.

Those of us involved in the Berkeley system, however, have taken the position that a purely conversational approach to instrument design (while very attractive to inexperienced study designers and satisfactory for simple studies) will eventually prove less desirable than a QISB-type programming language -- at least for complex studies in which study designers exercise the full range of capabilities which we want CATI to provide. The rationale for this preference is essentially threefold.

First, we are convinced that an integrated (printed) source file or written program containing all of the specifications for a given survey represents an important discipline for the study designer, for the translation process forces the study director to make (and examine the consequences) of all line by line changes in the questions and logic which determine the study's content.

Second, and closely related, our commitment to the QISB language is also based on the readable quality of its syntax and format. The logic in a QISB instrument is expressed in terms (such as "goto") which are more readily understood than alphanumeric parameters, and such commands appear right next to the question or answer categories to which they apply, so that complex instruments may be more easily created and modified than in systems in which the instrument logic is separated from the question text. Thus, we believe that the readable quality of QISB files (and their similarity to conventional paper and pencil instruments) provides for both easy setup by study directors and a documentation of instrument content for direct review by external agencies or administrators.

Finally, we believe that the preparation of machine-readable interview schedules in a "source" language can play an important role in the exchange of methods (and results) between organizations. Although it is still too early to assess the degree of eventual compatibility in CATI methods between survey organizations, those units which do use the same general approach to interview schedule construction (such as QISB) will soon be able to exchange a wide variety of highly specialized interview schedule "modules" to both improve the quality of survey instruments and simplify the process of developing them.

Interviewer Actions and Instrument Logic. As a result of our experience (with UCLA) in the California Disability Survey, we became convinced that our own research (like most other surveys conducted for academic and governmental organizations) cannot be satisfactorily implemented in CATI unless two (closely related) requirements are met. First, we decided that the CATI executor must strictly enforce the logic built into the interviewer's (and the coder's) instrument -- with absolutely no exceptions or "override" capabilities for the supervisory staff -- if we are to take full advantage of CATI's error-checking and automatic provision of clean data. Second, although we do not permit a case to be completed if it contains any departures from the instrument's logic, we insisted that interviewers and coders be given the maximum possible freedom to (spontaneously) move around within the interview schedule -- both by "jumping" backward in order to review (or modify) answers to questions which have already been asked, and by "skipping" forward to a section which would normally follow questions that the interviewer may want to postpone.

In contrast, the programs used in the California Disability Survey (like other CATI systems) did not give the interviewers enough flexibility to back up and correct the problems which arose in handling complex cases, but (in part to overcome that inflexibility) the system did permit the interviewer to make some changes (primarily in the content of the household roster) which were then inconsistent with the rest of the recorded data. These problems were then compounded by giving coders additional capabilities to "override" other aspects of the instrument's basic logic, thereby producing a large volume of inconsistencies which had to be "cleaned" after the CATI process was completed.

Based on our experience with the Disability Survey, the Berkeley CATI system reflects a major investment in interviewer commands which permit the interviewer to "jump back" directly to any previously answered question (provided that the designer has not prohibitied such a jump), to change the answer to that question and then move forward (one question at a time or in a single jump) to find the next appropriate (unanswered) question or test on the basis of the revised answer -- or simply return (automatically) to the original question and resume the interview at that point, if nothing has been changed. In addition, the CATI executor permits interviewers to "skip" ahead in the schedule to question series which appear "later" in the schedule (if the designer decides to permit such actions). Finally, as in the case of a "jump back", CATI provides for an automatic "return" after a "skip" to the question from which the interviewer departed from the normal instrument sequence, and interviewers may not complete any case until all questions that have been skipped are either answered or marked as refused. The complete set of these commands (which are available to both interviewers and coders) is described in the system Overview. As far as we know, the capabilities provided by these commands are unique among CATI systems, in at least three respects.

First, many CATI systems provide only limited "backup" capabilities, and none provide a "jump back" command which guarantees that no inappropriate questions will be accessed. Second, some systems automatically erase all of the answers to questions which have been "backed over" (instead of preserving them in order to avoid entering the same answers again), and only the SRC CATI system provides a "jump forward" which automatically returns to whichever question is the next appropriate one -- whether or not an answer has been changed. Finally, to our knowledge, no other approach has yet provided a "skip forward" capability which preserves the logic of the instrument by guaranteeing a "return" to any questions not answered, and which annotates any answers to "backed over" questions which are subsequently rendered inappropriate by answers provided after the skip.

