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Changes in Interview Setting Under CAPI

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This article explores the effect of the change from paper and pencil interviewing to computer assisted personal interviewing (CAPI) in the U.S. Current Population Survey (CPS) on the setting of the survey interview, and the effect of this change on data quality and costs. The change to CAPI has had a large effect on the number of doorstep interviews conducted in CPS. The choice of interview setting is found to vary systematically by interviewer, householder and (to a lesser extent) environmental characteristics. In addition, doorstep interviews (those conducted with the interviewer standing, outdoors, and using a battery for the laptop computer) are associated with poorer quality data, but are shorter in duration than indoor seated interviews. The implications of these findings for nonresponse and response error and costs are discussed.

Key words: CAPI; data quality; interview setting; survey data collection.

1. Introduction

Computer assisted personal interviewing (CAPI) has gained widespread acceptance for large-scale survey data collection in recent years. Although few studies have directly examined the data quality effects of the move from paper and pencil interviewing (PAPI) to CAPI (for exceptions, see Martin, O'Muircheartaigh, and Curtice 1993; Bradburn et al. 1991), the general conclusion is that CAPI provides data of equal or better quality to that of PAPI (see Nicholls, Baker, and Martin 1995), and for about the same cost (Weeks 1992). However, the benefits of CAPI relative to PAPI may not be as great for surveys using short interviews that may be conducted on respondents' doorsteps. In these circumstances, the computer hardware (e.g., weight, screen visibility and battery life) may constrain the ability of the interviewer to conduct an effective and efficient interview using CAPI.

This article examines whether the change from PAPI to CAPI affects data quality by changing the setting in which the interview takes place. In doing so, we address three questions. First, what effect, if any, does CAPI have on the interview setting relative to PAPI? Second, what other factors affect the setting in which a CAPI interview takes place? Third, is there a relationship between the CAPI interview setting and the cost and quality of data collected? We focus on the Current Population Survey (CPS), a survey with a relatively short interview, that may be particularly susceptible to the constraining effects of computer hardware on the interview setting. By

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"interview setting" is meant the immediate environment in which the interview occurs, and the physical orientation of the interviewer and respondent during the interview. This includes whether the interview was conducted indoors or outdoors, whether one or both of the participants were sitting or standing during the interview, and whether the interviewer used battery power or had access to an electrical outlet.

2. Background

Much progress has been made since the early days of CAPI in terms of the ergonomics of the laptop computers used for interviewing. However, most laptop computers in use for CAPI surveys at the time of this study (1993) still weigh more than an interviewer can reasonably be expected to hold during an interview (see Couper and Groves 1992; Statistics Sweden 1990), and the typical battery life may still be shorter than the average interviewer workday. While some organizations are considering the use of handheld computers or pad-based machines for short interviews or screening operations, the use of standard laptop computers for CAPI is still widespread. For a lengthy interview in which interviewers can carry the computer into the respondent's home, set it up on a table or lap, and use an electrical outlet, these limitations should have little effect on their work (see Baker 1992). However, for interviews of relatively short duration, which have often been conducted on the respondent's doorstep, issues such as weight of the laptop, battery life, and time to boot the computer become more salient. We thus expect fewer doorstep interviews to be conducted using laptop computers for CAPI. Factors relating to interview setting may affect other aspects of the interview; for example, concerns about conserving battery power may lead interviewers to leave the computer switched off until a respondent agrees to do the interview and the interviewer has safely reached an electrical outlet. This may increase the overall interview time, thereby adding to the costs of data collection.

This article uses data from the CATI-CAPI Overlap Survey (CCO)[2], a parallel survey conducted in preparation for the full automation of the CPS in January 1994 (see Bregger and Dippo 1993). The CCO and CPS both involve relatively short interviews (15-20 minutes per household) and are thus more likely to be conducted on the doorstep. Although most personal visit interviews last longer than the CPS, many surveys currently employ screening operations which involve enumeration of household members prior to determining eligibility and selecting an appropriate respondent. The feasibility of CAPI for such screening operations may be questioned given the current state of computer hardware. Other surveys such as the housing component of the Consumer Price Index survey (see Couper, Groves, and Kosary 1989) that rely primarily on doorstep interviews may also be affected by the computer hardware used. Finally, even for longer interviews, non-negligible proportions of the interviews may be conducted standing or outside the respondent's home. For example, in May 1992, 17% of National Health Interview Survey (NHIS) interviews were conducted outside and 7.1% were done standing, while for the Survey of Income and Program Participation (SIPP), 15.3% were done outside and 7.6% standing.

