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A Review of Survey Data-Collection Modes: With a Focus on Computerizations

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Abstract

Surveys are conducted using many different modes (e.g. face-to-face, mail, telephone, Internet). Because different modes have different error structures, it is very important to understand the advantages and disadvantages associated with each mode. In recent years there have been major changes in the modes typically utilized in surveys. In particular, there has been increases in the use of computers in data collection, self-administration, and mixed-mode designs. The implications of these and future changes are considered.

Keywords and phrases: CATI, CAPI, CASI, mode, measurement effects

1 Introduction

Surveys are conducted using a wide variety of data-collection modes. The variety of modes is increasing and the complexity of survey designs is growing. Moreover, in recent decades there has been an appreciable change in what modes are typically employed. Perhaps the most far-reaching development has been the expansion of computer-assisted survey information collection (CASIC).[1)] As Couper and Nicholls (1998) have noted, "survey research has undergone many important changes in the last half century…. Yet none of these changes may have more far-reaching effects on survey research than the application of computer methods to survey data collection and capture." Furthermore, this is a change that Couper (2008) characterizes as "inexorable."[2)]

In light of the major changes in modes and the increased computerization of surveys, this paper examines 1) the complex variety of modes that are used in survey data collection, 2) the use of mixed-mode surveys, 3) measurement effects and operational differences resulting from different modes, and 4) mode-related changes that have been and are likely to continue to develop.

2 Typologies of Survey Modes

Various schemata have been developed to classify surveys (Couper 2011; Tourangeau, Conrad, and Couper 2013; Tourangeau and Smith 1996). Table 1 shows a typology of surveys on three dimensions. Along the rows, are the four standard modes of survey: In-person or Face-to-Face,

Telephone, Mail, and Internet or Online. The columns distinguish two more dimensions: whether 1) computers are or are not utilized in data collection[3)] and 2) the survey is interviewer- or self-administered. The first row covers In-person surveys. In the upper left corner are traditional paper and pencil interviews (PAPI) in which an interviewer conducts an in-person interview with a respondent and reads questions from and records responses into a printed, hardcopy questionnaire. Moving to the right are PAPI surveys that include one or more self-administered questionnaire (SAQ) components. PAPI+SAQ is a mixed-mode format since the SAQ typically represents only a minority of the total questionnaire. Next comes computer-assisted personal interviews (CAPI) in which an interviewer administers the survey as in PAPI, but reads from and records responses into a computer. The final variants of in-person interviews are a variety of computer-assisted self-interviews (CASI) also known as computerized self-administered questionnaires (CSAQ). Traditionally, these involve having the interviewer turn the computer around and having the respondent read questions and enter their answers into the machine without the interviewer observing their responses. Extensions of CASI include 1) audio computer-assisted self-interviewers (ACASI) in which the computer reads the questions aloud to respondents who usually listen on earphones and often simultaneously see the written questions on the computer screen and then enter their answers into the computer, 2) video computer-assisted self- interviews (VCASI) in which respondents are shown either still or dynamic visuals on the computer as either part of content of the question or as the response options, and 3) audio-video computer-assisted self-interviews (AVCASI) in which respondents both listen to audio (either the questions being read and/or sounds being evaluated as part of the question content)and watch visuals (stills and/or dynamic). These are sometimes referred to as multi-media presentations.

The next row covers telephone surveys. In the left-most column are traditional telephone interviews (TI) not utilizing computers in which interviewers read from and record responses into a printed questionnaire. There is no current self-administered version of TIs that do not utilize computers. There used to be fax surveys in which a questionnaire was faxed to respondents, printed out by them, manually-filled out and then faxed back to the sender. Next comes computer-assisted telephone interviews (CATI) which are administered like TIs, but the interviewer reads from and enters responses into a computerized questionnaire. Most CATIs use centralized data collection and desktops, but Distributed-CATI, in which interviewers use desk/laptops from their homes, are also utilized (Couper 2008). Self-administered telephone interviews consist of both 1) fully computerized systems using interactive voice response (IVR) in which a computer contacts respondents, introduces the survey and orally asks the questions (with the sound typically being machine generated using text-to-speech (TTS) software (Couper 2008; Couper et al. 2014; Smith and Sokolowski 2011) and responses are collected by respondents answering using phones with traditional touchtone keypads and smartphone equivalents, or orally with their responses being captured by automatic speech recognition (ASR) or voice recognition (VR) software and 2) hybrid telephone audio computer-assisted interviews (T-ACASI) in which interviewers initially contact

