ASKING SENSITIVE QUESTIONS
THE IMPACT OF DATA COLLECTION MODE, QUESTION FORMAT, AND QUESTION CONTEXT

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Abstract This study compared three methods of collecting survey data about sexual behaviors and other sensitive topics: computer-assisted personal interviewing (CAPI), computer-assisted self-administered interviewing (CASI), and audio computer-assisted self-administered interviewing (ACASI). Interviews were conducted with an area probability sample of more than 300 adults in Cook County, Illinois. The experiment also compared open and closed questions about the number of sex partners and varied the context in which the sex partner items were embedded. The three mode groups did not differ in response rates, but the mode of data collection did affect the level of reporting of sensitive behaviors: both forms of self-administration tended to reduce the disparity between men and women in the number of sex partners reported. Self-administration, especially via ACASI, also increased the proportion of respondents admitting that they had used illicit drugs. In addition, when the closed answer options emphasized the low end of the distribution, fewer sex partners were reported than when the options emphasized the high end of the distribution; responses to the open-ended versions of the sex partner items generally fell between responses to the two closed versions.

Over the past 2 decades, two trends have transformed survey data collection in the United States. The first trend has been the introduction and widespread adoption of computerized tools for surveys; these

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tools have automated many survey tasks, including data collection. Some of the most obvious of the technological innovations during this period are optical scanning of self-administered forms, word processing software for producing questionnaires, computer-assisted telephone interviewing, computer-assisted data entry, and computer-assisted personal interviewing (CAPI). In addition, new data collection technologies—including audio computer-assisted self-administered interviewing (ACASI), Touch-Tone data entry, and data collection systems based on voice recognition—are already on the horizon. If the recent past is any guide, the new technologies are likely to be adopted both quickly and widely. Still a novelty in the middle 1980s, CAPI has become perhaps the most commonly used method of face-to-face data collection today; the National Medical Expenditure Survey, the National Longitudinal Survey of Youth, the Current Population Survey, the Medicare Current Beneficiary Survey, the National Survey of Family Growth, and other large federal surveys have adopted CAPI as their primary mode of data collection. Many advantages are claimed for the new methods of data collection, ranging from improvements in data quality (e.g., lower rates of missing data) to faster delivery of data and reduced cost.

At the same time that computerization has altered the methods of collecting survey data, a second trend has altered the content of surveys. Surveys are collecting increasingly sensitive information, information about illegal or embarrassing activities, such as drug use and sexual behavior. A question is sensitive if it raises concerns about disapproval or other consequences (such as legal sanctions) for reporting truthfully or if the question itself is seen as an invasion of privacy. Since the beginnings of modern survey research in the 1930s and 1940s, survey questionnaires have steadily broached ever more sensitive topics, but the trend seems to have accelerated in the past 2 decades, spurred by continuing concern over the widespread use of illicit drugs and new concerns over the onset of the AIDS epidemic. The main routes of AIDS transmission involve sexual contact and intravenous drug use; moreover, the risk of infection depends in part on specific sexual practices. Other social problems, such as rising rates of teenage pregnancy, have no doubt also contributed to the trend for surveys to ask increasingly sensitive questions.

Although the need for information about these topics is clear, it is not clear whether the data collected about them in surveys are accurate. One potential threat to accurate results is nonresponse. Members of the sample may refuse to take part in the survey at all, or they may decline to answer specific questions. Either way, the very persons with the most sensitive information to report may be the least likely to report it.

A second potential threat to accuracy is reporting error. The mere fact that a respondent answers a question provides no assurance that the answer is accurate. A large body of methodological evidence indicates that embarrassing or socially undesirable behaviors are misreported in surveys (Bradburn 1983). Two findings in the methodological literature illustrate these problems with survey data on sensitive topics. The first one involves survey reports about abortion: comparisons between estimates of the number of abortions based on survey data from the National Survey of Family Growth (NSFG) and estimates based on data collected from abortion clinics suggest that fewer than half of all abortions are reported in the NSFG (Jones and Forrest 1992). The second set of findings involves reports about sex partners. Within a closed population, men and women should report the same total number of opposite-sex sex partners; members of both sexes are being asked to report the same pairings. However, as Smith (1992a) has documented, men consistently report more opposite-sex sex partners than women do, a difference that persists even when differences in population sizes are taken into account. The most plausible account for the discrepancy is that members of both sexes are prone to systematic reporting error, with men overstating their partners and women overlooking theirs. A recent review of the methodological problems in AIDS research described the situation this way: "Most sex research is based on self-reported sexual behavior of unknown validity" (Catania et al. 1990, p. 339). The findings on the differences in the numbers of sex partners reported by men and women suggest that self-reports about sexual behavior may include considerable error.

Mode effects and sensitive questions. The literature on sensitive questions demonstrates that the method of collecting the data can affect the answers that are obtained. Table 1 summarizes the findings from some of the key methodological studies. Several of these studies have demonstrated that self-administration of sensitive questions increases levels of reporting relative to administration of the same questions by an interviewer. Respondents are apparently reluctant to admit to an interviewer that they have engaged in illegal or otherwise embarrassing activities. Studies comparing self-administered questionnaires (SAQ) with conventional paper-and-pencil interviewer administration (PAPI) have shown that self-administration increases reporting of abortions (London and Williams 1990; Mott 1985), alcohol consumption (Aquilino and LoSciuto 1990; Hochstim 1967), and illicit drug use (Aquilino 1994; Aquilino and LoSciuto 1990; Schober et al. 1992; and Turner, Lessler, and DeVore 1992). The question naturally arises whether administration of the questions by a computer directly to the respondent would yield increases in reporting similar to those obtained through conventional self-administration on paper questionnaires.

Table 1. Key Results of Prior Studies of Mode Effects

Study	Modes of Data Collection	Topic	Setting	Major Findings
Aquilino 1994	SAQ vs. PAPI vs. telephone	Illicit drug use; alcohol consumption	National survey	More drug use and alcohol consumption reported on SAQ; reporting lowest on the telephone
Aquilino and LoSciuto 1990	SAQ vs. PAPI vs. telephone	Illicit drug use; alcohol consumption	State survey	More drug use reported on SAQ
Baker, Bradburn, and Johnson, in press	CAPI vs. PAPI	Birth control	NLSY	More birth control use reported by CAPI respondents
Bradburn et al. 1991	CAPI vs. PAPI	Alcohol problems	NLSY	More alcohol problems reported by CAPI respondents
Card et al. 1974	CASI vs. PAPI	Gastrointestinal problems	Medical clinic	Computer diagnoses slightly less accurate than physician's
Erdman, Klein, and Greist 1983	CASI vs. SAQ	Alcohol consumption	High school	Greater alcohol consumption reported under CASI
Hochstim 1967	SAQ vs. PAPI vs. telephone	Alcohol consumption	Local survey	More alcohol consumption reported on SAQ