[2] Also referred to as the Parallel Survey or Overlap Survey.

Both of these are relatively lengthy paper and pencil surveys that are planning the transition to CAPI (see Matchett, Creighton, and Landman 1994).

It is not that the interview setting is relevant only to CAPI surveys. Where and under what circumstances a personal visit interview is conducted is also an issue in paper and pencil surveys. Rather, the introduction of CAPI has made salient an aspect of the data collection process that has heretofore received little attention. What CAPI may have done is place greater constraints on the choices of the interviewer and respondent in determining the setting for the interview.

Why should we be concerned about the setting and circumstances of the survey interview? There are various effects the setting may have on the quality and costs of data obtained from a CAPI survey. First, the setting may affect unit *nonresponse*. Concerns about personal safety may make interviewers reluctant to go into certain homes. Similarly, respondents may be unwilling to let interviewers into their homes for fear of victimization, embarrassment over the state of the home, or other reasons. These two factors may lead to nonresponse if CAPI makes doorstep interviews difficult to conduct. Furthermore, lengthy delays in setting up the computer and getting to the first question may lead to rushed or harried respondents changing their minds about participation in the survey. The limitations on conducting standing CAPI interviews may thus constrain the ability of the interviewer to obtain data for critical items from people who may otherwise be nonrespondents. A common problem reported by CCO interviewers in focus groups and other discussions is the difficulty of conducting quick doorstep interviews with reluctant respondents (see Esposito and Rothgeb 1993).

Second, the interview setting may intrude on the interaction between respondent and householder during the interview, producing *response errors*. For example, during doorstep interviews, interviewers may be more concerned about taking care of the computer (e.g., worried about battery running out, fatigue from holding machine), and consequently pay less attention to the respondents' answers. This may be manifest in a desire to rush through the interview, resulting in shorter answers recorded in response to open-ended questions, and a reluctance to go back and change previous answers. In addition, respondents with time constraints may be impatient to complete the interview, and may resort to satisficing (Krosnick 1991), providing minimally satisfactory answers in order to get the interview over. Finally, the limitations of the computer hardware and their effects on the setting may increase the *costs* of survey data collection. For instance, the marginal effect of a lengthy "startup time" (i.e., the time taken from switching on the computer to getting to the first question of the interview) is greater for a 15-minute survey interview than it is for an hour-long one, especially if the interviewer waits to enter the household before switching on the computer.

We cannot address the nonresponse issue directly here, as we do not know how many cases are lost (i.e., are nonrespondents) because of potential difficulties with the interview setting. Obviously, there are trade-offs between nonresponse error and response error. This article does not address whether it is better to accept a unit nonresponse or to obtain a limited amount of information from reluctant respondents. However, we can address some indicators of differential data quality among those interviewed using CAPI in the CCO.

3. Design and Data Collection

As noted above, the CCO was a parallel survey designed to measure automation and questionnaire design changes on the CPS. Because of these changes, the CPS and CCO surveys are not exactly equivalent. However, both are relatively short (less than 20 minutes on average) interviews collecting demographic characteristics and information on labor force participation from household members. The CAPI application for CCO was written in QISC, the U.S. Census Bureau's authoring system. The hardware used at the time was a Librex 386SX laptop computer, weighing 6 pounds, with 4 Mb RAM, a 20 Mb hard disk, a backlit monochrome LCD screen, and removable floppy disk drive and external 2400 baud modem (Spendlove and Brewer 1992). Battery life was "anticipated to be one to two hours" (Spendlove and Brewer 1992 p. 624), but actual experiences in the field varied greatly. The decision to use batteries versus an AC outlet was generally left in the hands of interviewers (U.S. Bureau of the Census 1993, p. H-1), but given early field experiences, there may have been variation in instructions to interviewers by different supervisors.

The design of the CCO closely paralleled that of the CPS. It used a rotating panel design, with households in sample for four consecutive months, out for eight and then in for another four. The first and fifth interviews were designated for personal visit, while the remaining interviews were eligible for completion by telephone. One of the design changes from CPS to CCO was an increase in the proportion of cases interviewed from centralized CATI facilities. We restrict our analyses to first and fifth interviews only to limit the data to personal visit interviews.

