EXPERIENCES WITH CATI IN A LARGE-SCALE SURVEY

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This paper presents the experiences of the California Disability Survey with the Computer Assisted Telephone Interviewing (or CATI) System developed by the Center for Computer Based Behavioral Sciences of UCLA's Institute for Social Sciences Research [3]. This survey represents the first large-scale test of the UCLA-CATI System and illustrates many of its strengths as well as its current disadvantages.

The paper describes a *demonstration* of CATI, not an experimentally controlled comparison of CATI with other survey methods, such as manual (or paper and pencil) telephone interviewing. Major changes are presently being considered in the basic architecture of the system, while alternate methods of programming a variety of survey operations are still being reviewed. Side-by-side tests of CATI with manual telephone interviewing appropriately lie in the future when the system has stabilized and is more fully documented.

Without a clear basis of comparison, these comments will necessarily be largely discursive and impressionistic. This is especially the case since the California Disability Survey has only recently completed its field work, and full records of its performance are not yet available.

The California Disability Survey

The California Disability Survey was a random-digit-dialing telephone interview survey of approximately 30,000 California households undertaken jointly by the Survey Research Center of the University of California at Berkeley and the Institute for Social Science Research at UCLA for the California Department of Rehabilitation. Its purpose was to estimate the prevalence of disability among working-age adults in the state's household population and in each of 26 Rehabilitation Districts and to describe the characteristics of the working-age, disabled population.

A cross-sectional, household survey design was employed. A proportionately stratified sample of telephone households was chosen by clustered, random digit dialing and arranged into 21 independent replicates which were telephoned sequentially. Counting nonworking and nonresidential numbers, more than 70,000 telephone numbers were called.

When a household was reached, an interview was completed with any responsible adult household member. Demographic information was requested about each member of the household, and screening questions were asked to identify the disabled among persons age 16 to 64. For each identified disabled person, a series of questions was asked covering activity and mobility limitations, time of onset, disabling conditions, work history, and government support. The interview concluded with questions on type of housing, number of telephones, ethnicity, and household income. Interviews averaged 10-12 minutes for households without a disabled person and about 25 minutes for those with one disabled adult. About one household in four included a disabled person.

Although the interview was brief, it was highly complex, involving several hundred branch points (or GO TO statements) and numerous questions at the sixth or seventh level of contingency. The complexity of the instrument and the large sample size were among the reasons prompting the choice of computer assisted telephone interviewing. Other reasons for this choice have been described elsewhere [2].

The survey was conducted from two sites, one at Berkeley and one at UCLA. Identical CATI programs were run on a dedicated PDP-11/34 at Berkeley and a dedicated PDP-11/45 at UCLA. Together, these two installations supported 22 interviewing and 3 coding terminals plus one supervisor's terminal each. The supervisor's room at each installation also contained a bank of slaved monitors reproducing the screen of each interviewing terminal. At peak production, the two sites jointly completed and coded about 1,750 interviews per week.

Interviewing

The California Disability Survey employed many of the CATI interviewing functions described in the previous paper by Rustemeyer and Shure, plus some others. The interviewing functions included: automatic branching to the next appropriate question; keyboard entry of both precoded and typed-in responses; maintenance of a roster of previously obtained key items about each household member which could be displayed and modified by the interviewer at any point; insertion of the text of precoded answers from previous questions in subsequent questions; maintenance of both English and Spanish versions of the instrument on disk with easy transition between them; the ability to restart interrupted interviews at a variety of points; and the ability to back up to and correct previous questions, at least within major sections of the interview, and then proceed to the next newly appropriate question.

After the first name and sex of each household member were obtained, subsequent questions about each person were automatically filled with the appropriate names, pronouns, and verb forms. Thus, the respondent was asked, "*Are you* now married, divorced, separated, widowed, or *have you* never been married?". The same question for the next household member might read: "*Is Jack* now married, divorced, separated, widowed, or *has he* never been married?". If the respondent was changed in mid-interview, the name, pronoun, and verb fills were automatically revised.