Jobe et al., in press	CASI vs. SAQ vs. CAPI vs. PAPI	Sexual partners	Local survey	More sexual partners reported by women in self-administered groups
Locke et al. 1992	CASI vs. PAPI	HIV risk factors	Red Cross blood donation center	More HIV risk factors reported in CASI
London and Williams 1990	SAQ vs. PAPI	Abortion	NSFG (Cycle IV)	More abortions reported with SAQ
Lucas et al. 1977	CASI vs. PAPI	Alcohol consumption	Alcohol clinic	More alcohol consumption reported under CASI
Mosher and Duffer 1994	ACASI vs. CAPI	Abortion	NSFG pretest	More abortions reported with ACASI
Mott 1985	SAQ vs. PAPI	Abortion	NLSY	More abortions reported with SAQ
O'Reilly et al. 1994	ACASI vs. CASI vs. PAPI	Sensitive topics	Laboratory study	More sensitive behaviors reported in computer-assisted modes
Robinson and West 1992	CASI vs. SAQ vs. PAPI	Urinary symptoms	Medical clinic	More symptoms reported under CASI
Schober et al. 1992	SAQ vs. PAPI	Illicit drug use	NLSY	More drug use reported on SAQ
Turner, Lessler, and Devore 1992	SAQ vs. PAPI	Illicit drug use	NLSY	More drug use reported on SAQ
Waterton and Duffy 1984	CASI vs. PAPI	Alcohol consumption	Local survey	More alcohol consumption reported under CASI

NOTE.—SAQ = self-administered questionnaires; PAPI = paper-and-pencil interviewer administration; CAPI = computer-assisted personal interviewing; CASI = computer-assisted self-administered interviewing; ACASI = audio computer-assisted self-administered interviewing; NLSY = National Longitudinal Survey of Youth; NSFG = National Survey of Family Growth.

There are a few indications in the literature that by itself computerization of the data collection process may increase the accuracy of the responses given to sensitive questions. For example, in an early test of CAPI in the National Longitudinal Survey of Youth (NLSY), Bradburn and his colleagues found that CAPI yielded significantly more reporting of alcohol-related problems than conventional paper-and-pencil interviews (Bradburn et al. 1991). A larger experimental comparison of CAPI and PAPI in the next round of the NLSY found that both male and female CAPI respondents were more likely than PAPI respondents to report having used birth control during the past month (Baker and Bradburn 1991; see also Baker, Bradburn, and Johnson, in press). Both of these experiments, however, examined questions administered by interviewers, whether conventionally or with computer assistance; neither examined administration of the items by computer directly to the respondent.

Early comparisons of computer-assisted self-administration (via CASI) with paper-and-pencil interviews suggest that computer administration of survey items produces gains similar to those from conventional self-administration. Waterton and Duffy (1984) found that reported alcohol consumption was some 35 percent higher when the computer administered the questions than when an interviewer did. Most of the other early methodological studies that have examined CASI have involved specialized institutions or populations rather than the general population (e.g., Card et al. 1974). The results of these studies are, however, largely consistent with the findings reported by Waterton and Duffy (1984). For example, in a sample of males undergoing treatment, Lucas and his associates compared reports about drinking problems elicited by computer with those obtained by direct questioning by medical staff and found that the average reported consumption was 30 percent higher in the computer than in the face-to-face interview condition (Lucas et al. 1977). A study of potential blood donors revealed that CASI elicited significantly more HIV risk factors than a conventional face-to-face interview (Locke et al. 1992). Respondents also rated the CASI interview as more private. A CASI version of the Diagnostic Interview Schedule (DIS) yielded diagnostic information consistent with the traditional interviewer-administered DIS, but the respondents considered the computer contact "less embarrassing" (Erdman, Klein, and Greist 1983). In a study of patients at a genitourinary clinic that compared CASI, paper-and-pencil interviews administered by physicians, and conventional SAQs, Robinson and West (1992) found that more symptoms were reported on the computer than on a paper SAQ, with both yielding significantly more symptoms than were obtained by physicians.

Several of these early studies of CASI confound the two major fea-

tures of the new method—use of computers in the data collection process and self-administration of the questions. We know of only one study, carried out by Jobe and his colleagues, that attempts to disentangle the effects of these two variables (Jobe et al., in press; see also Tourangeau et al. 1995). That study compared four modes of data collection—CAPI, PAPI, CASI, and paper SAQs—in a sample of 1,000 women from the city of Chicago. The basic finding from the study was that computerization per se had little effect on the level of reporting; consistent with the results of prior studies, however, self-administration—whether computer assisted or not—had a clear impact on reporting, especially the reporting of sexual behavior.

Because CASI requires respondents to read the questions, it is subject to some of the same limitations as other methods of self-administration. The requirement that respondents read the questions and follow the directions may make it difficult to use CASI among populations with poor reading skills. Because it features auditory presentation of the questions, ACASI may circumvent this restriction (e.g., Johnston and Walton 1992; O'Reilly et al. 1994). ACASI may thus preserve the privacy of self-administration without imposing the same demands on respondent literacy. To date, methodological research on ACASI is limited (though there is some additional research examining a related method of data collection using portable cassette players rather than computers to administer questions that may also be relevant; see Cynamon and Camburn [1992]). The most comprehensive study on ACASI to date was carried out by O'Reilly and his colleagues (O'Reilly et al. 1994). Although the sample was small, this study nonetheless demonstrated that ACASI can be used with a range of respondents; indeed, respondents preferred both forms of CASI—with or without sound—over traditional paper SAQs. Computer-assisted questioning also elicited higher levels of reporting of sensitive behaviors, although the differences by mode of data collection were not significant. A study of ACASI conducted as part of pilot work by Cycle V of the National Survey of Family Growth also found a small gain in abortion reporting relative to CAPI, but did not compare ACASI to other methods of self-administration (Mosher and Duffer 1994).

Variables underlying mode differences. The revolution in computerized data collection has multiplied the methods available for face-to-face interviewing; at least six methods can be used to collect data: (1) paper-and-pencil personal interviews (PAPI); (2) paper-and-pencil self-administered questionnaires (SAQ); (3) Walkman-administered questionnaires (audio-SAQ); (4) computer-assisted personal interviews (CAPI); (5) computer-assisted self-administered interviews (CASI); and (6) audio computer-assisted self-administered interviews (ACASI).