A set of debriefing questions on the interview setting were included at the end of the CAPI instrument. These are shown in Appendix A. Interviewers completed these items before exiting the interview. In January and July 1992 a similar set of questions (minus the question on battery use) was included in the paper and pencil CPS questionnaire to permit comparison across the two surveys.

For the analysis of interview setting in the CCO, we examine all first and fifth month (personal visit) interviews conducted in the six-month period September 1992 to February 1993. Given the rotation design, each sample household was interviewed only once during this period. Although data are collected on all adults in the household, we limit the analysis to the household level (rather than person level) by limiting the data to self-response (by the initial household reporter) items only. This means the data set contains a single record per household. This leaves us with 13,462 completed interviews (eligible households) for this six-month period.

Data on interviewers were collected by means of a mail questionnaire administered to all interviewers prior to CCO training (see Couper and Burt 1993). This data collection ran through December 1992, and a total of 385 completed questionnaires were received, representing 95.3% of all interviewers trained prior to January 1993.

The data are weighted by the inverse of the selection probabilities. Taylor series approximation (using SUDAAN; Shah, Barnwell, Hunt, and La Vange 1993) was used to estimate standard errors reflecting the stratified and clustered nature of the CCO sample design.

We should caution that these data are observational in nature, and not based on an experimental design. Thus, it is important to attempt to control for other household

and environment factors that may affect data quality independent of the interview setting. Although we have data on the interview setting, we do not know *why* the interview was conducted in this particular manner. This could be an outcome of respondent or interviewer decisions, or a combination of both. Thus, we cannot establish causal links between the interview setting and data quality. For example, it may be that respondents who are likely to provide poor data insist on doorstep interviews, rather than the doorstep interviews themselves producing lower quality data. Despite these limitations, the data provide an initial assessment of the effect that interview setting may have in a CAPI survey.

4. Analyses

Four binary measures were created from the CAPI version of the setting questions in Appendix A. These are:

STAND: Interview conducted with interviewer standing.
HOLD: Interview conducted with interviewer standing with no support (e.g., a table) for the computer. Note that HOLD is a subset of stand, and will not be used in all analyses.
INSIDE: Interview conducted inside respondent's home.
BATTERY: Battery used to power laptop computer during interview.

These are all coded as 1 = yes, 0 = no for the multivariate analyses to follow. Using these variables and other measures obtained from the CCO questionnaire and the interviewer questionnaire, we can address in turn each of the three questions posed earlier.

4.1. Effect of CAPI on interview setting

Univariate distributions of the setting variables are presented in Table 1. The first two columns compare PAPI and CAPI for the same month (July 1992). The base of these percentages is all personal visit interviews for the two surveys. The effect of the laptop computer on the interview setting is clear: more CAPI interviews are conducted inside, fewer are conducted standing (less than half of that for PAPI), fewer are done with the interview materials (computer or questionnaire) supported on the interviewer's arm, and much fewer are done standing unaided (8% for CAPI versus 28% for PAPI). These data support debriefing reports from the field, where it was "soon discovered that interviewing anywhere but inside the household ought to be avoided, as the computer is too heavy to hold for any length of time" (Spendlove and Brewer 1992). Similar measures taken in January 1992 for both PAPI and CAPI (not shown here), show that the relative levels of the interview settings for the two surveys are similar, but there are fewer doorstep interviews in January (reflecting the effects of winter weather). This may also explain the lower levels of CAPI doorstep interviews (outside, standing) in the third column (September 1992 through February 1993).

Wojcik and Baker (1992) report that batteries were used on 30.1% of interviews for the 1990 NLSY, an interview that lasted over an hour on average. Given the

Table 1. Comparison of interview setting for PAPI and CAPI

	July 1992		Sept 92–Feb 93
	PAPI (CPS) percent	CAPI (CCO) percent	CAPI percent
Where was interview conducted:			
Inside respondent's home	57.6	75.3	86.6
On porch, in hallway	28.6	16.1	7.1
Elsewhere on property	11.8	5.9	3.6
At office or other location	2.0	2.7	2.7
Interview sitting or standing:			
Sitting	61.1	82.7	87.4
Standing	38.9	17.3	12.6
Standing unaided (HOLD)	28.3	8.0	3.8
Support for questionnaire/computer:			
Table	21.8	42.5	49.5
Lap	39.8	40.5	39.8
Arm	29.2	9.4	4.5
Other (car, ledge, etc.)	9.2	7.5	6.3
Power source:			
Batteries	-	45.7	38.9
Wall plug	-	54.2	61.1
(unweighted *n*)	(16,859)	(3,801)	(13,462)

expectation that CCO interviewers would be battery dependent, and the relative length of the interview, we would expect greater use of batteries on the CCO. This is not found in Table 1. As Spendlove and Brewer (1992) note, concerns about reliability of batteries led to increased reliance on electrical outlets. This may be a function of the particular computers used in the CCO.

