
Research Paper

Review of Computer Assisted Telephone Interviewing (CATI) Procedures in Overseas Statistical Agencies

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Introduction

The following paper will endeavour to set out important aspects of computer assisted telephone interviewing (CATI) data collection procedures, drawing from statistical agencies around the world. The emphasis is on business surveys but most of the process also applies to household surveys. Some of the research is actually from studies of computer assisted personal interviewing (CAPI), where the issues are generally about the addition of computers to the interviewing process and therefore also relevant to CATI data collection. The paper does not explore in detail the advantages and disadvantages of using a CATI system, but examines how to go about developing and using a CATI system effectively.

The first section deals with the process of data collection itself, focusing on the Current Employment Survey as an example of an effective CATI survey. The section describes the specific procedures used, the impact of CATI on response rates and data quality, and the way the organisation is run to incorporate CATI. The second section focuses on the CATI instrument, describing some basic questionnaire design issues, desirable system functions, the importance of automatic scheduling and the length of the interview. The final section explores issues related to the people involved in the data collection process, the training of interviewers, the changing responsibilities of supervisors, getting feedback from interviewers, and monitoring interviewers and respondents. Developing a CATI survey is not just a simple process of sticking the paper questionnaire onto a computer. Using that computer as the data collection instrument affects the entire survey cycle.

The Process

The survey

This section describes the Current Employment Survey (CES) at the U.S. Bureau of Labour Statistics. The CES measures the employment, hours and earnings of over 300,000 businesses and is a very important economic indicator. A voluntary survey, the CES was originally collected every month by mail. It was converted to CATI specifically to increase the timeliness of the estimates produced, and additionally to increase response rates and reduce measurement error. CATI is used to focus on chronically late respondents to encourage them into reporting in a more timely fashion by personal attention from interviewers (Werking & Clayton, 1995).

The procedure

The CES questionnaire is mailed to businesses at the beginning of each year so that the employer can record the relevant data in it each month. A test (Werking & Clayton, 1995) demonstrated that an advance notice postcard, to remind respondents of the time of their prearranged CATI call and directing them to fill in their form, significantly increased the number of respondents who were ready with their data on the first call. There was also an increase in overall response rate, and a subsequent reduction in costs. The postcard was therefore added to the procedure, sent every month when the employer's payroll information became available. The interviewer then calls the respondent and collects and edits the data, addresses any respondent issues, and arranges an appointment for the next month's call. Timely respondents are eventually converted to touchtone data entry (TDE), generally after 6 months, to compensate for the cost of the CATI data collection.

The impact

The CES CATI was very effective in achieving the aims of the Bureau of Labour Statistics (Werking & Clayton, 1995). The employers who had response rates of 0-20 percent for preliminary estimates were brought up to response rates of 82-84 percent within 6 months. The total response rate reached the 80 to 90 percent required. The sample attrition rate for CATI was about one-third of that for mail, and large businesses had especially low rates. The data collection method also enjoyed broad support from respondents.

The quality of CES data is assessed by an independently conducted Response Analysis Survey (RAS) (Werking, Tupek & Clayton, 1988). The RAS explains the survey definitions and explores whether the respondent has applied includes and excludes correctly, relating responses to the employer's record keeping system. The respondent is trained to respond properly, with the interviewer using neutrally worded, yes/no questions. The RAS is conducted either by personal or CATI interview and afterwards, a form is sent to the respondent reminding them of any reporting changes they have agreed to. Testing of the RAS showed it had a significant impact on survey estimates, resulting in a larger change in production worker earnings than the non-RAS control sample and a similar trend for other data items.

Improvements in survey estimates by converting to CATI has been demonstrated by other surveys. The Canadian Labour Force Survey (Statistics Canada) showed an increase in reported average household size, indicating a large reduction in underenumeration when estimates were compared to the census (Drew, Dick & Switzer, 1989). The National Crime Victimization Survey (U.S. Bureau of the Census) showed significantly higher rates of major crimes among respondents interviewed by CATI compared to ordinary telephone interviews, indicating that the more controlled CATI interview, requiring strict adherence to the questionnaire, results in a higher quality interview (Rosenthal & Hubble, 1993).