respondents and some or all of the subsequent interview is administered by computer as in the pure IVR case. The former case is sometimes dismissively referred to as robopolls.

Table 1. Typology of Surveys by Mode and Medium

	No Computer		Computer	
	Interviewer	Self-Administered	Interviewer	Self-Administered
In-Person	PAPI	PAPI+SAQ	CAPI	CASI/CSAQ ACASI VCASI AVCASI
Telephone	TI	Null	CATI	IVR/T-ACASI
Mail	Null	MQ	Null	Mailed Disk
Internet	Null	Null	Null	EQ OQ

ACASI=audio computer-assisted self-interview
AVCASI=audio-video computer-assisted self-interview
EQ=email questionnaire
CAPI=computer -assisted personal interview
CASI=computer-assisted self-interview
CATI=computer-assisted telephone interview
CSAQ=computerized self-administered questionnaire
IVR=interactive voice response
MQ=mail questionnaire
Null=rare or non-existent
OQ=online questionnaire
PAPI=paper and pencil interview
SAQ=self-administered questionnaire
T-ACASI=telephone audio computer-assisted self-interview
TI=telephone interview
VCASI=video computer-assisted self-interview

The third row covers mail surveys. This mode is entirely self-completed and no interviewers are involved. Traditionally, a mail questionnaire (MQ) is sent to respondents who read it, manually complete it, and then mail it back to the sender. There used to be a partial computerized version in which a diskette was mailed to respondents who uploaded it on their own computer, completed the questionnaire, and then downloaded it on to the diskette and mailed it back to the sender (or possibly emailed it back in some cases), but this is no longer used (Wright and Marsden 2010).

The final row covers Internet surveys. Naturally, these only involve computers. Traditionally, like mail surveys, these have been entirely a self-completion mode, but, as discussed below, their nature is evolving along with the Internet. The initial version involved email questionnaires (EQ) in which respondents were sent a questionnaire as an attachment, completed it on their computer, and electronically sent it back to the sender (Couper and Bosnjak 2010; Wright and Marsden 2010).

These have largely been replaced by a variety of online questionnaires (OQ)(Couper and Bosnjak 2010). In the most common case, respondents are sent an electronic invitation with a link to a website where an interactive questionnaire can be completed and submitted. There are an enormous variety of OQs varying on several dimensions such as how the sample is drawn (e.g. probability and non-probability access panels, river sampling, list samples of some sub-population like students in a college or employees of a company), the device on which respondents complete the survey (desktop, laptops, tablets, smartphones), the operating systems and software utilized, and how basic or advanced the questionnaire design is (Couper 2008; Couper and Bosnjak 2010; Tourangeau et al. 2013).

Table 2 elaborates on the different types of surveys by examining administration mechanism - visual, audio, or mixed (both employed) and again subdivides surveys by whether a computer is used or not and whether it is interviewer- or self-administered (Smith and Sokolowski 2011). By emphasizing the administration mechanism or channels of communication rather than the standard survey modes, Table 2 shows the similarities and differences that exist across the many different varieties of surveys delineated in Table 1.