These modes of in-person data collection differ from each other

along several dimensions. One of these is the computerization of the data collection process. Computerization can have several effects on the data that ultimately are collected. Most obviously, the programs are typically designed to prevent errors of administration; as a result, computer assistance sharply reduces the number of questions that are inadvertently skipped and the number of responses that are outside the permitted range or logically inconsistent with other answers. Along with increased timeliness and reduced cost, the reduction of administration errors is perhaps the feature of computerized data collection most widely cited by proponents of the new methods and most consistently demonstrated in the literature. Computer assistance may, however, have subtler effects on data quality. For example, laptop computers are still a novelty for many respondents, and the use of laptop computers in the respondent's home may affect the respondent's perception of the interview: a survey may be seen as more important or more objective when computers are used to collect the data. At the same time, computers may make other respondents nervous and increase their reluctance to take part in the survey. Resistance to the computer may be especially high when respondents must interact with the computer directly, as with CASI data collection (Couper and Rowe 1995).

A second difference among these six methods of in-person data collection involves whether the questions are self-administered or administered by an interviewer. Self-administration can have marked effects on the responses obtained; by reducing fears of embarrassment or of disclosure to other household members, self-administration appears to increase respondent candor. The participation of an interviewer may also reduce the respondent's concentration, diverting the respondent's attention from the task of answering the question. It is also possible, of course, that the involvement of an interviewer helps maintain respondent motivation. In general, one might expect reduced variability across interviewers when the data are self-administered than when they are administered by the interviewer (Tourangeau et al. [1995]; however, cf. Sudman et al. [1977] on the modest impact of the interviewer on the answers obtained).

A final difference among the methods involves whether the questions are read to the respondent or by the respondent. Methods of data collection, such as CAPI or ACASI, in which the questions are presented aloud reduce the overall cognitive burden imposed on the respondent and eliminate the requirement that the respondent be able to read. This may be especially important within subpopulations where literacy problems are common. On the other hand, when the questions are only read aloud, the respondent has less control over the pace of the interview and may be prone to "primacy" effects, favoring options

presented early in the list of permissible answer categories over those presented toward the end (Krosnick and Alwin 1987). Further, auditory presentation (without concurrent visual display) may overtax the respondents' listening ability, and their comprehension of even moderately long or complicated questions may suffer as a result.

Particular combinations of these three underlying variables may produce additional differences among the six modes. For example, self-administered paper questionnaires allow respondents to look ahead and go back to earlier items and may therefore reduce the impact of question order (Bishop et al. 1988). Although CASI and ACASI applications may also in principle allow respondents to "leaf" through the questionnaire, respondents are probably less likely to take advantage of this capability on a computer than with a paper questionnaire. Because they present the items one at a time on the screen, CASI and ACASI may increase the time respondents spend on each question relative to an SAQ.

Study design. This study compared the three methods of computer-assisted data collection—CAPI, CASI, and ACASI—currently available for face-to-face interviewing. Computer-assisted personal interviewing (CAPI) differs from the other two modes in that the questions are administered by an interviewer rather than directly by the computer. Computer-assisted self-administered interviewing (CASI) differs from the other two in its reliance on visual presentation of the items. The three modes were compared in a cross-sectional sample of respondents from Cook County. The key outcome variables were nonresponse rates and levels of reporting, particularly reporting of illicit drug use and sexual behavior. Our hypotheses were that, relative to CAPI data collection, CASI and ACASI data collection would increase the proportion of respondents admitting illicit drug use and decrease the disparity between the average number of sex partners reported by men and women. More generally, we predicted that, by offering greater privacy to the respondents, the two self-administered modes would reduce the effects of social desirability on the answers. Because a large number of partners is often seen as undesirable for women and a small number of partners is often seen as undesirable for men, we expected self-administration to have opposite effects on the number of sex partners reported by men and women. We did not anticipate a difference in overall response rates by mode.

Because of our interest in the reporting of sex partners, the design included two other variables besides data collection mode that were designed to affect responses to the sex partner questions; these variables were the format and context of the sex partner questions. A study by Bradburn and his colleagues (Bradburn et al. 1979) showed that open-ended items tend to elicit higher levels of reporting of alcohol

consumption than closed items, at least among those who report drinking at all. There are at least two reasons to suppose that open items may increase accuracy. First, as Burton and Blair (1991) have argued, closed items may suggest to the respondents that approximate answers are acceptable and encourage responses based on estimation processes; their results, however, offer limited support for the hypothesis that closed items reduce accuracy. Second, when the item is closed, respondents may infer that the middle response option represents the typical value and use this option as an anchor for their own answers (Schwarz and Hippler 1987). It is possible that the use of closed items may increase the discrepancy between the number of sex partners reported by men and women by suggesting that inexact answers are legitimate; it is also possible, on the other hand, that the use of broad categories (especially at the upper end) will make it easier for women to report large numbers of partners. To test the effect of the answer options presented in the closed questions, we used two versions of each closed item—one with categories mainly at the low end of the range and a second version with categories concentrated at the high end of the range. In addition to these two closed forms, we also included an open form of each of the sex partner questions.

This study also examined the effects of prior items on the reporting of sex partners. Just before the sex partner questions, respondents answered one of two sets of questions about their sexual attitudes. One set of items was designed to encourage respondents to report large numbers of sex partners; these questions consisted of statements expressing "permissive" views about sexual activity. The other set of questions was designed to discourage reporting large numbers of partners; these statements in this set expressed more "restrictive" views about sex. Studies have shown that prior items can affect responses to later items (see Smith [1992b] and Tourangeau and Rasinski [1988] for reviews). We thought that, because reports about sexual behavior may be affected by attitudes toward sex, the permissive items would encourage female respondents to admit how many partners they had and that the restrictive items would encourage male respondents to admit how few they had.

Method

Sample selection. We selected an area probability sample of dwellings in Cook County, Illinois. At the first stage of selection, we selected a systematic sample of 32 area segments, with the first-stage selection probabilities proportional to the number of housing units on the seg-

ment (according to 1990 census data). Each segment consisted of a single block or several adjoining blocks. Prior to selection, all blocks in the county had been sorted by census tract and, within census tract, by block number. A systematic sample of segments was selected that gave proportionate representation to all areas of the county. Seventeen of the 32 sample segments were located in the city of Chicago. The remainder were drawn from the balance of Cook County.

At the second stage of selection, we designated a sample of 1,122 housing units (HUs) for a short screening interview to determine whether anyone living there was in the 18–45-year age range. The screening sample constituted an equal probability sample of the housing units in Cook County. Fifty-three of the sample HUs were unoccupied; screeners were completed at 975 of the 1,069 occupied HUs, for a completion rate of 91.2 percent.

Eligible persons were identified at 643 of the HUs that completed the screener. When more than a single HU resident was eligible for the study, we randomly designated one of them to be the respondent. Residents selected for the main interview were told that the survey concerned health and was supported by funding from the National Science Foundation. Of the 643 potential respondents selected in this way, 365 completed the main interview, for a final completion rate of 56.8 percent. Unfortunately, the study used a new version of Auto-Quest to administer the items, and a design flaw in this version of the program prevented some 79 of these initial interviews from being downloaded from the laptops. Subsequently, the error was corrected, and 53 of the original cases were reinterviewed under the same experimental conditions they had been assigned to originally. (Twenty-five ACASI interviews, 12 CAPI interviews, and 16 CASI interviews were redone.) The results presented here are, except where noted, based on 339 completed cases (including the 53 reinterviewed cases). The results are not appreciably altered if the reinterviews are excluded from the analysis.