These capabilites for backup and answer modifications are also related to another fairly unique aspect of the SRC CATI system. As we understand the range of capabilities in other systems, interviews that cannot be completed in a single call are sometimes started over from scratch, resumed only after re-entering the data from the first call, or resumed only at a few section boundaries, or only at the precise question where the breakoff occured. Although some survey organizations may not need the added flexibility, our own field staff requested the ability to review the status of every callback before dialing and specify the (previously answered) question with which it would be best to resume the interview -- while preventing the interviewer (as in other areas) from accessing a question which is not appropriate on the basis of existing answers. Our current view is that this flexible approach to re-entry, like the more general jump back and answer modification capabilities, is crucial for complex or factual surveys conducted by academic and governmental organizations.

Integration of Interviewing and Coding. The Berkeley SRC CATI system also departs from several other approaches in the degree to which the coding function is handled in the same fashion as interviewing. Although our approach to coding may be less relevant for non-academic surveys that do not routinely use open ended questions or develop supplementary codes for "other" responses, the integration of coding within CATI also has implications for the processing of non-telephone surveys, and for the preparation of full machine-readable documentation and analysis-ready data files. The following paragraphs describe the coding process in Berkeley SRC CATI, including its relationship to both interviewing and post-coding data processing.

First, the coder's "instrument," while technically a separate document or file, is in fact a modified version of the (machine-readable) interviewer's intrument -- and is therefore also written in the QISB language. Thus, when the interviewer's instrument is near completion, the study staff simply modifies a copy of it by making the following kinds of changes:

(a) interviewer codes which should not be legitimate values in the final data are excluded;

(b) supplementary codes are added for open-ended questions;

(c) codes are added for those precoded questions with an "other specify" category -- i.e., for those situations where the interviewer has provided supplementary textual information that must be reflected in the final coding scheme; and

(d) "cleaning checks" are written to assure consistency between different survey items. Logical checks between original (or newly coded) items of the survey instrument may be included, such as comparing reported age against reported periods of service in the Armed Forces. These tests serve the same function as "consistency checks" in standard data cleaning.

Second, when a draft of the QISB coder instrument is complete, that instrument is translated by the same program used for the interviewer's instrument. As before, CATI execution is not possible if the QISB instrument contains any detectable designer errors. The resulting coder instrument may then be amended as often as necessary during the course of coding.

Third, based on the coder instrument, a "protocol" is prepared which shows the answer to each precoded question and all text entered by the interviewer, including answers to open-ended questions, "other specify" responses, and interviewer notes. This protocol also provides a list of all survey items requiring coding, i.e. text answers, "other specify" responses, and failed cleaning checks. This list focuses the coder's attention on tasks that need to be completed.

Fourth, the coder enters new codes, and makes changes where necessary, employing the same commands used by interviewers.

Fifth, when the coder believes that coding is complete, the case is indicated as ready for "certification". If the case successfully passes all of the logic checks built into the coder instrument, a "certification protocol" is prepared as the final hardcopy record of the coded case -- and the case is moved to an accumulating file of rectangular data records where it is available for analysis.

Note: As in interviewing, the system intentionally prohibits any way to "override" the logical tests built into the coder instrument. Thus, neither coders nor supervisors may "force" a case through certification while any of the conditions specified in the coder instrument remain unsatisfied. If unanticipated problems are encountered with unusual cases, the coder instrument may be rewritten to accommodate them. But our experience suggests the crucial importance of enforcing the logic which the designer placed in the coder instrument, so that the resulting data is "clean," and so that the final coder instrument provides complete documentation of the procedures employed in data collection and reduction.

Finally, a full machine-readable study codebook can be developed from the coder's instrument through software associated with the Berkeley SRC Codebook Generating System. Marginals (or stratified marginals) are then inserted in the codebook from a run of the final data tape in batch mode. The codebook generating system also provides a means of adding additional explanatory text to the codebook and of creating variable definitions for SPSS and other analysis packages.

In addition to the advantages of CATI coding for telephone surveys, the above combination of instrument flexibility, rigid control over the range of valid codes, contingencies, and other consistency checks, and the ability for automatic generation of machine-readable documentation -- have all combined to maximize CATI's attractiveness for the entry and processing of data collected outside the telephone survey context.

Commitment to a Time-Shared Environment. Finally, the basic design (and actual programming) for the Berkeley CATI system reflects our continuing belief that the flexibility in computer-assisted survey methods which most survey units need must use software that is developed for (and in) a full time-shared operating system, rather than a "real time" environment which prohibits or sharply restricts the number and variety of independent processes that can be executed simultaneously. Our experience with both the California Disability Survey (which used the original UCLA system) and our subsequent developmental efforts have persuaded us that efficient operation of telephone interviewing systems invariably calls for flexible scheduling of several different programs simultaneously (rather than only one or two in fixed memory partitions), and that the frequent reprogramming of these routines makes the simultaneity offered by a time-shared system virtually essential for development as well. In such an environment, for example, one staff member can compile or test a new version of the CATI software while others use the current version in a production study, and still others simply edit files to be used in setting up future surveys, or carry out substantive or accounting tabulations for studies just completed.