The organisation

The CES is run from two Data Collection Centres (DCCs). Originally the survey was run separately from each state but technical, financial, organisational and administrative considerations led to the states giving their CATI workloads to the DCCs (Donohue, Clayton & Werking, 1992). It was inefficient to continue in the states with a small, specialised staff over short periods, and the success of CATI collection conducted by the states varied considerably with some response rates as low as 67 percent compared to the overall response rate of 80-85 percent (Donohue et al., 1992). The centralisation of the data collection was cost-effective and had other positive effects as well. The survey response rate increased by 10 percent overall and between state variation in response rate dropped from 30 percent to 3 percent (Werking & Clayton, 1995). Once respondents are converted to TDE they are returned to the states' control.

This tendency towards CATI data collection from just a few centres has been demonstrated by other statistical agencies including the U.S Census Bureau (Nicholls & Matchett, 1995) which runs all its CATI business surveys from one centre in Indiana and its household surveys and tests from two other centres. One of the Census Bureau's business surveys run by CATI is its monthly Retail and Wholesale Trade Survey, which was withdrawn from the Bureau's 12 regional offices when the survey was automated (Nicholls, 1988). Centralisation allows standardised interviewing procedures and better quality control, through making recruitment, training and supervision of interviewers easier, as well as allowing better access to technical support for the CATI instrument itself.

The Instrument

Basic questionnaire design

Designing a CATI questionnaire is more complex than a paper and pencil instrument. There needs to be more precise specification of skip logic and valid response values, but the extra effort is generally considered to save processing time later in the cycle (Tarnai, Kennedy & Scudder, 1998). Layout of the questions on the screen is an important issue. Early computer-assisted interviewing presented each question on a separate screen but this method has two main disadvantages: interviewers can lose track of the questions' purpose, especially with extensive branching; and it is more difficult to notice mistakes and correct them than with a paper questionnaire which gives a continuous overview of the questions and answers (Saris, 1991). The more recent form-based CATI questionnaires, such as that used by the CES (Donohue et. al., 1992) present several questions on the screen at once so that the interviewer can move more freely through questions in the order they prefer. This means that, for example, when respondents tell interviewers the answer to a data item before the question has been asked, the value can still be entered.

Assessing opinions of CATI forms, Statistics Canada found that interviewers were critical of screens that displayed instructions or introductions only, and many of these were reduced or removed from their tested form to improve the flow of the questionnaire (Catlin, Ingram, & Hunter, 1988). It is very important to remember the design standards that exist for paper questionnaires and to apply them with the expanded capability of the CATI instrument. For example, use distinctly different formats for questions compared to instructions, with colour, bolding, and underlining, don't use too much text on the one screen, and be consistent with the use of different parts of the screen (Saris, 1991). The CATI instrument has a great potential to improve the quality of data collection interviews if it is used appropriately. A large survey of U.S. commercial and academic statistical organisations using CATI demonstrated that those organisations who used more of the seven CATI functions listed rated themselves significantly more satisfied with their CATI system than those who used fewer of the functions (Groves & Tortora, 1998).

Design functions

Some important functions that should be included in a CATI system are as follows:

Editing- capacity to edit during the course of an interview is one of the main advantages of using a CATI system. Internal consistency checking can be used in addition to simple range edits, as well as comparisons to a respondent's data given in previous surveys. For example, a monthly turnover of \$3 million should not trigger a simple range edit for that data item- lots of businesses may have a turnover that high. However, a good CATI system would trigger an edit query if the relevant business had a size of only two employees, or had a turnover of only \$2,000 the previous month. Online edits allow the identification of inconsistencies in respondents' answers as well as recording errors made by the interviewer (see Saris, 1991). On-line editing dramatically reduces post-interview edits and follow-up with respondents, saving time and effort (Couper & Nicholls, 1998). The CES CATI instrument provides access to 16 months of historical microdata for longitudinal editing (Donohue et. al., 1992).