Questionnaire. The questionnaire included items concerning a range of sensitive topics. It was divided into five major sections. The first section included standard demographic questions (asking about the respondent's sex, date of birth, marital status, and educational attainment). The next section asked about a number of health conditions, among them several sexually transmitted diseases. The third section consisted of items on marriage and cohabitation, pregnancy, and sex partners; the sex partner items asked about the number of opposite-sex sex partners during the past year, the past 5 years, and over the respondent's lifetime. In each version of the questionnaire, the sex partner items followed a set of three or four questions on sexual attitudes; these attitude items were designed to encourage or discourage full reporting of sex partners. The fourth section of the questionnaire con-

tained two items on AIDS risk and a series of items on condom use. The fifth section of the questionnaire included several items on illicit drug use. The interview concluded with a few questions assessing attitudes toward abortion and the legalization of marijuana.

The questions were mostly drawn from existing sources. The bulk of the items in the questionnaire were taken from an earlier study—the Women's Health Study—conducted as a pretest for Cycle V of the National Survey of Family Growth (NSFG; see Jobe et al. [in press]). Most of the items in that study were taken from earlier cycles of the NSFG. The sex partner items in the questionnaire were quite similar to those used in a series of supplements to the General Social Surveys (GSS); the only difference is that the GSS items asked about partners since age 18 rather than over the lifetime. The items on illicit drug use were modeled on those used in the National Household Survey of Drug Abuse (see, e.g., Turner, Lessler, and Gfroerer 1992).

Experimental design. Prior to screening, each HU was randomly assigned to an experimental condition; the data collection mode variable was crossed with the context and format of the sex partner items, producing a total of 12 conditions. Random assignment was done within segments to assure that the experimental conditions were not confounded with geographic areas.

The main experimental variable was the mode of data collection: respondents were assigned to data collection by computer-assisted personal interview (CAPI), computer-assisted self-administered interview (CASI), or audio computer-assisted self-administered interview (ACASI). With CAPI, the questions appeared on a computer screen and were read to the respondent by the interviewer; the interviewer then entered the response. With CASI, the identical program was used, but the respondent interacted directly with the computer. The interviewer merely entered the respondent's identification number at the outset and gave the respondent some brief instructions about how to complete the interview. The first few items in the questionnaire were in fact practice questions and allowed the respondents to familiarize themselves with the response procedure. The very first item—which asked for the respondent's date of birth—was the most demanding item in the questionnaire in terms of keystrokes; respondents had to enter in turn the numbers corresponding to the month, day, and year in which they were born. None of the respondents had any apparent difficulty with this or subsequent items. Each question appeared by itself on the screen; along the top of the screen, the program displayed brief instructions to remind respondents how to back up to a previous question, move forward to the next question, and indicate their refusal to answer a question. With ACASI, the information displayed on the screen was identical to the information displayed in the CAPI and

CASI conditions. The only difference was the simultaneous playing of a digitized recording of the question to the respondent via earphones. Two recordings were made, one for male respondents and one for females. (This allowed us to use appropriate sex-specific terms in the recorded questions; e.g., we could ask men about their female sex partners.) Both recordings were made by the same female interviewer, who read each question into a microphone on a laptop computer; software provided with the computer's sound card saved the recording of each question as a separate sound file.

Within both the CASI and ACASI conditions, the interviewers were instructed not to look at the screen while the respondent completed the questions, but to listen for any beeps that might indicate that the respondent was having a problem. The interviewers were told to busy themselves during the interview with administrative chores (such as completing the record of calls) and were also asked to fill out a short observation form recording any difficulties the respondent encountered. In all three data collection conditions, the AutoQuest software was used to administer the items. In the ACASI version, AutoQuest called an external DOS program that triggered the playing of the sound file; the DOS program interrupted the sound file if the respondent pressed any key. Although the AutoQuest program allowed interviewers or respondents to back up to previous questions, it did not allow them to scroll forward without first entering an answer to each item.

The sex partner items were the subject of two additional experimental variables. The first was whether the sex partner questions used an open or closed format and what response options were offered in the closed format. Three versions of the sex partner questions were used. The open version simply asked for the number of partners; for example, the 1-year question administered to women respondents asked: "During the last 12 months, that is, since August/September 1993, how many men (if any) have you had intercourse with? Please count every partner, even those you only had sex with once." A number was entered as the answer. The closed versions of this question presented the same question followed by a set of response options. The response options presented to one group of respondents were 0, 1, 2, 3, 4, and 5 or more; the options presented to the other group were 0, 1–4, 5–9, 10–49, 50–99, and 100 or more. A follow-up item asked respondents in the closed format groups the exact number of partners (when that could not be inferred from the response category they had selected). Respondents received the same version of the sex partner item for all three recall periods (1 year, 5 years, and lifetime); moreover, the same set of response options was used for all three items. We will refer to the three groups of respondents as the *open*, *closed-low*, and *closed-high* respondents.

The final experimental variable consisted of the items that preceded the three sex partner questions. Each of these context items consisted of a statement with which respondents were to indicate their agreement, using a 5-point scale. We created two sets of attitude statements for each sex, one that expressed relatively "permissive" views about sexual activity and a second set that expressed more "restrictive" views. Slightly different items were used for women and men because of the presumed differences in attitudes toward sexual behavior within the two sexes. The women received either four permissive statements ("Women should have as much freedom as men have," "Women should be frank and open about their sexual needs and desires," "It's only natural for people who date to become sexual partners," and "The sexual double standard that approves of men having many sex partners but disapproves of many sexual partners for women is unfair and outmoded") or three restrictive statements ("Women who have many sex partners are often insecure and lack self-esteem," "It's wrong for a married person to have sexual relations with someone other than his or her spouse," and "Casual sexual relations are unwise and often dangerous"). Men got either three permissive statements ("Sexual desire is a healthy, natural impulse—there's little reason why adults should not fulfill it," "To choose the right person to marry, it's best to have sexual experience with many women," and "It's only natural for people who are dating to become sexual partners") or three restrictive ones ("Men who have many sex partners are usually trying to prove something and lack maturity," "It is wrong for a married person to have sexual relations with someone other than his or her spouse," and "The more sex partners you have, the more likely you are to catch a sexually transmitted disease like herpes, AIDS, or syphilis"). We will refer to the conditions as the *restrictive* and *permissive* context groups.