Table 2. Typology of Surveys by Visual/Audio Dimensions and Mode

	No Computer		Computer	
	Interviewer	Self-Administered	Interviewer	Self-Administered
Visual	Drop-off	Mail Classroom handout	Null	OQ CASI
Audio	PAPI TI	Null	CAPI CATI	IVR/T-ACASI
Mixed	PAPI+show cards	TI+show cards TI+diary PAPI+SAQ	CAPI+show cards	ACASI AVCASI

ACASI=audio computer-assisted self-interview
CAPI=computer-assisted personal interview
CASI=computer-assisted self-interview
CATI=computer-assisted telephone interview
Null=rare or non-existent
PAPI=paper and pencil interview
SAQ=self-administered questionnaire
TI=telephone interview

The first row covers visually-administered surveys. Visual-administration includes both reading text (i.e. questions and questionnaire instructions) and viewing static or dynamic images (e.g. photographs or animated and real-life videos). Visuals include both their use as part of the stimuli (e.g. still and dynamic pictures to be evaluated by respondents) or as part of the response options

(e.g. scales of response options). Visual modes using interviewers and not using computers would include when an interviewer drops-off a questionnaire which the respondent completes and which is later picked up by the interviewer (or sometimes mailed back). Visuals neither using an interviewer nor a computer would include MQs and classroom handout questionnaires. Visuals using computers and self-administered include OQ and CASI surveys. Surveys only using visuals (no audio) and using both computers and Interviewers essentially do not exist.

The second row includes audio-administered surveys. Those using interviewers and no computer include PAPI and TI. Those self-administered and without a computer do not occur. Audio surveys using computers and interviewers include CAPI and CATI. Those using computers and self-administered include IVR and T-ACASI. These also cover ASR in which responses are given verbally and converted into data by the receiving computer. Computerized audio formats (e.g. IVR, ACASI) may involve recordings of actual people reading the questions or artificial voices often generated by TTS programs (Smith and Sokolowski 2011). The shift over time has been from the actual to the artificial. In addition, programming options for the computerized voices have become more sophisticated and one can regulate many aspects of the audio such the gender of the voice and such other features as accents, volume, timbre, and pitch. Also, if questionnaires are needed in multiple languages, multilingual TTS programs can produce audio in the respective languages.

The third row contains surveys that use both audio and visual elements. Even many surveys that primarily use one collection mode often use a mix of mechanisms. Those using mixed surveys without a computer and with an interviewer include PAPI surveys using show cards listing response categories and PAPI surveys with visual stimuli such as a contingent valuation survey that showed different pictures of the sky over the Grand Canyon and asked people how much they would pay in taxes to achieve clearer views (and cleaner air). Mixed surveys incorporating self-administration and no computer include TI in which show cards or diaries had been previously mailed to the respondents. In the case of hardcopy diaries, these would usually later be mailed back by respondents. It would also cover PAPI surveys with a hardcopy SAQ component. These are self-completed by respondents and then often placed in a sealed envelope before being returned to the interviewer. Mixed surveys using computers and an interviewer include CAPI+show cards or CAPI with still or dynamic visuals shown on the computer. Those using computers and not using an interviewer include ACASI (since question text and response options are usually provided along with the audio) and AVCASI. These would also typically use TTS to program their questionnaires as well. It would also include OQs that had an audio component as part of their question content, such as evaluations of music or speeches. It would also cover ASR in which responses are given orally, but these are uncommon.

Table 3 further elaborates on how data are collected in the interaction between interviewer/questionnaire and respondent. It distinguishes between how the survey is administered and how responses are retrieved (Smith and Sokolowski 2011). The first column lists the main current forms of surveys delineated in Table 1, the second column indicates how questions are administered to

respondents and the third column shows how answers are retrieved from respondents.

Table 3. Administering and Retrieving Methods of Data Collection by Survey Type

Type	Administration	Retrieval
PAPI	Audio (Spoken/Heard)	Audio (Spoken/Heard)
PAPI+Show cards	Visual (Seen/Read)	Audio
PAPI+SAQ	Visual	Written
CAPI	Audio	Audio
CASI	Visual	Typed/Touched/Clicked
ACASI	Audio	Typed/Touched/Clicked/“ASR”
TI	Audio	Audio
CATI	Audio	Audio
IVR/T-ACASI	Audio	Typed/“ASR”
MQ	Visual	Written
OQ	Visual/Audio	Typed/Touched/Clicked/“ASR”