"Fill" capability- when the CATI application tailors the text of a question based on answers to previous questions, easing the burden of the interviewer. For example, a question that in a paper form would read "What was the turnover for this legal organisation in this state for the month of June?" would be tailored by the CATI system as the interviewer reached it to read "What was the turnover of *Joe's Shoes* in *NSW* for the month of June?" by retrieving the name of the organisation and the state traded in from answers to earlier questions. This capability is especially important for surveys where it has been shown that the interviewer using the paper version makes errors in question wording and has delays in asking the question due to trying to assemble the proper words (Groves & Nicholls, 1986).

Enforced probing- when the respondent does not give the appropriate answer at first, the interviewer is routed into extra probing questions. For example, when the question requires a specific number of days and the respondent gives a range of days, or a "don't know" response then the interviewer can code that answer, and is then directed by the CATI form to ask "Would you think for a minute and give me your best estimate?" (Groves & Nicholls, 1986). Requiring the interviewer to probe can have a positive impact on item non-response.

Randomising response options- for questions with long lists of response options that need to be read to the respondent. It is often difficult for respondents to remember everything on a long list, so they will simply pick the first or last option. Randomising the list for each interview means that at an aggregate level the results should not be biased (Saris, 1991).

Backwards movement- when the interviewer or the respondent has made a mistake, it is important for the interview to be able to move backwards through the questionnaire and correct the answers of previous questions. After such corrections have been made, the CATI system needs to be able to route the interviewer to other questions that may be affected by the changed answer and then return to where the interview was up to (Groves & Nicholls, 1986).

On-line help- Regardless of the amount of training undergone by the interviewer, it is still very useful to provide extra information about any potentially problematic data items, either on the screen with the question or on a separate help screen to be called up when necessary (Saris, 1991). It is too burdensome for interviewers to remember lots of definitions and other information pertinent to the meaning and purpose of questions, and help screens are a practical solution.

Autodialing- when the computer dials the respondent's number automatically instead of the interviewer having to do it manually. Autodialing speeds up the interview process and removes human error (Edwards, Suresh & Weeks, 1998). It also reduces some of the physical burden of the interviewers, because when they are dealing with a keyboard and sometimes pens and paper as well, they can be overreaching to use the telephone and this can cause strain injuries.

Automatic scheduling

Scheduling calls to respondents automatically is a vital part of a CATI instrument that has a large impact on the duration of the survey cycle. This list from Edwards, Suresh and Weeks (1998) describes all the functions a call scheduling system should have, based on a survey of U.S. and Canadian statistical organisations:

- Keeping track of appointments and scheduling callbacks
- Controlling scheduling based on availability of telephone interviewers to keep the appointments
- Scheduling "cold calls" (i.e., first calls to cases and callbacks to cases where no prior contact has been made) at times when the chances of contacting an eligible respondent are best
- Implementing pre-specified calling algorithms for various other types of cases, e.g. busy numbers, broken appointments
- Randomising and scattering call attempts across varying days of the week and times of day
- Prioritising so that the most important cases are called first
- Assigning special cases to appropriate types of interviewers, e.g. refusal converters, bilingual interviewers
- Adjusting for time zone differences so that cases are not called at inappropriate times
- Closing out cases automatically, or referring them to a supervisor for review, after a prescribed outcome or level of effort has been reached
- Projecting staffing needs for future work shifts, based on number and types of cases available
- Producing a variety of status reports

A study at Westat (Edwards, & Cunningham, 1994) examined whether there were specific times or days that were better for calling businesses. Apart from predictable gaps around lunchtime, the rate of completed interviews remained fairly constant throughout the day until late afternoon for the week as a whole, and completion rate was significantly higher on Tuesdays than other days.

Interview length

The same principles that apply to standard telephone interviewing of individuals or businesses necessarily apply to CATI interviewing. Respondents have pressures on their time, and the interview must be brief. According to Lester and Wilson (1995), from the University of Reading in the U.K., "an interview exceeding 10 minutes is dangerous, and one exceeding 12 minutes is very dubious indeed as to data quality". The actual length of the CATI interview depends on three things: the length of the questionnaire itself, the efficiency of the CATI instrument and the experience of the interviewers. The experience of the interviewers will of course increase over time, and it is reasonable to expect a reduction of interview length after a few months of using a CATI instrument in a survey. For example, the average duration of a CATI phonecall for the CES decreased by one-third as the instrument was improved and the interviewers got used to it (Werking & Clayton, 1995). Similarly, the Canadian Labour Force CATI survey went from 11.9 minutes to 7.95 minutes on average after three months (Catlin et. al., 1988).