Data collection. The initial 365 interviews were completed in August and September of 1994. The 53 reinterviews were completed in February of 1995. A total of 22 interviewers conducted the interviews that make up the final data set. All but one of them were women. Because of the need to manipulate the sound files, the ACASI condition required faster machines than the CAPI or CASI conditions. As a result, we rented a limited number of Compaq Conturas and ASTs (386 laptops) for the ACASI interviews and assigned these machines to eight of the interviewers; these eight interviewers completed only ACASI interviews. The remaining field staff received slower Compaq LTEs (286 laptops) and were assigned to conduct both CAPI and CASI interviews.

Available interviewers from both groups were used to conduct the reinterviews. Nine interviewers ultimately completed cases in all three

modes of data collection, 10 completed only CASI/CAPI interviews, and three completed only ACASI cases.

Results

The analysis examines three main issues: the impact of the different modes of data collection on participation in the study (i.e., on unit nonresponse); the effects of mode, question context, and format of the questions on responses to the sexual behavior items; and the effect of mode on responses to the questions on illicit drug use. Because the sample was clustered by area segment, we analyzed the data using SUDAAN, which uses Taylor Series approximation to estimate standard errors and compute significance tests (Shah et al. 1993). However, because of the experimental design we used (in which the experimental factors were crossed with area segments), the SUDAAN standard errors were consistently smaller than those computed under the assumption of simple random sampling. Similarly, in every case, the significance levels were more extreme when we used SUDAAN to take the clustering into account than when we ignored the clustering. As a result, we report the inferential statistics from the analyses that assume a simple random sample. In every case where the results differed, this is the conservative approach. In general, these differences involved higher-order interaction terms with no clear interpretation.

Unit nonresponse. We examined nonresponse in the initial wave of interviewing. The overall response rate for this wave was 56.8 percent (365 completed interviews out of 643 eligible cases).[1] The response rates did not differ significantly by mode of data collection. Of the 211 cases assigned to ACASI data collection, 55.5 percent (117) completed the interview; of the 220 assigned to CAPI, 57.7 percent (127) completed the interview; and of the 212 assigned to CASI, 57.1 percent (121) completed the interview. There were also no significant differences in refusal rates by mode, although the refusal rate was somewhat lower among the CASI (22.7 percent) than among the ACASI (42.4 percent) and CAPI (34.9 percent) cases.

Even though the overall levels of participation were similar across modes of data collection, it is still possible that different types of respondent tended to complete interviews under the different modes.

1. Although the overall response rate for the study may seem low, the sample was restricted to residents of a single large metropolitan area; many surveys have relatively low response rates in such areas. In Cycle IV of the National Survey of Family Growth (NSFG), e.g., the response rate in the 10 largest metropolitan areas was below 60 percent (Rieger, Judkins, and Sperry 1991). The NSFG sample covers a similar age range and the questionnaire covers similar content areas to those used here.

Because differences in the composition of the three groups could explain any apparent differences in the levels of reporting, we compared the groups on marital status, educational attainment, age, and sex. These analyses are based on the 339 cases for whom questionnaire data ultimately were obtained. Little information about the nonrespondents is available beyond the segment from which they were selected and the experimental condition to which they were assigned.

There were no significant differences in the three mode groups in marital status, age, or sex; there was, however, a significant difference in educational attainment ($\chi^2_8 = 20.16$; $p = .01$). Table 2 shows the composition of the three mode groups by the background characteristics. Relative to the other two groups, the ACASI respondents include fewer respondents at the lowest level of educational attainment and more respondents at the highest level. In analyzing responses to the sensitive questions, we included education as an additional control variable; adding education to the models did not change any of the conclusions and, as a result, the results presented here are based on the analyses that leave education out.

Reporting of sex partners. Respondents were asked to report the number of their sex partners over three time periods (past year, past 5 years, and lifetime); respondents who were administered the closed versions of these questions were also administered an open-ended follow-up item to determine the exact number of sex partners for each time period if that was not already apparent from the option the respondent had selected in answering the closed item. (We note that some of the respondents in the closed conditions may have anticipated the open-ended follow-up item for the 5-year and lifetime questions.) We examine the final exact answers here; comparisons between the final and initial answers in the closed conditions revealed very few discrepancies between the two. Still, many respondents in the closed conditions answered two questions about each time period rather than a single item, as in the open condition; this difference may contribute to any differences in the answers given under the open and closed formats.

The distribution of the reported number of sex partners for each time period was quite skewed. To reduce this skewness, we transformed the sex partner data by adding .5 to the reported number and taking the natural logarithm of the result. A further problem with the sex partner data was the presence of outliers. Two cases reported 50 partners in the prior year, one reported more than 100 partners during the previous 5 years, and two reported more than 100 partners in total. We dropped these outliers from the analyses reported here; their removal had little impact on the conclusions drawn. We then carried out analyses of variance on the transformed reports for each time period. The factors

Table 2. Final Sample by Mode and Selected Background Characteristics (Percent)

Characteristic	ACASI	CAPI	CASI	$\chi^2(p)$
Sample size	104	115	120	
Sex:				
Female	63.5	60.9	61.7	$\chi^2_2 = .16$
Male	36.5	39.1	38.3	(.92)
Age:				
Under 20 years	3.9	11.3	9.2	$\chi^2_6 = 7.56$
20–29 years	27.9	26.1	30.0	(.27)
30–39 years	35.6	40.9	33.3	
40 and older	32.7	21.7	27.5	
Marital status:				
Married/cohabiting	49.5	42.6	47.9	$\chi^2_4 = 1.49$
Formerly married	14.6	18.3	14.3	(.83)
Never married	35.9	39.1	37.8	
Education:				
Less than high school	4.8	13.0	11.7	$\chi^2_8 = 20.16$
High school graduate	25.2	33.9	20.8	(.01)
Some college	33.0	20.0	36.7	
College graduate	15.5	22.6	17.5	
Graduate/professional	21.4	10.4	13.3	

NOTE.—CASI = computer-assisted self-administered interviewing; CAPI = computer-assisted personal interviewing; ACASI = audio computer-assisted self-administered interviewing.

included sex, mode of data collection, format of the question, and context of the items.[2]

For all three time periods, there were significant main effects for the sex of the respondent. As has been found in prior studies, the male respondents reported more partners than their female counterparts (2.9 vs. 1.6 for the past year; 5.2 vs. 2.7 for the past 5 years; and 8.4 vs. 4.8 over the lifetime). The F values for the transformed data range from 7.69 for the 5-year reports to 9.29 for the 1-year reports (all p's less than .01). Table 3 displays the means for both the raw and transformed reports.[3]

2. Because random assignment occurred prior to screening, the final cell sizes differ across the experimental groups. As a result, we used analysis of variance procedures suitable for unbalanced designs. The effect of the unequal Ns by group is to reduce the power of the analyses somewhat.