With one exception described later, these interviewing functions met both the interviewers' and survey designer's needs for this complex study. Most also proved easy to use once mastered, although some, such as respondent changes and roster editing, required unnecessarily cumbersome multi-step interviewer commands. Further simplification of CATI's interviewing functions

should receive high priority in future programming.

Respondent and Interviewer Acceptance of CATI

Computer assisted telephone interviewing provides new experiences for the respondent, for the interviewer, and for the designer of the survey instrument. We are only beginning to understand what those experiences mean to each.

At present, we know least about what CATI means to the respondent, other than that most respondents apparently find computer assisted interviewing acceptable. When the survey was introduced to respondents, they were told that their answers were entered "directly into a computer," and very few raised objections. Exact counts were not kept, but it was the field staff's impression that persons refusing the interview because they objected to direct computer entry were far less common than persons refusing because they objected to being called on an unlisted telephone number. Further indications of broad respondent acceptance of CATI were: (1) the high proportion answering that they would be willing to participate in future studies by the same organizations; and (2) the survey's overall response rate. Interviews were completed at approximately 86 percent of the households reached. This is usually regarded as a high response rate for a cross-sectional survey conducted by academic survey research organizations.

During initial interviewer training and the first few weeks of field work, staff anxiety and frustration were common. This was understandable, since the system was new to all and occasional design, programming, and operational errors caused frequent malfunctions. As these problems were corrected, both the interviewing and supervisory staff generally adopted favorable attitudes toward CATI. This is illustrated in Tables 1 and 2 which summarize selected responses to a debriefing questionnaire completed by the

TABLE 1

INTERVIEWERS' OPINIONS OF CATI BY PREVIOUS INTERVIEWING EXPERIENCE

Degree of Agreement With Opposing Views of CATI[a]	Score	Previous Experience As Interviewer: Yes	Previous Experience As Interviewer: No	Total
CATI helps interviewers to do their work better	5	24%	73%	49%
	4	60%	15%	37%
OR	3	16%	4%	10%
	2	-	-	-
CATI makes it hard for good interviewers to do their work	1	-	8%	4%
Total = 100%.....		(25)	(26)	(51)
Mean score.....		4.08	4.46	4.27
Working with CATI makes interviewing more fun	5	29%	50%	40%
	4	17%	15%	16%
OR	3	50%	19%	34%
	2	4%	12%	8%
Working with CATI makes interviewing more frustrating	1	-	4%	2%
Total = 100%.....		(24)	(27)	(50)
Mean score.....		3.71	3.96	3.84
During the study I felt I was in control of what CATI was doing for me	5	42%	44%	43%
	4	29%	32%	31%
OR	3	17%	4%	10%
	2	12%	16%	14%
During the study I felt CATI was in control of what I was doing for the computer	1	-	4%	2%
Total = 100%.....		(24)	(25)	(49)
Mean score.....		4.00	3.96	3.98

[a]These questions were asked in a semantic differential format with positive views of CATI alternately placed on the right and left. Interviewers not answering each question are omitted from its tabulation.

field staff near the end of the survey. Even allowing for omission of less favorable opinions by those who resigned (or were terminated) before the questionnaire was administered, the responses are surprisingly positive.

When asked to choose between opposing views of CATI, 86 percent of the field staff agreed that "CATI helps interviewers do their work better;" only 4 percent agreed that "CATI makes it hard for good interviewers to do their work;" and 10 percent took a neutral position between these views. The field staff also was more likely to see CATI as "fun" than "frustrating" and to feel that they were in control of CATI rather than vice versa. On the average, experienced interviewers were less enthusiastic about CATI than those newly trained for this survey, but this may be explained by the more difficult tasks the experienced interviewers were frequently assigned, such as supervision and refusal conversion.