It is our impression that other survey organizations have now reached the same conclusion as a result of experimentation with other approaches -- and that those "real time" environments in which CATI is functioning well represent fairly advanced systems which most closely approximate the process-scheduling flexibility of a time shared system -- but this general difference between systems is likely to remain for some time.

In addition to our own project's general commitment to a time-shared environment, we should note that the Berkeley SRC CATI system is closely tied to UNIX*, a time-shared system which was originally designed for the PDP 11 series computers. Our choice of UNIX was in part dictated by

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*Note: UNIX is a trademark of Bell Labs.

the computing environment at Berkeley, but the extensive terminal-, process- and file-handling capabilities of the UNIX system have made it possible for our project to concentrate its design and programming efforts on extending the scope and power of the (CATI) executing program and/or the QISB language translator (QTL) rather than on systems-level development.

CURRENT DEVELOPMENTAL ACTIVITIES

While Berkeley SRC CATI is currently in use for ongoing surveys, the system will continue to change (and expand) fairly quickly for at least another year. As of this writing, several new capabilities have been added to the system but not yet used in production surveys, and two major additions are nearing completion. Each of these new capabilities is discussed briefly below.

New Capabilities Now Completed. Several changes have already been incorporated in the system (but not yet tested in production surveys). The first of these involves inclusion of additional arithmetic and logical operators, and instructions which will record the DATE and TIME at specific points in the interview chosen by the survey designer. Such instructions will be especially useful in calculating the length of individual sections of the interview in pretesting and to include the date and length of the interview as standard variables in final data files.

Also, the first version of Berkeley SRC CATI, which was in use throughout the past year, employed largely manual sample management and call scheduling. In that system, the calling times of sampled cases were not set by the system but were chosen by the supervisor and communicated to the interviewers on assignment forms, and interviewers entered the case identification for a given telephone number when he or she was ready to call it. Similarly, calling times for scheduled recalls were not stored in the computer but were maintained on paper records.

Programs to permit computer-controlled sample management have now been completed, and are being tested for inclusion in the Center's next production CATI system. This new version will accommodate: (a) computer scheduling of both initial calls and callbacks; (b) computer implementation of callback standards chosen by the survey designer; (c) routing of cases to the supervisor or to specialized interviewers, such as language specialists, under selected conditions, and (d) supplementary supervisor commands to assign refusals and other special cases to specified interviewers for recalls.

In designing these scheduling programs, a central objective has again been to place detailed decisions on the choice of calling routines, callback standards, and other aspects of case management in the hands of the survey instrument (QISB) designer rather than to freeze such specifications into the CATI system itself -- or to restrict the designer's options to only a few pre-specified sets of parameters. (These parts of the instrument, of course, will not be seen by the interviewing staff, and recommended instrument modules will be developed for survey designers who do not wish to develop their own.)

Major Change I: Accommodating Complex Formats. The present system accommodates one level of rostering, but many surveys require both multiple roster levels and multiple (parallel) rosters at each level. For example, a survey might ask about recent doctor visits made by each member of the household. Such questions may be viewed as involving two roster levels -- a first roster level of persons and a second roster level of doctor visits within persons. The example may be further complicated by considering another series of questions asking about recent hospitalizations for each person. This would require two different (parallel) rosters (one for doctor visits and another for hospitalizations) within the person roster level.

The current production version of Berkeley SRC CATI cannot easily accommodate survey instruments of this complexity (nor can any of the systems we have examined). A technical method for collecting and processing such data has existed for some time, but we have delayed its implementation while considering alternate ways in which the designer (and interviewer) can handle such materials with concise yet understandable commands. A first version of these commands is now being developed, but an extended period of testing and trial use will undoubtedly be necessary before we can be sure it will accommodate most of the structures in complex surveys.

Major Change II: Processing of Non-Telephone Surveys. As suggested above, the same basic CATI programs may also provide an excellent foundation for procedures to enter, code, and clean survey data collected by more conventional methods, such as personal interviews and mail questionnaires. In such applications, the data reduction staff would perform the initial data entry as well as any data reduction or supplementary classification, based on already completed paper-and-pencil forms. The potential advantages of CATI for this use are: (a) its requirement that each entry be within the allowed answer set; (b) the system's ability to branch selectively only to those items appropriate for a given case; (c) the labor-saving potential of combining coding, data entry, and cleaning in a single process; and (d) the system's ability to automatically generate a machine-readable codebook from the QISB instrument.