The number of data items in the questionnaire must be kept to a minimum. The increased capacity of a CATI instrument compared to paper should not lead to adding too many questions for the patience of a respondent to withstand. For example, the CES consists of only five or six numeric data items (Donohue et. al., 1992). The response time of the CATI system must be able to keep up with the fastest interviewer, so there are no uncomfortable gaps in the conversation (Catlin et. al., 1988; Saris, 1991). Replacement of one screen by another, edits, coding and calculations must be performed fast enough so that there are no delays longer than a few seconds. Streamlining the questionnaire and allowing the interviewers to gain experience, to keep interview length down and data quality up, requires appropriate, extensive testing of the instrument and training in using it.

The People

Interviewer training

As the most desirable characteristics of an interviewer are being able to contact respondents, persuade them to participate and get complete, accurate interviews from them, these skills are generally what are looked for in recruiting interviewers (Wojcik & Hunt, 1998). Computer skills were originally a low priority and there still remains a large proportion of interviewers with little computer experience, despite the increasing importance of computers in data collection. For an example of how inexperience can be a problem, the Canadian Labour Force Survey CATI tests used inexperienced interviewing staff and it took several months for some interviewers to be able to focus on conducting interviews without being distracted by what would happen when they pressed the next key (Catlin et al., 1988). It is clear that training CATI interviewers requires a different approach to that of traditional telephone survey interviewers.

There has been a shift from formal classroom training to increased self-study, for example the U.S. Census Bureau now includes a computer-based tutorial component on technical aspects such as function keys, and have transferred some questionnaire content and basic interviewing skills training from classroom to home study (Clark, Martin, & Bates, 1998). Some agencies train at the regional level, with the staff trainers being the people who will be responsible for the interviews later and travel costs being reduced. Other agencies have centralised training allowing increased standardisation and increased communication between the trainers (Wojcik & Hunt, 1998). Training of interviewers for the CES is conducted at the two Data collection centres and goes for over a week, and covers interviewing techniques, hands-on training of the CATI hardware and software, and extensive coverage of the definitions and edit and screening processes (Donohue et. al., 1992). Overall length of training varies significantly across organisations but two to five days of in-person training plus self-study should be sufficient, as too much training can be detrimental to performance (Wojcik & Hunt, 1998).

Content of CATI interviewer training courses should include helping interviewers overcome computer anxiety and teaching them to use the system to complete interviews. It is also vital to retain the same amount of training in administering the CATI questionnaire as was necessary with the paper version. A lot of time is usually spent on getting interviewers used to the content and flow of a paper questionnaire, this is even more important with a CATI instrument as their position within a questionnaire and the direction questions are going is less obvious. Some organisations use flowcharts and other graphical descriptions of the CATI questionnaire to help interviewers get more familiar with the instrument. Videotape is often used in addition to in-person training. On-line tutorials are supplementing the more common written materials and exercises. Mock interviews and then supervised live interviews should always round up the training before an interviewer begins a normal workload (Wojcik & Hunt, 1998).

Supervisor responsibilities

Two of the principle changes due to implementing CATI reported by survey organisations are retraining of supervisory staff and changes in salary and career patterns of telephone centre staff (Tarnai et. al., 1998). For example, at the Social Science Research Centre at Boise State University, the telephone supervisors had to assume programming and computer maintenance duties and therefore required computer skills training and received higher salaries. New supervisory staff with the appropriate skills were also recruited. To make up for the increase in time spent on these duties, the responsibility of hiring interviewing staff was transferred to other people (Tarnai et al., 1998). At the US Census Bureau interviewer supervisors monitor keystroke files and statistical analysis of interviews, looking for software and hardware problems as well as supervising the interviewers. Survey organisations in general report that in automating surveys, staff had to perform a wider range of tasks (Clark et. al., 1998). Broadening of responsibilities due to using CATI, for interviewer management and other staff including technical support, is more common in large organisations (100+ full time staff) than in smaller organisations, perhaps because the staff in smaller organisations already had broader responsibilities than those in larger organisations (Groves & Tortora, 1998).