At the administration stage the stimuli both presents the content of what is being asked about and indicates the response options that apply. The mediums being used may be the same for both parts of the question or different. Examples of possible variants include 1) an item be read aloud, mentioning the both content and response options verbally, 2) the content may be read aloud with respondents directed to a show card to select a response or 3) the item may ask respondents to evaluate several pictures and say which they most like. In PAPI interviewers read questions aloud to respondents and they answer back verbally. The exchange is similar for CAPI interviews. But CAPI also has the option of using computer audio recorded interviewing (CARI). CARI records both the interviewer and the respondent and is used for both substantive and methodological purposes (Smith and Sokolowski 2011). For PAPI+show cards surveys, a visual element is added to the audio. Respondents look at show cards with response options while the interviewer reads the questions out loud. Respondents then reply verbally just as in PAPI. For PAPI+SAQ respondents are given a printed SAQ and write in their responses and then return it to the interviewer. With CASI respondents read the questions from the computer screen and provide their answers by touching the screen, clicking, or typing in a response. With ACASI the computer reads the questions to respondents usually while the question text is also showing on the screen (Tourangeau and Smith 1996). Then, as in CASI, they reply by typing, clicking, or touching the computer screen or in rare instances by having a computer with ASR process verbal responses. With both TI and CATI an interviewer reads questions aloud and respondents reply verbally. In addition, the interview or parts of it may be recorded or monitored by a supervisor for quality-control and validation purposes. For IVR and T-ACASI, a computer reads the questions and responses are provided by typing or via ASR. Unlike CASI, typing is restricted to the use of the telephone keypad rather than by using a full computer keyboard. MQs are visually administered on a printed questionnaire and respondents write in their answers and then mail back the questionnaire. OQs have primarily been visually delivered and replies are entered either via touching the screen, clicking, or typing. But

audio stimuli are also possible and with the expansion of computer speakers and VOIP (Voice Over IP) audio, and mixed-mode delivery, audio OQs are emerging. Similarly, response via ASR is a developing possibility, but still uncommon.

As discussed above, mode variations are usually thought of as varying between the major modes of data collection (e.g. in-person, telephone, mail, and Internet) and/or between interviewer- and self-administered modes. But there are also important differences within the basic modes. For example, CAPI and OQ surveys can be conducted on laptops (or desktops for OQ surveys), tablets, and/or smartphones. Questionnaires have to be designed differently for these different platforms. For example, certain formats, which work well for lap/desktops, work poorly or not at all on smartphones. Similarly, PAPI surveys vary considerably in terms of the use of show cards, the format of questions, the amount of interviewer probing, and in other ways. This sub-mode variation of course makes the situation even more complex.

3 Mixed Modes

The array of survey modes described above are further complicated by the fact that increasingly survey designs are becoming more complex and often employ mixed or multiple modes (Couper 2005, 2011). There are several different types of mixed-mode surveys (MMSs – Couper 2011; de Leeuw 2005; Dillman, Smyth, and Christian 2009): 1) Concurrent MMSs contact respondents and offer the prospective respondents two or more modes in which to complete the survey. For example, a mailed letter may offer recipients the options of completing a MQ or doing a OQ. 2) Sequential MMSs contact all cases in one mode and then switch to other modes to increase the response rate. One common practice is to start with the least expensive mode and then progress to more expensive and more persuasive modes, such as starting with a MQ and followed next with CATI and finally with CAPI. 3) Parallel or experimental MMSs divide the survey into two or more random subsamples and using different modes for each subsample. This is often done as part of methodological research on mode effects, to calibrate a shift in a time series from one mode to another, or to reduce overall costs by combining lower and higher cost modes. 4) Modular MMSs use multiple modes across different sections of a survey. For example, the PAPI US General Social Survey (GSS) used to include sections using SAQs and the current CAPI GSS uses CASI to administer sensitive questions. 5) Panel MMSs use different modes across different waves. For example, the US Current Population Survey initially contacts households in-person and then utilizes telephone as the primary mode for reinterviews in waves 2-4. 6) Combination MMSs use two or more of the previous five types of MMSs. For example, a sequential design may also employ modular MMS components. One needs to fully take into consideration the complexity of mixed-mode designs regarding conducting surveys and assessing mode effects.