The remainder of the article focuses on the data from the third column in Table 1, to investigate further the factors associated with interview setting in the CCO. While the four variables (STAND, HOLD, INSIDE, BATTERY) are related, there are sufficient cases in each cell of the cross-tabulations to permit separate analysis of the variables (with the exception of HOLD, which is a subset of STAND). For example, 7.5% of all seated interviews were conducted outside, suggesting that interviewers may have sat on porch steps, outdoor furniture, etc. We note further that 28.5% of those who did the interview outside and 35.7% of those who did the interview standing nevertheless made use of respondent's electrical outlet as a source of power for the laptop computer. This again speaks to the lack of confidence interviewers may have had about the battery.

4.2. *Factors affecting CAPI interview setting*

We have seen from Table 1 that the transition from PAPI to CAPI for the CPS has had a significant effect on the setting in which the interviews are conducted, with fewer doorstep interviews conducted with CAPI. We next turn to an examination of factors

that may be associated with variation in interview setting across CAPI interviews. This addresses the issue of why and how the interview setting may affect the quality and costs of data collected. The choice of setting may be due to the interviewer, respondent, environment, or a combination of the three. We address each of these in turn, but focus primarily on the interviewer as the ultimate source of the decision regarding where and how the interview is conducted.

Three hypotheses can be posited with regard to interviewer-level effects on the interview setting: (a) physical constraints, (b) personal safety, and (c) interviewer skills. In terms of physical constraints, certain interviewers may have greater difficulty handling the weight (or other ergonomic aspects) of the laptop computer. Thus, we expect older, female interviewers to have fewer doorstep interviews. However, we also note that such interviewers may pose less of a threat to respondents, thereby increasing the likelihood of being invited indoors. A counter-hypothesis relates to personal safety. We hypothesize that certain types of interviewers (again, particularly female interviewers) may be more reluctant to enter respondents' homes for fear of victimization. This would argue for more doorstep interviews by such interviewers. Finally, interviewer skills (comfort and familiarity both with interviewing in general and the laptop computer in particular) may affect the setting. We expect that those with greater survey experience, computer experience and skills, and more positive attitudes toward computers will be more likely to stand and use the battery, and less likely to go indoors to do the interview. As far as typing skills are concerned, we expect that one-handed typists should do better than both inexperienced typists (fatigue effect of searching for right key) and touch typists in doorstep interviews, the latter because the transition to single-handed operation in a standing position may be more difficult for those used to touch typing.

Two competing hypotheses can be considered with regard to householder or respondent effects on interview setting. First, fear of victimization, suspicion of the interviewer, or concerns over privacy may make respondents reluctant to invite interviewers into their homes. Second, reluctant respondents or those with little time available may want to get the interview over quickly and thus not invite the interviewer in. If the first hypothesis is true, then we would expect that older, female respondents, and those living alone would be more likely to do doorstep interviews. If the second hypothesis applies, then respondents who are employed, have high incomes, took a larger number of calls to be contacted, etc., should have more doorstep interviews. We do not have good measures of respondent time constraints or reluctance, and are limited to weak proxy indicators such as employment status.

Another respondent-level factor may be reactions to the computer. Respondents with little experience of, or interest in, computers may be less likely to invite interviewers carrying laptop computers into their homes. Given the evidence of the predominantly positive (or at least neutral) reactions of respondents to CAPI (see Weeks 1992), we expect little effect on setting, but include respondent education, in addition to sex and age, as key correlates of computer experience and attitudes (Couper and Burt 1993; Kominski 1991).