3. The sex partner items asked respondents about the numbers of persons with whom they had sexual intercourse. It is possible that respondents omit certain types of persons in answering these questions. We included two follow-up questions to examine this

Table 3. Mean Reported Sex Partners by Experimental Variables

	1-Year Partners			5-Year Partners			Lifetime Partners		
	Raw	Log	*N*	Raw	Log	*N*	Raw	Log	*N*
Females	1.60	.51	187	2.73	.83	188	4.79	1.20	188
Males	2.92	.80	106	5.17	1.12	104	8.35	1.62	104
F (*p*)	9.29 (<.01)			7.69 (<.01)			9.18 (<.01)		
ACASI	2.26	.67	86	4.52	1.01	87	7.05	1.45	88
CAPI	2.14	.59	103	3.44	.95	103	5.51	1.33	102
CASI	1.87	.60	104	2.99	.85	102	5.75	1.28	102
F (*p*)	.93 (n.s.)			2.19 (n.s.)			3.03 (<.05)		
Open	1.65	.50	102	3.12	.85	102	7.20	1.45	103
Closed-low	1.43	.43	105	2.62	.78	103	4.73	1.23	103
Closed-high	3.38	.98	86	5.33	1.21	87	6.28	1.37	86
F (*p*)	14.05 (<.001)			7.03 (<.01)			2.35 (<.10)		
Permissive context	1.88	.57	148	2.95	.85	145	5.77	1.34	146
Restrictive context	2.28	.66	145	4.24	1.01	147	6.34	1.36	146
F (*p*)	2.92 (<.10)			4.03 (<.05)			.52 (n.s.)		

NOTE.—*F*-values based on log-transformed data. See table 2 for definitions of acronyms.

There were significant main effects for all three of the experimental variables. For all three time periods, ACASI elicited the highest mean number of reported sex partners. The effect of data collection was significant for the lifetime reports and marginally significant for the 5-year reports: $F(2,256) = 3.03$ ($p = .05$) for the lifetime data and $F(2,256) = 2.19$ ($p < .12$) for the 5-year data. An additional contrast revealed that, for both lifetime and 5-year reports, ACASI yielded significantly higher numbers of reported partners, on average, than CASI did—$F(1,256) = 5.95$ ($p < .05$) for the lifetime and $F(1,256) = 4.35$ ($p < .05$) for the 5-year data. For the 1-year and 5-year periods, the closed item with the high-response categories elicited the highest level of reporting and the closed item with the low-response categories, the lowest; in both cases, the open item produced intermediate levels of reporting. The effect of item format was significant for both the 1-year and 5-year data: $F(2,257) = 14.05$ ($p < .001$) for the 1-year data

possibility. After the lifetime sex partner question, male respondents were asked whether they had omitted any contacts with prostitutes from their lifetime tallies; female respondents were asked if they had omitted any males who had used force or threats to have intercourse with them. The corrections based on responses to these questions were quite small and did not affect the results. The results presented here are based on the uncorrected lifetime sex partner data.

and $F(2,256) = 7.03$ ($p < .01$) for the 5-year data.[4] Finally, the restrictive context elicited higher numbers of sex partners than the permissive context for all three time periods; however, this "backfire" effect was significant only for the 5-year data—$F(1,256) = 4.03$ ($p < .05$)—and the effect of context was qualified by higher-order interactions. A potential complication here is that the permissive and restrictive items may have differed in their effectiveness. Overall, the permissive items elicited lower levels of support than the restrictive items did; averaging across the items, only about 58 percent of the respondents agreed with the permissive context items, whereas 78 percent of the respondents agreed with the restrictive ones. Some of the respondents apparently found the permissive items a little too permissive.

The data in table 3 show the usual discrepancy between men and women in the reported number of sex partners. We expected this discrepancy to be reduced when the questions were self-administered. Moreover, we expected the impact of self-administration to differ by sex—with males reporting fewer partners and women more partners—under the two self-administered modes than under the interviewer-administered mode. The results in figure 1, which plots the means of the transformed sex partner reports by sex and mode of data collection, are consistent with these hypotheses. For all three time periods, the disparity between the number of sex partners reported by men and women was largest under CAPI; in addition, CAPI yielded the highest level of reporting for the men and the lowest level for the women. However, none of the mode-by-sex interactions was significant. The two-way interactions apparent in figure 1 were qualified by higher-order effects involving the context variable. Figure 2 graphs the means for each combination of data collection mode, respondent sex, and item context. The three-way interactions were significant for both the 1-year and lifetime reports: $F(2,257) = 5.10$ ($p < .01$) for the 1-year data and $F(2,256) = 3.71$ ($p < .05$) for the lifetime data. The patterns apparent in figure 1 were far more pronounced among respondents who received the restrictive context items than among those who received the permissive items. Within the restrictive context groups, the

4. These findings on the effects of item format are somewhat at odds with results from an experiment on the General Social Survey. The GSS experiment showed no significant differences between open and closed formats in the number of sex partners reported. As in the present experiment, GSS respondents in the closed conditions were asked a follow-up item to determine their exact number of partners. The GSS offered closed-response options intermediate between those used in the closed-high and closed-low conditions here; the closed GSS item included 0, 1, 2, 3, 4, 5–9, 10–20, 21–100, and 101 or more partners as response options. The trend in the GSS data was toward increased reporting in the closed condition. For example, respondents reported a mean of 3.1 partners in the past 5 years in the closed condition vs. a mean of 2.3 partners in the open condition.

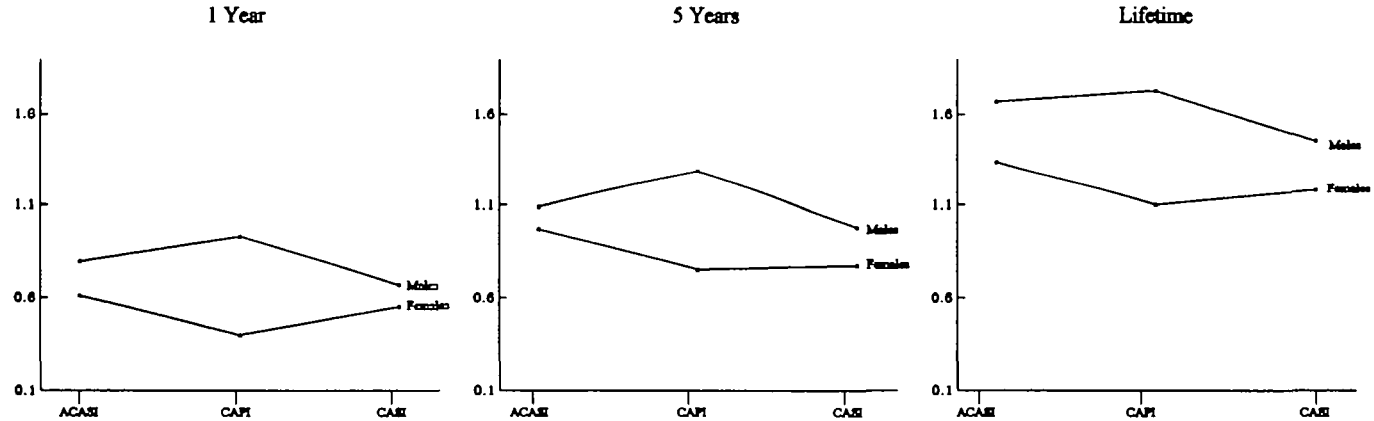

Figure 1. Mean reported sex partners by mode and sex (transformed data)