The field staff also ended the study with a preference for future CATI assignments, as shown in Table 2. When offered a hypothetical choice among a CATI telephone survey, a paper-and-pencil telephone survey, and a personal interview survey, CATI was most frequently reported as the one liked most.* When the options were narrowed to a CATI or paper-and-pencil telephone survey, 86 percent said they definitely preferred CATI, 8 percent somewhat preferred it, and 6 percent said the form of interviewing made no difference. Not one interviewer expressed a preference for paper-and-pencil telephone interviewing. The primary attractions of CATI reported in an open-ended followup question were its automatic branching capabilities and its freedom from cumbersome paper work and editing. A few interviewers expressed the view that these features permitted the interviewer to concentrate more fully on what the respondent was saying and on maintaining rapport.

These generally positive attitudes toward CATI do not imply that the field staff was uncritical of the CATI programs or uniformly persuaded that even its most automatic features were completely trustworthy. Occasional hardware and operations failures and the frequent inability to distinguish programming from interviewer errors contributed to a healthy skepticism among the staff which helped to identify problems needing correction. Specific interviewer complaints and suggestions, which generally were too technical for presentation in this paper, are currently being reviewed in preparation for future modifications of the system.

*A few interviewers chose more than one type of survey as "liked most," while others chose none. Thus, the "liked most" responses do not necessarily sum to 100 percent across the three types of surveys. Such atypical replies may reflect the interviewer's desire (or lack of desire) for future interviewing assignments of any type.

The survey remained in the field for more than five months and some interviewers completed as many as 600 interviews each. Without a comparable non-CATI survey for comparison, we are uncertain whether interviewer turnover during this period was atypical. We can report that some interviewer trainees and some experienced interviewers were either unable to learn or unwilling to accept computer assisted telephone interviewing and left the study during training or their first week of production. After these early losses, interviewer turnover was less than anticipated by the supervisory staff.

Instrument Design

The UCLA-CATI interviewing functions also provide a new experience for the designer of the survey instrument. Table formats for questions, or grids, are not easily accommodated, and the designer must learn to live with the restriction that no more than one survey question generally may appear on the console screen at a time. In compensation, CATI's branching functions are very powerful and permit GO TO statements based on precoded answers to any combination of previous questions. These new guidelines for instrument construction force a closer attention to the logical flow of the interview while eliminating many traditional problems of instrument design. On balance, the author found the experience of designing a CATI instrument liberating rather than restricting. A few illustrations may suggest how writing a CATI instrument changes familiar ground rules.

First, some of the vaguest areas of any survey instrument are the beginning and ending pages in which interviewers introduce themselves and the study, decide if a Spanish-speaking interviewer or other specialist is needed, determine whether the person they are speaking to is an appropriate respondent, and schedule callbacks with that person or another household member if needed. These opening and closing steps are frequently left to the discretion of the interviewer who is encouraged to follow general guidelines in the interviewer instructions and to make appropriate entries in blank spaces and cover tables provided for these purposes. However, many of these opening and closing steps can be reduced to logical sequences of precoded questions and instructions, with each step prompted and recorded by CATI. This is one of several ways in which CATI forces a clearer explication of traditional, if unsystematized, practices.

Second, the design of survey instruments for detailed factual studies is often severely constrained by the necessity of placing contingent questions close to the leading questions which establish their applicability. Thus, if certain questions are to be asked only of persons who are not now employed but who were employed in the past, they generally must follow immediately after questions on last employment. Otherwise, too great a strain may be placed on interviewer memory with losses of information when memory fails. With CATI, the survey designer is freed of this restriction. Computer memory can retain many details about the respondent indefinitely and either display or omit any question at any