There are also contextual factors that may serve to facilitate or constrain the setting, acting on both interviewer and respondent. Interviewers or respondents in

Table 2. Logistic regressions of interviewer, household and environment variables on interview setting

	Stand	Inside	Battery
Intercept	−0.61*	0.32	−0.90**
	(0.26)	(0.26)	(0.22)
Interviewer			
Sex (female)	−0.46**	0.56**	−0.29**
	(0.083)	(0.083)	(0.070)
Age	−0.033**	0.033**	−0.041**
	(0.0034)	(0.0033)	(0.0026)
Typing experience:			
(Unfamiliar with keyboard)	-	-	-
Hunt-and-peck	0.34**	−0.47**	1.68**
	(0.13)	(0.13)	(0.12)
Touch typist	0.24*	−0.46**	1.50**
	(0.11)	(0.12)	(0.11)
Computer experience:			
(None)	-	-	-
Moderate	−0.27**	0.067	0.13*
	(0.071)	(0.071)	(0.054)
Extensive	−0.29**	0.24**	0.24**
	(0.077)	(0.079)	(0.062)
Interviewing experience at Census Bureau:			
(None)	-	-	-
Other surveys	0.61**	−0.47**	0.40**
	(0.10)	(0.099)	(0.075)
CPS	0.73**	−0.60**	0.87**
	(0.097)	(0.095)	(0.076)
Household(er)			
Household size	−0.16**	0.16**	−0.050**
	(0.024)	(0.025)	(0.018)
Poverty rate	0.0084*	−0.0080*	0.015**
	(0.0033)	(0.0036)	(0.0033)
Sex (female)	−0.27**	0.22**	−0.025
	(0.055)	(0.055)	(0.040)
Age	−0.0063**	0.0050**	0.0040**
	(0.0017)	(0.0017)	(0.0013)
Education:			
Less than High school	0.28**	−0.045	0.31**
	(0.091)	(0.091)	(0.070)
High school	0.19**	−0.016	0.16**
	(0.074)	(0.071)	(0.054)
(College degree)	-	-	-
Contact attempts	0.055	−0.26**	0.077**
	(0.039)	(0.031)	(0.29)
Environment			
Region:			
Northeast	0.53**	−0.076	0.31**
	(0.084)	(0.087)	(0.066)

Table 2. Continued

	Stand	Inside	Battery
Midwest	0.32**	0.31**	0.35**
	(0.079)	(0.084)	(0.062)
West	0.51**	−0.20*	0.19**
	(0.088)	(0.086)	(0.065)
(South)	-	-	-
Urbanicity:			
Central City of SMSA	0.0018	0.023	−0.18*
	(0.085)	(0.086)	(0.082)
Balance of SMSA	−0.13	0.29**	−0.096
	(0.091)	(0.090)	(0.084)
Other urban	−0.21	0.43**	0.10
	(0.11)	(0.11)	(0.11)
(Rural)	-	-	-

*p < 0.05.
**p < 0.01.
Standard errors in parentheses.

certain areas (particularly those perceived to have relatively high levels of crime) may lead both parties to avoid indoor interviews. In the absence of direct measures of these environmental factors, we make use of indirect indicators at our disposal. These include the poverty rate of the census tract (defined as the proportion of families living under the poverty level), an indicator for urbanicity, and an indicator identifying multi-unit (high-rise) apartment complexes. We would expect all of these to be positively related to doorstep interviews (i.e., standing, outside, battery). A second set of environmental factors relates to climate (seasonal variation, daylight hours, weather, etc.). We use region as a weak proxy for some of these effects (noting that the six-month setting measures included fall and winter).

Finally, we also note that there is a set of household-level variables that affect the length of the interview. These include household size (information is collected about all household members) and labor force status (more detailed information collected from those currently employed). An indicator of reluctance (the number of personal visit attempts made to the household) is also included. These variables are included as controls, as they are expected to exacerbate both fatigue effects and concerns about battery failure on the part of interviewers.

Table 2 presents a set of logistic regression models, with each of the three interview setting variables in turn as dependent variables, and the variables discussed above as predictors. Separate models for each of the sets of predictors (interviewer, household(er) and environment) produce essentially the same results as those presented here.

The coefficients for interviewer sex and age both support the physical constraints hypothesis rather than that of concerns for safety. Female interviewers and older interviewers are significantly less likely to conduct standing CAPI interviews, and more likely to conduct CAPI interviews indoors. They are also less likely to use

batteries while conducting the interview. This suggests that finding a place to set the computer down and plug it in may override concerns about entering certain households to do the interview.