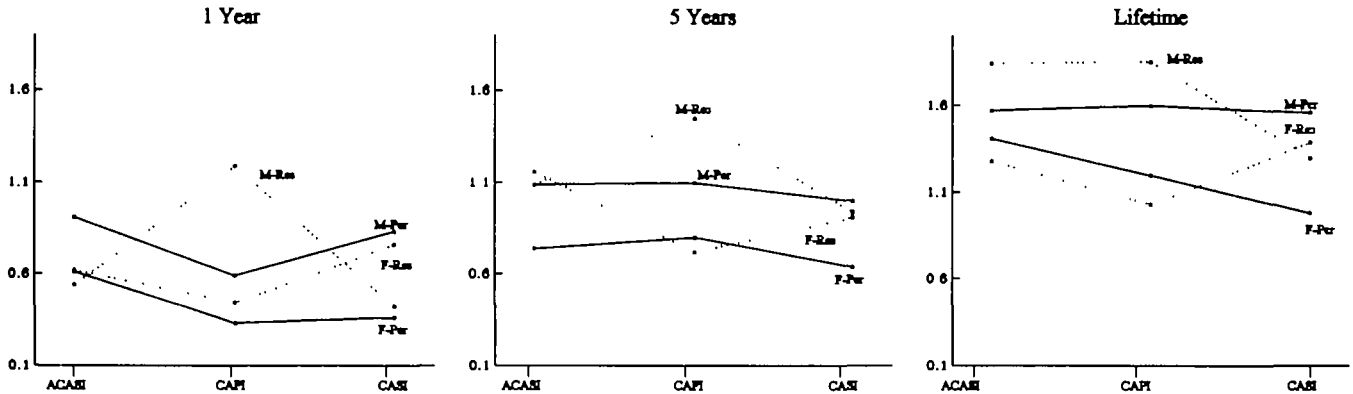

Figure 2. Mean reported sex partners by mode, context, and sex (transformed data). M-Res and F-Res refer to the restrictive contexts for males and females; M-Per and F-Per, to the permissive contexts.

mode of data collection had a large impact on the reported number of sex partners, and the gap between men and women is widest under CAPI data collection; within the permissive context groups, the mode of data collection had relatively little impact on the number of partners reported, and the disparity between the reports by men and women remained apparent under all three modes of data collection. Figure 2 also reveals that the overall trend toward backfire effects apparent in table 3 was, in fact, mainly produced by the women respondents, especially those in the CASI condition.

Besides the three-way interaction plotted in figure 2, we found one other consistent interaction effect, involving the mode of data collection and item format. For both the 5-year and lifetime reports, the mode and format variables interacted significantly: for the 5-year data, $F(4,256) = 3.24$ ($p < .05$); for the lifetime data, $F(4,258) = 3.32$ ($p < .05$). The same interaction is marginally significant for the 1-year data as well—$F(4,257) = 2.08$ ($p < .10$). Figure 3 displays the cells means (of the transformed data) relevant to these interactions. The means suggest that CAPI data collection reduced the impact of the response format variable. For all three time periods, the means for the three response formats converge markedly under CAPI (see fig. 3); the convergence is particularly striking for the lifetime reports. Figure 3 reveals another oddity—for the lifetime reports, the closed-high response format produced the lowest level of reporting under CASI. We are unable to account for this reversal of the usual pattern for the different format conditions.[5]

Rounding of sex partners. Prior research indicates that many respondents answer the sex partner questions using round numbers, suggesting that their answers are, at best, approximations (Tourangeau et al. 1995). In this study, a total of 66 respondents reported eight or more lifetime sex partners, 37 of them reporting a total that was a round value—that is, an exact multiple of five. We analyzed the proportion of the respondents reporting at least eight lifetime partners who used round values to report their answers. Because of the small numbers of respondents involved, we fitted an additive logistic regression model rather than a fully saturated model; the model included main effects for the sex of the respondent, the mode of data collection, the context of the sex partner questions, and the format of these questions. There was a significant effect of item context ($\chi^2_2 = 5.74$; $p < .05$); respondents who answered the restrictive context items were

5. One other significant interaction effect emerged from the analysis of the sex partner data—a three-way interaction between the mode of data collection, the sex of the respondent, and the response format of the sex partner items. The effect was significant only for the 5-year partner data and was not readily interpretable.

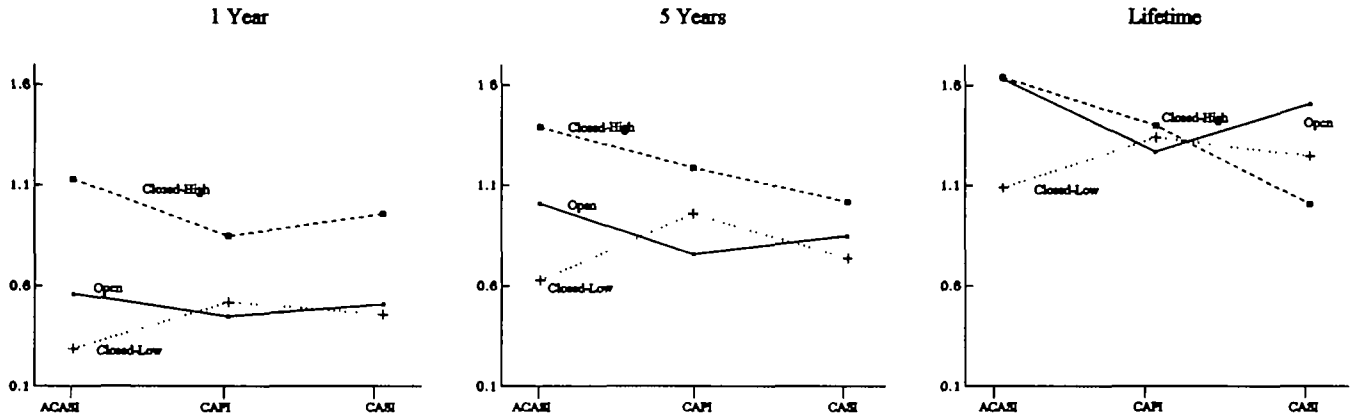

Figure 3. Mean reported sex partners by mode and format (transformed data)

more likely to report a round number of lifetime partners (68.6 percent) than those who answered the permissive context items (41.9 percent). There was also a significant effect for the item format variable (χ^2_2 = 8.91; $p < .05$); respondents in the closed-high and open conditions were far more likely to report a round number of lifetime sex partners (72.7 percent and 65.2 percent) than those in the closed-low condition (28.6 percent). Neither the sex of the respondent nor the mode of data collection significantly affected the proportion of respondents reporting a round number of lifetime sex partners.