The current SRC Berkeley System can already be used for some straightforward coding applications, including the simple entry of an entire survey instrument in regular QISB form (so that the coders enter one survey response at a time), and the use of complex branching instructions for open ended questions which direct the coder to increasingly specific (or narrow) decisions until a final classification is reached. Additional capabilities are needed, however, before the system can be efficiently used for routine data entry -- or to replace conventional keypunching. In order for CATI to be efficient for this purpose, while preserving its characteristic branching to avoid inapplicable questions and automatic consistency checking, additional QISB instructions and terminal handling routines are now being developed to accommodate a substantial number of question labels and associated coder entries on the CRT at the same time, and to provide appropriate cursor controls to guide the entry of specific fields.

In the special case where data is collected by more than one method (e.g., a mixture of in person and telephone interviewing) these new features should prove particularly attractive. As in the case of routine data entry for conventional surveys, however, extended comparison studies will be needed to assess the relative cost effectiveness of these new procedures.

FOOTNOTES

1. For an earlier statement on CATI capabilities and potential, see the Proceedings of the 1978 American Statistical Association, Survey Research Methods Section. (Washington, D.C., American Statistical Association, 1979.) For a more recent summary of this rapidly changing field, see J. Merrill Shanks and Howard Freeman, The Emergence of Computer-Assisted Survey Research, a summary of the National Science Foundation-supported Conference on Computer-Assisted Survey Methods, to be released in 1981.

2. For a partial listing of academic, governmental, and commercial survey units using or planning CATI operations, see Survey Research, (Survey Research Laboratory, University of Illinois), Summer-Fall, 1979

3. A more extensive introduction to the capabilities in the current Berkeley system appears in An Overview of Berkeley SRC CATI, by William Nicholls, II, George Lavender and Merrill Shanks (Survey Research Center Working Paper 31).

4. Gerald H. Shure and Robert J. Meeker, "A Minicomputer System for Multi-Person Computer Assisted Telephone Interviewing," Behavior Research Methods and Instrumentation, 19 (April, 1978), 196-202.

5. In addition to the Conference report cited in footnote (1) above, the experience of other organizations in developing and using

computer-assisted telephone interviewing has been described by: Raymond G. Nelson, Boyd L. Peyton, and Bruce A. Bortner, Use of an On-Line Interactive System: Its Effect on Speed, Accuracy, and Cost of Survey Results, (Radnor, Pa.: Chilton Research Services, 1972); John N. Kofron, Dean J. Kilpatrick, and Andrew J. Brown, Cathode Ray Tube (CRT) WATS Line Interviewing, (Radnor, Pa: Chilton Research Services, 1974); Robert J. Meeker, Gerald H. Shure, and Richard Lutz, Administrative System for Computer Assisted Telephone Surveys: Final Report, Prototype Development, (Los Angeles, Ca.: University of California, Center for Computer Based Behavioral Sciences, 1976); Anitra Rustemeyer and Arnold Levin, Report on a Telephone Survey Using Computer Assistance, (Washington, D.C.: U.S. Department of Commerce, Bureau of the Census, 1977); and Anitra Rustemeyer et al., "Computer Assisted Telephone Interviewing: Design Considerations," Proceedings of the 1978 American Statistical Association, Survey Research Methods Section, (Washington, D.C.: American Statistical Association, 1979) 1-8.

6. See Nicholls, Lavender and Shanks, op. cit.

7. Experiences with the CCBS CATI system in the California Disability Survey have been summarized in: William L. Nicholls II, "Experiences with CATI in a Large-Scale Survey," Proceedings of the 1978 American Statistical Association Section on Survey Research Methods, (Washington, D.C.: American Statistical Association, 1979), 9-17; and William L. Nicholls II, California Disability Survey: Technical Report, SRC M36, (Berkeley Ca.: University of California, Survey Research Center, 1979); and J. Merrill Shanks, Howard E. Freeman, and William Nicholls, II, "The California Disability Survey: Design and Execution of a Computer-Assisted Telephone Study," Sociological Methods and Research, (forthcoming).

8. The name "QIS" (Questionnaire Implementation Specifications) was chosen by the UCLA Center for Computer Based Behavioral Sciences for the language in which machine-readable specifications for the logic and content of CCBS CATI survey instruments are prepared. Berkeley SRC CATI adopted much of the syntax and overall appearance of CCBS QIS, although the programs to translate and implement its instructions are wholly new. "QISB" is therefore the Berkeley (B) version of the QIS language.

9. See Shanks and Freeman, 1980, op. cit.