Interviewer feedback

As the people who will actually be using the system, interviewers can give very useful feedback about it. Systematically collecting information from interviewers, their attitudes and expectations, can be reasonably cheap and easy and can guide the development of the system so that it is more efficient and obtains data of higher quality. Gaining feedback from interviewers can also lead to understanding what makes a successful interviewer, and how to optimise recruitment, training and remedial work (Couper & Burt, 1993). The use of CATI systems is certainly a different experience for interviewers compared to paper questionnaires. Interviewers' opinions will change over time and therefore should be measured regularly to check that the system is performing properly and that the interviewers become comfortable with it.

One example of a comparison study is from Statistics Canada (Catlin et. al., 1988) where interviewers used CATI and paper forms in alternative weeks and were asked their opinions of the two methods. After the first month, 80% of the interviewers preferred the paper form, but by the third month their preference had swung to 80% in favour of CATI. The interviewers became highly enthusiastic about the CATI system, as it reduced their workload through functions such as automatic scheduling and branching. However, the interviewers experienced frustration because corrections were more difficult, and non-productive calls were more time-consuming. They also experienced a feeling of lack of control over the interview. Subsequently the interviewers found their CATI weeks more stressful. There were fewer hours worked during CATI weeks due to increased lateness and illness. Catlin et. al. suggested that higher stress from using CATI could result in higher turnover of staff and that shorter shifts or more frequent breaks for CATI interviewers may be necessary.

Some examples of statements, to agree or disagree with, for use in attitude surveys of interviewers comes from the U.S. Bureau of the Census (Couper & Burt, 1994):

- Learning how to use a computer will be (was) fun
- I am afraid of breaking the computer
- Using a computer will (has) help(ed) improve my skills and training
- Using a computer for interviewing will enhance the professional image of interviewers
- By using a computer, I will feel as if I'm being "watched" all the time
- Using a computer will (has) slow(ed) me down during interviews
- Interviewer's jobs may be threatened because of the use of computers
- The computer will allow (allows) me to concentrate on conducting the interview rather than worrying about which questions to ask
- Learning to use a computer for interviewing will be (was) easy

Results from these measures should be examined based on such factors such as interviewers' age, survey experience, typing skill, computer experience and education level.

Interviewer and respondent monitoring

Monitoring of interviewers through direct observation, tapes of CATI interviews and remote monitoring via telephone links and duplicate computer screens is invaluable for examining the performance of interviewers and the effectiveness of the CATI system. Monitoring ensures that proper procedures are followed and that the interviewer applies survey concepts appropriately and uses good telephone etiquette. The U.S. Bureau of the Census (Beach, Woods, & Burt, 1996) uses telephone headsets and connected computers to monitor all their interviewing staff regularly. Monitoring is done by supervisors or specially trained "coaches". All new interviewers are monitored for their first three interviewing sessions as they settle in. Interviewers who have been having trouble in some way with interviewing are monitored extensively and given extra feedback. All current interviewers are monitored for about 2.5 to 5 percent of their log-in time. Assessments of interviewing skills are based on six basic categories: manner and voice; reading skills; probing skills; proper data entry and notes; handling difficult situations; and understanding and explaining survey concepts. Findings are fed back to interviewers in a timely fashion so they know how they are going.