TABLE 2

MEASURES OF INTERVIEWER PREFERENCE FOR DIFFERENT TYPES OF SURVEYS BY PREVIOUS INTERVIEWING EXPERIENCE

Questionnaire Item	Previous Experience As Interviewer: Yes	Previous Experience As Interviewer: No	Total
A. What are your present feelings about working on future surveys of the following kinds?			
A CATI telephone interview survey?			
This is the one I would like most.....	64%	59%	61%
Would be okay but not liked best.....	24%	11%	17%
Would consider it.....	8%	11%	10%
Would rather not work on this.....	-	8%	4%
No answer.....	4%	11%	8%
Total = 100%.....	(25)	(27)	(52)
A paper-and-pencil telephone interview survey?			
This is the one I would like most.....	8%	-	4%
Would be okay but not liked best.....	52%	33%	42%
Would consider it.....	24%	33%	29%
Would rather not work on this.....	16%	26%	21%
No answer.....	-	8%	4%
Total = 100%.....	(25)	(27)	(52)
A personal interview survey in respondents' homes?			
This is the one I would like most.....	48%	22%	34%
Would be okay but not liked best.....	32%	22%	27%
Would consider it.....	12%	30%	21%
Would rather not work on this.....	4%	15%	10%
No answer.....	-	11%	8%
Total = 100%.....	(25)	(27)	(52)
B. If you were to work on another telephone interview survey, would you prefer a CATI or paper-and-pencil telephone survey?			
Definitely prefer CATI.....	80%	93%	86%
Somewhat prefer CATI.....	8%	7%	8%
Makes no difference to me.....	12%	-	6%
Somewhat prefer paper-and-pencil.....	-	-	-
Definitely prefer paper-and-pencil.....	-	-	-
Total = 100%.....	(25)	(27)	(52)

point based on previously obtained information. Thus, contingent questions may be postponed to later points in the interview where they are more psychologically pertinent, appear less threatening, or avoid boring the respondent with too much detail on the same topic at once.

Third, the restriction that the interviewer sees only one question at a time is frequently an advantage since it permits the insertion of backup questions which do not appear unless needed. Thus, requests for exact age may be followed by probes on age ranges for those unwilling to report their exact age. Similarly, elaborate series of contingent questions may be inserted for small segments of the population, such as the vision or hearing impaired, without confusing the interviewer since they only appear when relevant. In general, CATI permits a survey instrument of far greater complexity than is feasible with traditional paper-and-pencil forms.

Fourth, CATI also facilitates the use of alternate forms of questions more appropriate to the respondent's actual situation. For example, the traditional Census Bureau questions on educational attainment read: "What is the highest grade or year of regular school you have attended?" and "Did you complete that year?". This is adequate but can be improved. If the respondent attended the 12th grade, a more appropriate followup is: "Did you graduate from high school or get a high school diploma?". Similarly, if the respondent attended the fourth year of college, a more appropriate followup is: "Did you get your bachelor's degree?". These more specific probes are unlikely to be included in paper-and-

pencil instruments since they clutter up the form and may confuse the interviewer. With CATI, they are easily accommodated and probably make for easier interviewing and and more accurate data.

Sampling

Many new functions were added to the UCLA-CATI System for the California Disability Survey. Most sampling, call scheduling, and coding operations were placed under computer control to expand CATI from an interviewing system to a surveying system. I will briefly describe four of these additions, beginning with sampling.

A proportionally stratified, clustered, random-digit-dialing sample was employed. Following the clustering procedures described by Waksberg [4], the population of dialable telephone numbers was conceptually divided into banks of 100 consecutive numbers. An initial sample of telephone numbers (called the primaries) was then drawn by systematic random sampling and called. If a primary number was found to be a nonworking or nonresidential number, no further telephone numbers were sampled from its hundred bank. However, if a primary was found to be a residence, whether interviewed or not, additional telephone numbers (called "secondaries") were sampled from its hundred bank until a fixed cluster size of residential secondaries was reached. The cluster size of the California Disability Survey was set at six residential secondaries.

The initial sample of primaries was selected outside CATI and entered into the system by replicate as needed. All remaining sampling steps were performed by batch programs within CATI. When a residential primary was identified, the programs generated six additional numbers within the same bank to be called. As these secondaries were reached, nonresidential numbers were replaced by new randomly generated numbers in the bank, while a count was kept of residential secondaries found in each bank. When the fixed cluster size of six residential secondaries was reached, no additional numbers were generated for that bank. The programs also prepared daily reports of the status of each active and resolved number by geographic stratum, replicate, and status as a primary.