Interviewers with some typing experience are more likely to conduct standing interviews, and to use batteries. Difficulties using the keyboard may add to the length of the interview, further constraining the opportunities of those with weak typing abilities to do a standing interview with the laptop computer. It is interesting to note that the coefficients for "hunt and peck" typists are larger for STAND and BATTERY than those for touch typists. This may suggest that two-handed typing skills (touch typing) put interviewers at a slight disadvantage when having to operate the laptop computer with one hand (see Wiklund, Dumas, and Hoffman 1987).

The effect of computer experience on interview setting is somewhat surprising. Those with some or more computer experience are significantly *less* likely to conduct standing interviews than those with no experience (the omitted category), controlling on the other variables in the model. One possible explanation is that those with prior computer experience are more familiar with using a desktop computer, and more comfortable using the laptop in the same manner (i.e., seated). The hypothesis that greater computer experience would be associated with greater use of the battery is supported, however.

The coefficients for survey experience support the notion that experienced interviewers appreciate the need to do doorstep interviews in order to maximize response and minimize the burden of the interview for the responding household. Another reason for the experience effect may be that for those relatively unfamiliar with the task of interviewing, the laptop computer represents an additional burden or distraction; hence less-experienced interviewers seek interviews seated indoors in order to concentrate on the interviewing task at hand.

The effects of household variables on the interview setting are less clear, but a number of significant effects are found. Clear effects are found for household size, presumably related to the increased length of the interview, further restricting the doorstep option for interviewers. Female respondents appear less likely to do doorstep interviews, again not supporting the fear of crime argument (interactions of respondent and interviewer sex do not produce significant effects). Similarly, older respondents are more likely to do indoor interviews, suggesting that fatigue from standing, different norms of politeness or fewer time constraints among older respondents may lead to fewer doorstep interviews. Finally the reluctance indicator suggests that doorstep interviews are more likely to be conducted with households that were more difficult to contact.

Generally, the environment variables produce mixed results. Areas with high rates of poverty appear to be associated with more doorstep interviews, providing modest support for concerns about the environment. However, the urbanicity variable does not produce effects in the expected direction. One reason for the lack of clear support for the environmental hypotheses may be the inability to disentangle these effects from those of interviewers, given the nonrandom assignment of interviewers to areas. The effects of the environment are expected to work primarily through the interviewer (and, to a lesser extent, the respondent) in shaping the interview setting.

Overall the effects for the set of interviewer variables are strong relative to the householder and environment variables (as measured by differences in log likelihoods between full and reduced models). We expect much of this to be interviewer-driven, given that the primary decision regarding interview setting is in the hands of the interviewer. In addition, the strength of the household(er) variables suggests differences in the length of the interview (which affects interviewers' decisions about setting), but also possibly differences in inviting interviewers indoors. Having shown that the choice of interview setting varies systematically with a number of interviewer, household(er) and environmental variables, in the next section we examine whether the setting has any effect on data quality.

4.3. Effect of interview setting on data quality

The final question we address is whether there is a relationship between the interview setting and the costs and quality of data collected. Ideally, we would want independent measures of data quality, such as that obtained from reinterviews. In the absence of such measures, we make use of crude indicators constructed from the CCO data themselves. First, we created an item missing data rate, restricted to the set of common variables asked of all respondents (a total of 93 closed-ended items). Missing data are defined to include both "don't knows" and "refusals." Separate analyses of refusals only (about 54% of the missing data) produce essentially the same results. A second indicator is industry and occupation (I&O) coding errors. These are cases identified in the coding operation that have insufficient information to permit detailed I&O coding to standard 3-digit industry and occupation codes (see Cantor and Esposito 1992). A related variable is the length of text (number of characters) entered by interviewers in response to the I&O series of questions. Both these variables apply only to currently employed respondents (who are asked this series). Finally, the length of each interview (in minutes) is obtained from the CCO data files. This last variable may also serve as an indicator of costs. Note that this includes only the time to administer the survey questions as measured by the CAPI instrument, and does not include time taken to introduce the survey, set up the computer, or access or save the interview data.

We hypothesize that doorstep interviews are associated with poorer quality data (i.e., more missing data, greater proportion of I&O coding failures, shorter text responses to open-ended questions) and shorter interviews. We believe it is not standing or being outside or using a battery that *causes* data quality problems, but that the two are both indicators of reluctance, time pressures, suspicion, concern for personal safety (by both the interviewer and respondent), and so on. Some of the relationships could easily be specified the other way around; for example, longer interviews may be more likely to be done seated, rather than that seated interviews are more likely to take longer.