4 Mode Differences: Advantages and Disadvantages

The major shifts in survey modes in recent decades have been the increased use of computerization

and the rise in self-administration (Couper 2008). The differences across modes along these changing dimensions in how surveys are conducted, their relative pluses and minuses, and variations in measurement error are considered next.

Computerization of surveys has several distinct advantages: 1) more complex survey designs with a) complicated skips and b) other customization can be utilized (Couper 2008; Couper and Bosnjak 2010; Stafford 2010), this includes the randomization of question order and/or the order of responses, customized question wording fills, and consistency checks (Couper and Bosnjak 2010; Nicholls, Baker, and Martin 1997). For example, surveys using factorial vignettes and dynamic item response theory (IRT) filtering are nearly impossible to implement without computerization. 2) Measurement error related to implementing filters and skips and suspect values (e.g. out of range) can be reduced (Caeyers, Chalmers, and De Weerdt 2012; Couper and Bosnjak 2010; Groves and Tortora 1998). 3) Item nonresponse can be lowered (Banks and Laurie 2000; Nicholls et al. 1997). 4) The time and costs of a separate, data-entry stage are eliminated (Dielman and Couper 1995). 5) Less time and effort are needed for post-production cleaning (Baker 1992; Couper and Nicholls 1998). 6) More paradata can be easily collected (e.g. keystrokes, GPS readings, interview and question timings - Caeyers et al. 2012; Caviglia-Harris et al. 2012; Couper, Hansen, and Sadosky 1997). 7) New format can be accommodated such as including musical or video content as stimuli (Couper and Bosnjak 2010). 8) Easier coordination of cases with case-management systems can be achieved (Hansen 2008). And 9) dependent interviewing is much easier to implement (this is primarily a benefit for panel surveys - Caviglia-Harris et al. 2012; Nicholls et al. 1997; Stafford 2010).

Several other claimed advantages have not been clearly established. First, the idea that interviewer variance will be eliminated or notably reduced is not well-supported. Interviewer variance relating to skip pattern errors is probably reduced, but many sources of interviewer variance (e.g. response rates, reading questions, assisting respondents) are not materially affected. Second, the hope that response rates would increase or at least that their general decline would stabilize has not been realized (Couper 2005; Kohno et al. 2008; Matsubayashi and Nishizawa 2012). Finally, the expectation that CAPI would reduce costs has not been routinely established (Baker 1992; Caeyers et al. 2012; Couper and Nicholls 1998; Groves and Tortora 1998; Singla et al. 2014). It is hard to rigorously compare costs and the relative costs depend on the type of staff that a survey organization employs, how the cost of laptops and survey hardware is allocated across multiple surveys, and other accounting issues. The best generalization is that CAPI usually saves costs for complex surveys with large samples and PAPI is still less expensive for smaller, simpler surveys. CATI is widely seen as less expensive than TI, but no rigorous studies appear to have documented this. OQs are apparently less expensive than MQs, but again studies carefully comparing costs while controlling for response rate, target population, and other variables do not appear to exist.

Computerization also has some negatives: 1) data-entry errors by interviewers cannot be caught