In general, the sampling programs of the California Disability Survey performed admirably and insured greater accuracy in sample selection than is usually possible with paper-and-pencil record keeping. They also meant that the sampling office had little to do during the course of the field work other than to follow the progress of the sample and troubleshoot occasional problems. Various improvements in the programs and reports are clearly possible, but the experience demonstrated the advisability of including sampling functions as a routine component of computer assisted telephone interviewing.

Scheduling Calls and Callbacks

Computer programs also were developed to schedule all on-line calls and callbacks.* The computer did not do the actual dialing but displayed the number to be called on the interviewer's screen at the appropriate time or as soon thereafter as feasible. The calling and callback programs had five basic components: a search pattern; a scheduled recall system; an automatic retry system; series of reserves; and a priority system.

The search pattern was designed to find someone at home and was followed until preset callback limits were reached or until superseded by an interviewer scheduled call. The calling day was divided into eight time slots shown in Table 3: morning early; morning late; afternoon early; afternoon late; supper early; supper late; evening early; and evening late. The first call to a number generally was scheduled for one of the morning or afternoon time slots to quickly eliminate nonworking and nonresidential numbers. Then a different time slot was tried on each successive day in the series shown in Table 3. When all eight time slots had been tried, the search continued through the same slots again in a different order.

If a household was reached but the interview could not be completed in that call, the search pattern was interrupted when the interviewer scheduled a callback by completing a series of questions at the end of the interview. Callbacks could be scheduled up to two weeks in advance and specified for the same interviewer, any available interviewer, or a special class of interviewers, such as those who speak Spanish. The number then appeared on the screen for the appropriate interviewer at the appropriate time and day with a message alerting the interviewer of its callback status. The supervisory staff had access to an even more flexible callback system in which calls could be scheduled up to a month in advance with any specified interviewer or any class of interviewers.

The system also included an automatic retry of selected types of uncompleted calls. If a called number was busy, it was automatically rescheduled for one additional call 30 minutes later. Similarly, if an interviewer-scheduled recall could not be reached at the appointed time, it was automatically retried one hour later. If these retries also failed to find someone at home, the number returned to the search pattern.

To avoid running out of available numbers in any time slot, several layers of reserves were maintained. The first reserves were numbers scheduled for an earlier time slot in the same shift but not then called. For example, if a number was scheduled for a search call in the morning early slot but was not called then, it became a reserve for the morning late slot. The second layer of reserves consisted of numbers scheduled for the other shift in the same day. Numbers scheduled for morning or afternoon calls

*Occasional calls were made off-line, that is without CATI, when a respondent requested an appointment at a time when CATI was not operating.

TABLE 3

SEARCH SEQUENCES OF CALLING TIMES EMPLOYED IN CALLING ROUTINES

Series[a]	Day								When Exhausted Goes to Series:
	1	2	3	4	5	6	7	8	
1	ME	AL	SL	EE	AE	SE	EL	ML	3
2	ML	SE	EE	AL	ME	EL	AE	SL	4
3	AE	SL	ML	SE	EE	ME	AL	EL	1
4	AL	EE	SE	ML	EL	SL	ME	AE	2
5	SE	ME	AL	EE	SL	AE	EL	ML	6
6	SL	ML	EE	AE	SE	EL	ME	AL	7
7	EE	AE	ME	SL	EL	ML	SE	AL	8
8	EL	AL	SL	ME	EE	SE	AE	ML	5

[a]Each case was assigned to an initial series for its first eight calls. Series 1-4 were most frequently used during the survey. Series 5-7 were employed when the number of evening calls was insufficient. Series 8 was used only for the first few days of interviewing.