The means of these four variables are presented in Table 3, along with the means by each of the interview setting variables. Note these are all relatively rare events; for example, missing data occur in less than 1% of questions, on average. Similarly, about 4% of all cases are referred back to the field for

Table 3. Mean performance values by interview setting

	ALL	STAND		INSIDE		BATTERY	
		Yes	No	Yes	No	Yes	No
I&O referral rate	3.8	4.2	3.8	3.9	3.2	3.3	4.1
(Percent of cases)	(0.17)	(0.50)	(0.18)	(0.18)	(0.41)	(0.25)	(0.22)
		n.s.		n.s.		*	
Missing data rate	0.89	2.62	0.69	0.59	2.81	1.41	0.56
(Percent of items)	(0.036)	(0.20)	(0.03)	(0.026)	(0.20)	(0.079)	(0.029)
		**		**		**	
Duration of interview	17.25	14.6	17.6	17.7	14.9	15.2	18.6
(Time in minutes)	(0.0095)	(0.21)	(0.10)	(0.10)	(0.22)	(0.13)	(0.12)
		**		**		**	
Length of text	150.93	147.5	151.4	151.4	148.1	150.4	151.2
(Number of characters)	(0.35)	(0.98)	(0.36)	(0.37)	(0.91)	(0.54)	(0.44)
		**		**		n.s.	
(unweighted *n*)	(13,462)	(1,691)	(11,771)	(11,630)	(1,800)	(5,207)	(8,213)

*difference significant, $p < 0.05$.
**difference significant, $p < 0.01$.
Standard errors in parentheses.

I&O coding failures. Despite this, these bivariate relationships suggest that interview setting is associated with data quality, with statistically significant differences found for all setting variables for the missing data rate and duration of the interview. The direction of these effects support the hypothesis that while doorstep interviews may be quicker (i.e., cost less), the quality of data obtained in such interviews may be poorer. While these differences appear modest, we note that the item missing data rate for standing interviews is more than three times that for interviews conducted sitting.

In order to control for possible confounding effects of interviewer, householder and environment on the relationship between the setting variables and the performance measures, a series of multivariate analyses were performed using the predictors in Table 2 as controls, and each of the four performance variables in turn as the dependent variable. These analyses (not shown here) confirm the results presented in Table 3. Even in the presence of these controls, the three setting variables (entered both singly and together in the models) have statistically significant effects on the missing data rate, the length of the interview, and (in the case of STAND and INSIDE) the length of text entered. The general effect is that doorstep interviews are associated with higher rates of missing data, are shorter in duration, and have shorter responses to open-ended questions.

Indoor interviews are more lengthy by an average of three minutes, or an increase of 19% over interviews conducted outdoors. This does not include the lengthy setup time that may be needed for indoor interviews using an electrical outlet, especially if the interviewer waits to enter the household before switching on the computer. Thus, the cost implications of interview setting should be considered along with the data quality effects.

Given the earlier results for typing skills, it was further hypothesized that touch typists should be fastest sitting down, while hunt-and-peck typists should be fastest

conducting standing interviews. A test of the interaction between interview setting (STAND) and typing skill for length of interview does not bear this out.

5. Conclusions

We have discussed various reasons why doorstep interviews may take place. Firstly, *interviewers* may choose not to go inside because of fear of victimization, because experience suggests asking to do so may increase the likelihood of nonresponse, or for other reasons. Alternatively, they may choose to go in because the computer is too heavy, they have difficulty reading the computer screen outside, they are concerned about people seeing the computer on the street, they cannot type standing up, or they are concerned about battery failure, etc. Secondly, *respondents* may choose not to allow or invite the interviewer in because they are in too much of a hurry, they are embarrassed by the state of the house, they fear being victimized by the interviewer, they consider the interview an invasion of their privacy or personal space, etc. Thirdly, factors related to the *environment* may affect the setting. Regardless of the weight of the computer, climatic factors such as extremes of temperature, precipitation and wind may make it difficult to conduct survey interviews outdoors. This is true of both PAPI and CAPI, but may be exacerbated in CAPI with the current generation of laptop computers that may be more sensitive to such factors than are humans. Thus, even though the advent of lightweight pad-based computers with longer life batteries may reduce the constraints on interviewers doing doorstep interviews, there may still be times when it is not feasible to do an interview outdoors.