(unless an invalid entry is caught by a range or consistency check). Interviewers are under pressure to move the survey along and may be less careful that data-entry clerks whose work can be quality controlled by supervisor oversight and/or double-entry validation (Dielman and Couper 1995).[4] 2) More training is needed for interviewers to cover matters such as the how the laptop or other device works, how the CAPI program works, and how to upload completed cases (Caviglia-Harris et al. 2012). 3) CAPI programming errors can cause skip and filtering errors. While CAPI notably reduces such errors on average, a programming error can create large error for the affected variables (Banks and Laurie 2000; Groves and Tortora 1997). Related to this is the concern that interviewers using CAPI are less familiar with the survey instrument and like automatons just blindly follow the CAPI program. 4) While post-production time is reduced by CAPI, preparing and usability testing the CAPI program necessitates longer set up time (Couper 2000; Fernee and Sonck 2013). 5) The need to continually adapt computer-assisted formats to the latest hardware and software presents a continuing challenge and increases the likelihood of failures if adaptions to the newer devices and programs are not fully successful. 6) Some types of computerized survey may have other problems. For example, there is evidence that OQs may encourage more satisficing by respondents and thus more measurement error (Couper 2011; Tourangeau et al. 2013). And 7) when transitioning from a PAPI design to a CAPI design, methodological artifacts can occur. The CAPI instrument must not only be a correct CAPI instrument, but also equivalent to the PAPI instrument. Surveys making the PAPI-to-CAPI transition have generally been very successful (Baker 1992; Banks and Laurie 2000; Couper 2000; Smith and Kim 2003), but examples of problems have been found (Caeyers et al. 2012; Nicholls et al. 1997). For example, Smith and Kim (2003) found that CAPI produced more multiple mentions of ethnicity than PAPI did because it in effect prompted interviewers to probe more. A subsequent experiment showed that a revised-CAPI version was able to duplicate PAPI results (Smith 2008). One adaptation that is difficult is the use of show cards. Show cards do not adjust well to CAPI. An interviewer cannot simultaneously read the respondents a question and show them a screen with response options. As a result, many surveys that used show cards with PAPI have retained the same identical printed show cards after transitioning to CAPI. When CAPI surveys are being designed de novo, question formats needing show cards are usually avoided. Another challenge is duplicating don't-know levels. For most questions Don't Know/No Opinion is a pre-coded, but unread response option. In PAPI surveys it is often a printed response along with the written responses (e.g. Yes/No, Strongly Agree…Strongly Disagree), while in many CAPI surveys it is not a listed response, but captured by the use of a designated key, such as F8. This seems to lower the recorded levels of Don't Knows in CAPI surveys (Smith and Kim 2003).[5]

Differences between computerized and non-computerized modes can vary according to their exact design. For example, both CAPI surveys designed to match baseline PAPI surveys and those in the initial adoption phase of CAPI are typically designed to closely resemble the style and format of PAPI surveys. This is not only due to an explicit goal of replicating established PAPI surveys, but also because questionnaire designers are used to designing PAPI surveys and merely apply their

standard approaches. But over time as CAPI programs have become more sophisticated, laptops have become more powerful and versatile, and questionnaire designers have adopted computerized questionnaires as their standard platform, CAPI questionnaires have evolved and become more differentiated from PAPI questionnaires. First, they have adopted computer-friendly formats (e.g. radio buttons) not previously utilized. Second, they have often utilized features not employable in PAPI surveys and even beyond the reach of early CAPI survey. These include the showing dynamic and/or still visuals (e.g. video clips and/or photographs) and the playing of music.

Several other expected disadvantages of computerization have not materialized. There has been concern that interviewers and/or respondents would not positively handle and react to the use of computers. Even when CAPI was first widely introduced (e.g. in the early 1990s in the US), this was not found to be a serious problem and concern about this has dissipated over time (Baker 1992; Caeyers et al. 2012; Couper et al. 1997; Groves and Tortora 1998). However, there are still appreciable differences across age cohorts in how familiar interviewers and respondents are with various types of hardware, software, and CAPI, CASI, and OQ functions and these are not likely to diminish since new technologies will continue to be introduced that are typically initially mostly adopted by younger cohorts and this will continually recreate cohort-based, digital divides that survey designers need to keep in mind. Also, different cultures and various sub-groups will often react to technologies in disparate ways (Fussell et al. 2008), but this has not proven to be a notable impediment to the computerization of surveys.

Also, there has been concern that the hardware would not hold up, but failure rates have been quite small (Nicholls et al. 1997) and CAPI has successfully be employed in even very remote and challenging environments (Caeyers et al. 2012; Caviglia-Harris et al. 2012; Leisher 2014; Paudel et al. 2013). Lost and stolen computers have also not materialized as a notable problem.