ME	Morning Early	9:00 a.m. to 10:29 a.m.	Day Shift
ML	Morning Late	10:30 a.m. to 11:59 a.m.	
AE	Afternoon Early	12:00 p.m. to 1:44 p.m.	
AL	Afternoon Late	1:45 p.m. to 3:29 p.m.	
----------	Break and Computer Processing	----------	
SE	Supper Early	4:30 p.m. to 5:59 p.m.	Evening Shift
SL	Supper Late	6:00 p.m. to 7:29 p.m.	
EE	Evening Early	7:30 p.m. to 8:29 p.m.	
EL	Evening Late	8:30 p.m. to 9:30 p.m.	

became reserves for supper and evening time slots and vice versa. Finally, if all previous reserves were exhausted, the numbers recycled, receiving multiple calls in the same time slot.

Since more than one number could be scheduled for the same time, a priority system was necessary. Recalls and retries had highest priority, while numbers in the search pattern had second priority. Among untried primary numbers in search, those with earlier replicate numbers had priority over those with later replicate numbers. The reserves were employed only when all other priorities were met. Like other components of the calling system, the priority system was essentially a translation of common sense practice into a set of explicit and programmable rules.

Although we have no clear basis of comparison to judge its efficiency, our impression is that the calling functions worked rather well, at least during the last half of the field work. Some initial problems were encountered in the treatment of weekends, in finding the appropriate mix of primary and secondary numbers, and in optimum day and evening staffing, but these were resolved by trial and error. The procedures also appear to have been effective in reaching most sampled households. Excluding confirmed nonworking and nonresidential numbers, about 97 percent of the remaining sample was reached.

As experience accumulates, it should be possible to further improve both the efficiency and effectiveness of the calling routines. Alternative sets of calling routines also will be necessary for different types of surveys. An opinion poll seeking to complete its field work in a week might employ several search calls per day to the same number rather than the leisurely one call per day used in the California Disability Survey. The major contribution of our experience may prove to be the development of a framework for this previously unsystematized area from which others may proceed.

Survey Coding of Completed Interviews

The California Disability Survey also added computer assisted survey coding to the UCLA-CATI System. At the end of each day's production, a protocol was printed for each completed interview containing the answers to each precoded question and typed-in answers to open-ended questions, interviewer comments, and interviewer notes. To focus the coding staff's attention on those parts of the instrument requiring their efforts, the protocol also flagged each item requiring coding and residual inconsistencies between answers prespecified in the coding program. Since the protocols were received the day after the interview was completed, the coding staff could query interviewers about ambiguous or incomplete answers while the cases were still relatively fresh in the interviewers' minds. When necessary, respondents also could be recalled to clarify incomplete answers without extensive delay.

The coding staff entered new codes and corrections on the same set of interactive consoles used by the interviewers. Coding functions were accessed by signing on as a coder rather than an interviewer. A new protocol was then printed showing the codes and revisions and flagging any residual problems, including incorrect coder entries. When all detectable errors were removed, the case was certified as fully coded and moved to the next step of processing.

The coding functions of CATI were among the most effective and efficient of the system. Since the programs focused coding efforts only where they were needed, a relatively small staff kept pace with the production of interviews. Direct computer entry also eliminated the need for traditional keypunching, data cleaning, and case correction. This is one survey operation where CATI may result in substantial savings for large studies.

Final Disposition Coding

A set of programs also was developed to insure that callback standards were met and to aid in classifying each sampled telephone number by its field outcome. Interviews were classified as "complete" by a programmed routine which augmented a counter as each stage of the interview was passed and then searched for key answers for each household member. If all required parts of the interview were present, the interviewer received a message that the interview was complete. Otherwise, the interviewer was led to the closeout for noncompleted interviews where a recall could be scheduled.

Nonworking and nonresidential numbers were automatically removed from the active file when these outcomes were confirmed by the interviewer. Counts were kept of all other outcomes, and the case was routed to a supervisor when preset limits were reached. Any of the following sent the case to a supervisor: one refusal; four callbacks without a completion; a language barrier other than Spanish; ten consecutive no answers; or fifteen mixed no answer and busy signals.