In evaluating the effectiveness of the CATI system, the behaviour of the respondent is also relevant. In a Westat study (Shepherd & Vincent, 1991) on a national survey of Student Financial Aid, CATI interviews were examined for interviewer compliance to the script as well as coded for different types of behaviour. It was found that due to the rigidity of the CATI questionnaire, skip-pattern non-compliance was very rare. Also, 94% of the asked questions were asked exactly as written and 4% with minor, non-biasing variations. Only 2% of questions were asked with major wording changes. These results indicate not only good interviewing, but well-worded questions and good screen layout. To more closely examine the quality of the interviews, the following behaviour codes were used:

| <i>Interviewer Behaviour codes</i> | <i>Respondent behaviour codes</i> |
|--|---|
| Ask question | Answer question |
| Storytelling, elaboration, unscripted conversation | Definition of term requested |
| Back-up, cancel | Echo question or part of question |
| Define term | Help requested from someone outside the interview |
| Echo answer or part of answer | Ask for interpretation of item meaning or content |
| Ask for response repetition | Interviewer training by respondent, instructs interviewer on manipulating instrument or recording information |
| Give examples to illustrate meaning | Long pause; greater than 6 seconds, including verbalised hesitations |
| Help requested from someone outside interview | Ask purpose of item or instrument |
| Interpret question meaning | Ask for answer to prior question(s) |
| Respondent training, instructions on how to answer questions | Answer this question in full or in part before it was asked |
| Interpret purpose of instrument or question | Request repeat of the question |
| Ask for meaning of response | Short pause; between 4 and 6 seconds, including verbalised hesitations |
| Ask for additional information | Storytelling, elaboration, anticipatory response |
| Suggest/summarise responses from prior responses | Agree with/accept interviewer statement |
| Repeat question | Refusal |
| Suggest/summarise response not based on prior responses | Don't know |
| Unscripted description of questionnaire design | |
| Agree with/accept respondent statement | |
| Ask for/encourage estimate or guess | |

Shepherd and Vincent (1991) used these codes to qualitatively evaluate the performance of the questions themselves as well as of the interviewers. They also counted the number of interaction pairs (one interviewer action and the corresponding respondent action) for each question, as a quantitative measure. The highest number of interaction pairs for a question was 28, indicating a very serious problem with that question.

Similar monitoring is conducted at other statistical agencies. Statistics Canada (Mudryk, Burgess & Xiao, 1996) monitors interviewers within a statistical framework, using systematic sampling to select several consecutive screen displays from whichever interviewers are conducting interviews at the time. The interviewers are stratified into four groups based on previous weeks performance, ranging from experienced or excellent to unacceptable, and interviewers are selected to be monitored at different rates depending on their group, so that the worst interviewers are monitored the most. The screen displays selected are observed using a telephone link and duplicate computer terminal by trained monitors who rate the interviewer on question delivery, respondent relations, subject matter knowledge and data processing. The Center for Survey Research (Massagli & Clarridge, 1995) also use systematic monitoring and require their monitors to have at least 200 hours of interviewing experience.

Audio-visual monitoring of interviews can be complemented by analysis of keystroke files. Keystroke, or trace, files can show the interviewer's typing errors, use of function keys, navigation through grids and so on (Couper & Horm, 1997; Potter, Edwards, Sperry & Dulaney, 1997). The typing behaviour of interviewers and the way it changes over time as they gain experience with the CATI instrument gives a useful demonstration of how easy the instrument is to use. For a new CATI survey or a survey newly converted to CATI, interviewer and respondent monitoring in various ways demonstrates how effectively the system can be used, initially and over time. This is of great value in developing the CATI instrument.

Conclusion

Computer assisted telephone interviewing has a great potential to improve the data collection process. The above research and methodology from statistical agencies, in particular the U.S. Bureau of Labour Statistics and the U.S. Census Bureau, has shown some of the main considerations when developing a CATI survey. The impact on response rates and survey estimates must be calculated to ensure there is no deterioration in data quality. Data collection should be centralised to avoid between state variation in training and procedures, therefore avoiding variation in estimates. The CATI instrument should be crafted carefully with appropriate screen layout, good edit checks and automatic scheduling as well as other useful functions. Interviewers need to be trained in the use of the computer system as well as in interviewing and supervisors and other staff will have changed responsibilities and may also need different training. The effectiveness of the interviewers and the instrument should be measured both by gaining feedback from interviewers and by monitoring them as they work. Like any data collection instrument, a CATI system and specific CATI questionnaires must be developed considering and testing the effect on the whole survey process, data quality and response rates, cost and speed, staff and respondents' reactions. With care, implementing CATI may be beneficial to all these aspects.

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