The other major shift has been an increased use of self-administration modes. Self-administration has the clear advantage of reducing social-desirability bias compared to interviewer-administered surveys (Mavletova and Couper 2013; Nicholls et al. 1997; Tourangeau and Smith 1996). The main disadvantage of self-administration is that there no interviewer to answer questions that respondents may have about the questions or the survey in general, to probe to clarify responses, or to encourage respondents to complete the survey (Couper and Bosnjak 2010; Tourangeau et al. 2013). Another problem is that with PAPI+SAQ and CASI cases are not actually always self-administered. Due to illiteracy, poor eyesight, respondent preference, or other reasons, self-administration may actually not occur. Couper and Rowe (1996) found that only 79% of CASI cases were actually fully self-administered. Also, even when self-administration is achieved interviewer effects may still occur. West and Peytcheva (2014) found that interviewer behaviors during ACASI affected responses. Additionally, switching to self-administration during a PAPI or CAPI interview often increases item nonresponse due to respondents declining to do the SAQ/CASI. Kim et al. (2010) noted that 10-16% declined to do the SAQ and that decliners were different from completers on a number of demographics.

While computer-use and mode of administration are independent dimensions, they interact with one another in various ways. For example, there is some evidence that the social-desirability bias reduction is even greater when computers are utilized such as when CASI or ACASI are used vs. PAPI+SAQs (Mavletova and Couper 2013; Tourangeau and Smith 1996; Turner et al. 1998). Likewise, computerized, self-administered surveys (e.g. CASI and OQ) could have help aids programmed in while it would be much more difficult for hardcopy SAQs to easily incorporate comparable assistance. Similarly, CASI and OQ can easily handle complex skips that are poorly navigated by respondents using SAQs. In addition, the use of both have increased over time mostly due to the rise of OQs, but also due to the technological advances that have replaced some CATI surveys with IVR and T-ACASI surveys.

5 Future Developments

Modes have been and will continue to evolve due both to technological advances and changes in other societal conditions that affect surveying (Couper 2022; Smith and Sokolowski 2011; Savel et al. 2014; Tourangeau et al. 2013). In CASIC surveys (CAPI, CASI, and OQ), newer devices are beginning to replace desk/laptops. Tablets rather than laptops have been successfully employed in CAPI (Leisher 2014; Paudel et al. 2013), CASI (Singleton et al. 2011), and OQ (Wells, Bailey, and Link 2013) surveys. Considerable careful effort is needed to adapt surveys designed for desk/laptops for surveys in general and special effort is needed when the tablets will be used for self-administration since respondents may not be familiar with their format or operation. Smartphones are a much more challenging device than tablets to conduct surveys on (Alam et al. 2014; Buskirk and Andrus 2014; de Bruijine and Wijnant 2014a, 2014b; Link and Murphy 2014; Mavletova and Couper 2014; Toepoel and Lugtig 2014; Wells et al. 2013). They have not been widely used, but that is likely to change rapidly (Fernee and Sonck 2013; Link and Murphy 2014). So far smartphones appear to have been used only with OQ and not with CAPI or CASI. Screen size is a major impediment that affects all smartphones (but ones with smaller screens more than others). A second obstacle is the wide range of different operating systems and devices (e.g. Android, IPhone, etc. – Buskirk and Andrus 2012; Savel et al. 2014; Wells et al. 2013). A smartphone survey needs to be compatible across these different platforms. Wells et al. (2013) found them much more difficult for respondents to use and resulted in higher breakoffs and more item non-response than those using other devices. While the use of newer devices present some promising opportunities, one should be cautious about employing the most cutting-edge hardware, apps, and features since many computer and Internet users at any point in time are not in the innovative avant garde and either do not have hardware and/or software capable of utilizing the latest technologies or are unfamiliar with the newest features and unable to easily handle them (Dal 2011).