Cases referred to the supervisor were removed from the active file and a report was generated for each providing the full record of calls by date, time, interviewer, and outcome and accumulating brief notes entered by the interviewers. The supervisor could then restart the case, increase the number of allowable "no answer" calls, or assign it for a scheduled callback. For example, all initial refusals were reassigned for another attempt. The supervisor also could permanently resolve a case by assigning it a final outcome code, such as "double refusal" or "never at home." Supervisory commands were accessed on the same terminals used by the interviewers by signing on as a supervisor.

Summary Advantages of CATI

Before turning to the disadvantages of CATI, its apparent advantages may be summarized.

First, to program survey operations, it is generally necessary to specify these operations more fully than is required for most traditional surveys. Many areas previously left to the unsystematized judgment of the field staff must become explicit and are, therefore, more easily tested for efficiency and effectiveness. In the long run, one of CATI's main benefits may be a fuller *explication* of survey operations upon which improvements may be based.

Second, CATI provides a very useful method of *managing* large-scale telephone surveys. By placing sampling, call scheduling, field work standards, and record keeping under computer control, many clerical tasks are removed from human hands and more accurately performed, while the study director receives more frequent and accurate reports on the status of the sample and field work.

Third, CATI contributes to a greater *standardization* of interviewing and field sampling than has previously been possible. This is produced by replacing human memory and judgment with computer control at many points and by closer monitoring of the interviewers by survey supervisors. Supervisors may both listen to the interview and watch questions and answers appear on the monitor screens without the interviewers' awareness that they are being monitored.

Fourth, CATI provides the opportunity to increase survey *quality control* at many points, including field sampling, interviewer performance, and maintenance of callback standards. Some forms of interviewer error are virtually eliminated while others can be more effectively controlled by computer programs, closer monitoring, and rapid feedback from coding to field.

Fifth, these gains can be attained while conducting large surveys from multiple sites and while employing survey instruments of greater complexity than are feasible with traditional paper-and-pencil instruments.

Current Disadvantages and Limitations

Computer assisted telephone interviewing also has major disadvantages, special costs, and limitations. To maintain a constant frame of reference, I will focus specifically on the UCLA-CATI programs used in the California Disability Survey. Future revisions of the UCLA-CATI programs will address many of these problems. Other Computer assisted telephone interviewing systems

may have quite different limitations.

The first disadvantage is the extensive time and effort required to prepare the UCLA-CATI System for a new survey. Approximately eight months of highly intensive work were required by three senior staff members and several assistants to design, program, and debug the programs employed in the California Disability Survey. This was more than twice the time projected initially. However, this included full development of new sampling, calling, and coding programs for the system, and setup of a highly complex survey instrument in two languages. The work also was delayed by unanticipated hardware and systems problems. Setup times should be greatly reduced in future studies as experience is gained, standard modules are designed for common functions, and improved documentation becomes available. For the immediate future, setup times and costs are likely to remain a major impediment to CATI use for all but the simplest surveys.

A second disadvantage of CATI is the extensive time required for interviewer training. At least 80 to 90 hours of training, spread over three weeks, were required per interviewer before the supervisory staff believed that an interviewer was prepared to begin production work. As shown in Table 4, interviewer perceptions also suggest that on the average the amount of training was about right. Curiously, experienced interviewers more frequently complained of too little training than did inexperienced interviewers. This may reflect the problems of unlearning previous habits, the more difficult tasks experienced interviewers were frequently assigned, or other unsuspected factors.

Although our supervisors believe that CATI-trained interviewers could be readied for another CATI study in two or three days, the costs of *initial* training are currently a deterrent to occasional use of CATI for surveys requiring its full range of present interviewing functions. Less training would be required for opinion surveys which do not request detailed information on each household member. Major reductions in CATI training for complex household surveys will probably require both new approaches to interviewer training and further simplification of CATI's more cumbersome interviewing commands.