However, it appears from these analyses that much of the decision about the interview setting lies with the interviewer, and particularly with concerns about operating the laptop computer. Given this, improved hardware designs (weight, ergonomics, screen visibility, speed, battery life, etc.), may again permit interviewers to do a doorstep interview when it is called for. By limiting this option for interviewers, we may be increasing nonresponse, decreasing efficiency and affecting data quality.

We have seen that CAPI may change the interview setting relative to paper and pencil, and that doorstep interviews may be associated with poorer data quality. Interviews conducted with the interviewer seated indoors and using an electrical outlet appear to have higher data quality than those conducted standing, outdoors, or using the battery. However, such indoor interviews may be more expensive to conduct (i.e., are longer) and may increase unit nonresponse. Can we thus conclude that the reduction in doorstep interviews from PAPI to CAPI in the CPS is good in terms of increased data quality? It is hard to say, as we have to consider the trade-off between nonresponse error and response error. We do not know how many interviews may be lost if we insist that interviewers go into the respondents' homes to conduct all interviews.

A comparison of response rates for CCO and CPS for the same six-month period suggests that the effect of the change in interview setting seen in Table 1 on nonresponse may not be large. The overall nonresponse rates for this time period were 4.45% for CPS and 6.54% for CCO, with the CAPI survey being about 2 percentage points higher. While the interview setting could affect all components of nonresponse (e.g., concerns about battery failures at the end of the day leading to more

noncontacts, or hardware failures leading to lost interviews) we expect the largest effects of setting to be on refusals. These show only a modest increase from 2.75% on CPS to 3.48% on CCO, suggesting that the effect of setting on nonresponse is marginal at best. While not having a large effect on overall nonresponse rates, the problems associated with doorstep interviewers may have had an effect on the composition of the nonrespondent group. However, the change in interview setting is only one of many factors that could have contributed to the change in response rates.

Based on these findings, what should we advocate interviewers to do on a survey such as this? It is not only difficult to prescribe interviewer behavior, but probably also undesirable. The decision should be left up to the interviewer, based on his or her evaluation of the prevailing circumstances at the household. The important thing is that the computer should not be the constraining factor in this decision. Only with the introduction of lighter computers that can comfortably be operated with one hand, with batteries that last sufficiently long and are sufficiently reliable, can we return this decision to the hands of the professional on the scene, the interviewer. The computer should be an enabler rather than a constrainer of interviewer behavior. It should give the interviewer more flexibility rather than less in terms of how best to obtain accurate and reliable data from (almost) all respondents, and to do so efficiently.

Many of the issues identified here have technological solutions. Further, these issues may represent a transitional phase in CAPI. Nonetheless, we should be careful to distinguish lengthy surveys for which a laptop computer is perfectly suitable from those (including doorstep screening, intercept surveys, and exit polls) which may have different hardware and software requirements. The findings discussed here suggest that it is important to consider the effects of these and other technological changes on the process of survey data collection and thus ultimately on the quality of the data collected.

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Appendix A Interview Setting Questions

CAPI VERSION

1. Type of interview conducted

Personal interview ..... ◯ (Go to 2)
Telephone interview ..... ◯ (Go to 5)

2. Where did you conduct this interview?

Inside respondent's house/
apartment ..... ◯
On respondent's porch/
in apartment hallway ... ◯
Elsewhere on respondent's
property ..... ◯
At respondent's office
or other location ..... ◯

3. Were you sitting or standing during MOST of the interview?

Sitting ..... ◯
Standing ..... ◯

4. How did you support the computer during MOST of the interview?

Table ..... ◯
Lap ..... ◯
Arm ..... ◯
Other (car, ledge, etc.) . ◯

5. Did you PRIMARILY use batteries or a wall plug during the interview?

Batteries ..... ◯
Wall plug ..... ◯

PAPI VERSION

1. Type of interview conducted

Personal interview ..... ◯ (Go to 2)
Telephone interview ..... ◯ (End)

2. Where did you conduct this interview?

Inside respondent's house/
apartment ..... ◯
On respondent's porch/
in apartment hallway ... ◯
Elsewhere on respondent's
property ..... ◯
At respondent's office
or other location..... ◯

3. Were you sitting or standing during MOST of the interview?

Sitting ..... ◯
Standing ..... ◯

4. How did you support the questionnaire during MOST of the interview?

Table ..... ◯
Lap ..... ◯
Arm ..... ◯
Other (car, ledge, etc.) .. ◯