Computer development has extended so far and is advancing so rapidly, that “interviewer” based OQs are on the cusp of being practical. Computer graphics used in movies and games and TTS programs have advanced to a level that human-like avatars can closely resemble the look

and sound of real people (Savel et al. 2014; Smith and Sokolowski 2011). Coupled with some artificial intelligence and human exchange programing, it will soon be possible to develop fully-computerized surveys that could closely resemble a human interview and even approach passing a simple version of the Turing test. Whether this development should be pursued is another question. Concern has been raised that the humanization of computerized surveys will shift them from being perceived as self-administered to being seen as an interpersonal exchange similar to that done by a human interviewer. If that occurred, then the reduction in social desirability bias that SAQs achieve might be lost. So far the research has indicated that the primitive humanization of OQs implemented so far has not led to this (Couper 2005; 2008; Tourangeau et al. 2013), but the nearly-feasible Turing-test passing "interviewers" might lose the reduction in social desirability bias achieved by self-administration.

Also, the expansion of webcams and photographic and video uploads from smartphones and tablets means OQs can be adapted to allow two-way, "face-to-face" interviews via the Internet. It also means that the collection of audio, visual, and audio-visual data from respondents (e.g. selfies, views of their immediate environment) is now feasible (Couper 2011; Smith and Sokolowski 2011).

Also as part of these technological developments, the distinctions across survey modes are muddying (Couper 2011). Unlike traditional landline and cell phones, smartphones are no longer solely a device for long-distant voice communication. Smartphones add written communication to audio – including emailing, texting, and tweeting, allow the taking and uploading of pictures and video, have the ability to access information in many forms from the Internet, and permit the broadcasting messages rather contacting specific individuals or organizations. It is likely that many smartphone users employ their devices more as computerized communicators and cameras rather than as telephones. This and other technological hybridizations mean that distinctions between survey modes are also likely to breakdown.

6 Conclusion

In a different context Marshall McLuhan noted that "the medium is the message." That observation applies to surveys as it does to mass-media distributions. Different survey modes have varied advantages and disadvantages and these can produce different outcomes, the result of so-called mode effects (a sub-category of the broader category of measurement effects). To optimize survey quality and increase reliability and validity, it is important to reduce total survey error in general and to minimize mode effects in particular. This goal has become more challenging as survey designs have become more complex and increasingly utilize mixed-modes and emergent technologies. Switching from traditional modes to newer modes (e.g. from mail to online or from PAPI to CAPI) always involves a learning curve and that often leads to a few adoption difficulties. Survey researchers need to fully understand the strengths and limitations of all mode options and to adopt survey designs best suited for the research topic under investigation, the target population, and other parameters of their specific investigation.

Notes

1) While some use the term computer-assisted interviewing (CAI) as a general term for surveys that uses computers as part of data collection, better terms are computer-assisted survey information collection (CASIC) and computer-assisted data collection (CADAC) since they clearly include both interviewer- and self-administration while CAI does not obviously do so (Collins, Sykes, and O'Muircheartaigh 1998; Couper and Nicholls 1998).
2) For the history of CASIC and its early adoption see Baker (1992), Couper and Nicholls (1998), and Wright and Marsden (2010). While computerization of in-person surveys in Japan has lagged behind that of most other advanced countries, there have been a number of applications. These include CAPI surveys such as the World Mental Health Japan Survey (Kawakami et al. 2005) and the Japanese Study of Stratification, Health, Income, and Neighborhood in the Tokyo metro area (Kanbayashi 2014) and the GLOPE Computer Assist Self-Administered Interview 2007 Study (Kohno et al. 2008).
3) Computers are of course now used in various ways in essentially all surveys. Even a printed, hardcopy questionnaire would almost always be created using a computer with word processing and probably no survey is analyzed without using a computer. Here the use of computers only refers to their utilization during the data-collection phase.
4) In capturing open-ended response misspelling and typos are very common with CAPI, although they rarely are so garbled to be unintelligible.
5) Mode differences in the handling of Don't Knows are even greater across interviewer- and self-administered questionnaires (Smith 2003; Smith and Dennis 2005, 2008; Dennis, Li, and Hadfield 2007).

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