A third disadvantage of CATI is its vulnerability to hardware and computer operations failures. Although we were prepared to lose a day or two of production from hardware and system crashes, this did not happen. Instead, the problems took less serious but more time consuming forms, such as scrambling the callback times and messages of active cases and the frequent need to

TABLE 4

INTERVIEWERS' OPINIONS OF THE AMOUNT OF TRAINING RECEIVED BY PREVIOUS INTERVIEWING EXPERIENCE AND TIME OF TRAINING

Opinion of Amount of Training Received	Previous Experience As Interviewer		Time of Training		Total
	Yes	No	Initial Crew	Later Crews	
Far too much.....	-	4%	3%	-	2%
Somewhat too much...	12%	37%	27%	21%	25%
Enough.....	40%	37%	27%	58%	38%
Not quite enough....	40%	22%	37%	21%	31%
Not nearly enough...	4%	-	3%	-	2%
Not reported.....	4%	-	3%	1%	2%
Total = 100%...	(25)	(27)	(33)	(19)	(52)

reprocess the same files repeatedly. The UCLA-CATI System presently requires many batch processing operations, performed by a computer operator working from the end of evening production to 3:00 or 4:00 in the morning. Since overnight processing entailed more than two dozen sequential steps keyed in by the operator, there were many opportunities for error, many of them realized. Entry of the wrong date at any of several steps could cause problems on the following day. Various methods of simplifying or eliminating CATI's overnight processing are currently being explored as first priority changes in the system.

A fourth disadvantage of the UCLA-CATI System is the difficulty of diagnosing malfunctions when they occur. Perhaps this is to be expected of any complex set of programs receiving input from a variety of different persons, such as interviewers, supervisors, coders, and computer operators. Nevertheless, the problem was a serious one which consumed much senior staff time. Some minor problems persisted for weeks before their causes were diagnosed, while others were not solved until the field work was complete. In compensation, the system was designed

to fail safe, and very few errors or malfunctions resulted in the unrecoverable loss of data.

A fifth disadvantage is CATI's present awkwardness in some atypical interviewing situations, especially those where the answers to early questions are changed late in the interview or previously unreported household members are mentioned only in the closing question. For complex, household interviews, the present system backs up within the same section of the interview, but does not back up from later sections to earlier sections. When these atypical interviewing situations occurred, it was often necessary to abandon CATI and switch over to paper-and-pencil forms and then add the late information during coding or a mock recall. In view of the number of interviewing functions which CATI handled well, this occasional awkwardness was acceptable in the California Disability Survey. More appropriate means of accommodating late information are essential if CATI is to find broad acceptance.

One of the most frequently cited benefits of computer assisted telephone interviewing is its ability to provide tabulations of survey results within a day or two of field work completion. The CRT Interviewing System designed by Chilton Research Services has this capability [1]. The UCLA-CATI System employed in the California Disability Survey did not. Standard output was produced in an awkward left-adjusted, alpha format, and several programming steps were required to prepare the data for easy tabulation. The goal of next-day tabulations also must be balanced against the need to recombine responses from alternate questions and residual checks on data quality. With sufficient development time and pretesting, preliminary next-day tabulations should be feasible, but our experiences suggested that they were not a routine or easily obtained product of the UCLA-CATI System.

Costs

Unfortunately, we can provide little firm evidence on the relative costs of a CATI survey. Final cost figures are not yet assembled; we have no firm basis of comparison; and as with any new enterprise it is difficult to separate development from production expenditures. Although savings appear to have been realized in coding, keypunching, and cleaning, on balance CATI surveys presently appear to be more expensive than comparable paper-and-pencil telephone surveys. For small surveys, where setup and training costs are spread over few cases, cost per case would undoubtedly be high, perhaps approaching that of personal interview surveys in respondents' homes.

While cost considerations will be important in future decisions to adopt CATI, they should not be determining. Rather, CATI is to be recommended for other reasons, such as its survey management capabilities, its improved standardization of survey practice, its opportunities for field and sampling quality control, and its ability to handle survey instruments of unusual complexity. On these grounds, we believe CATI was the appropriate choice for the California Disability Survey and one which other surveys should find equally appropriate in the future.

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