Other sexual behavior. In addition to the sex partner items, respondents were asked about some specific sexual behaviors, including how frequently they had had oral and anal sex over the past 5 years. We analyzed the proportion of respondents who reported that they had oral and anal sex at least some of the time as a function of data collection mode and of the item context and format variables. Only mode had a significant impact on reports about oral and anal sex. (A large number of questions separated these items from the earlier sex partner questions; it was, therefore, not surprising that neither the context nor the format of the sex partner items had any effect on responses to these two questions.) A larger percentage of respondents indicated they had oral sex under ACASI (75.3 percent) than under either CAPI (51.5 percent) or CASI (64.6 percent) data collection (χ^2_2 = 12.04; $p < .01$). Similarly, a higher percentage of respondents indicated they sometimes had anal sex under ACASI (20.2 percent) than under the other modes (4.8 percent and 9.8 percent under CAPI and CASI); the data collection mode effect was again significant (χ^2_2 = 12.22; $p < .01$). The results were similar for both male and female respondents.

Reporting of illicit drug use. The mode of data collection also had some effect on the proportion of respondents who admitted using illicit drugs. Table 4 displays the proportion of respondents who report using marijuana or cocaine ever, within the past year, and during the past month. For both drugs and all three reporting periods, ACASI yielded the highest percentage of reported drug use; in general, CAPI yielded the lowest level of reporting with CASI between the other two modes. The mode difference was significant for lifetime marijuana use (χ^2_2 = 9.39; $p = .01$) and marginally significant for 1-year marijuana use (χ^2_2 = 4.15) and lifetime cocaine use (χ^2_2 = 4.45). The difference between levels of reporting under ACASI and CASI was not significant for any of the drug use variables.[6]

6. As is not surprising, the format and context of the sex partner items had no apparent effect on responses to the drug use questions.

Table 4. Proportion Reporting Illicit Drug Use by Drug and Time Period

	ACASI		CAPI		CASI		
	Percent	*n*	Percent	*n*	Percent	*n*	χ^2_2 (*p*)
Marijuana:							
Lifetime	66.3	89	44.8	105	58.0	112	9.39 (<.01)
Past year	26.1	92	16.2	105	16.1	112	4.15 (.13)
Past month	17.4	92	10.5	105	12.5	112	2.13 (n.s.)
Cocaine:							
Lifetime	20.4	93	11.3	106	11.4	114	4.45 (.11)
Past year	5.4	92	1.9	106	2.6	114	2.19 (n.s.)
Past month	3.3	92	1.9	106	1.8	114	<1 (n.s.)

NOTE.—See table 2 for definition of acronyms.

Discussion

The study provides further evidence that computer-assisted self-administration increases respondents' willingness to make potentially embarrassing admissions in surveys. Across a range of items involving sexual behavior and drug use, ACASI and CASI generally elicited higher levels of reporting than CAPI did. Table 5 presents a summary of the findings. The first column of the table displays the ratio between the percentage of respondents admitting to a given behavior (e.g., lifetime use of marijuana) under ACASI to the corresponding percentage under CAPI; the second column presents similar ratios comparing reports under CASI and CAPI. The table indicates, for example, that ACASI respondents were 1.46 times more likely to acknowledge that they had had oral sex during the previous 5 years than were CAPI respondents. The ratios in the bottom portion of the table compare the mean number of sex partners reported under the different modes of data collection. Thus, ACASI respondents reported 1.28 lifetime partners, on average, for every sex partner reported by CAPI respondents. As is apparent from the table, the increases in reporting produced by ACASI are even more striking than those produced by CASI. In fact, ACASI produced significantly higher levels of reporting for three of the 11 variables in table 5; there were significant differences between the two self-administered modes of data collection for the proportion of respondents reporting anal sex and for the average number of 5-year and lifetime sex partners reported.

Table 5. Ratios Comparing Levels of Reporting by Mode of Data Collection

	ACASI vs. CAPI	CASI vs. CAPI
% reporting anal sex	4.21	2.04
% reporting oral sex	1.46	1.25
% reporting marijuana use:		
Past month	1.66	1.19
Past year	1.61	.99
Lifetime	1.48	1.29
% reporting cocaine use:		
Past month	1.74	.95
Past year	2.84	1.37
Lifetime	1.81	1.01
Average number of sex partners (both sexes):		
Past year	1.06	.87
Past 5 years	1.31	.87
Lifetime	1.28	1.04
Average number of sex partners (males):		
Past year	.75	.54
Past 5 years	1.00	.70
Lifetime	1.01	.90
Average number of sex partners (females):		
Past year	1.64	1.48
Past 5 years	1.88	1.16
Lifetime	1.66	1.24

NOTE.—Sex partner data are untransformed counts. See table 1 for definition of acronyms.

The only consistent exception to the rule that questions administered directly by computer increased reporting relative to questions administered by interviewers involved the number of sex partners reported by men; men tended to report either fewer or no more sex partners under CASI and ACASI than under CAPI. This sex difference in the impact of the mode of data collection is apparent both in table 5, which is based on raw counts of sex partners, and figure 1, which plots log-transformed counts. Particularly under CASI the number of partners reported by men dropped sharply; depending on the time period, men reported 10–46 percent fewer sex partners under CASI than under CAPI (see table 5). As figure 2 suggests, the combination of a restric-

tive context and computer-assisted self-administration erased the discrepancy between the sexes in the number of sex partners reported.

The findings on the reported number of sex partners are consistent with the view that responses to questions about sexual behavior are strongly affected by self-presentation concerns. The three-way interaction between respondent sex, mode of data collection, and context was particularly striking in this regard. Men appear to report more sex partners and women fewer sex partners when they must report their answers to an interviewer, and this pattern was strongest among the respondents who received the restrictive context items. It seems plausible to assume that the restrictive items increased self-presentation concerns relative to the permissive items. After all, even the most liberal of the permissive items do not imply any obligation to have a large number of partners; they merely suggest that large numbers are acceptable. That respondents were more likely to use round numbers in reporting their lifetime sex partners in the restrictive context condition also suggests that these items heightened self-presentation concerns; a round answer may serve as a kind of hedge. Interviewer administration had one other effect: it sharply reduced the impact of the format of the sex partner questions on the answers. This finding also suggests that sex partner reports are produced through a somewhat different process when the answers must be reported to an interviewer.

One possible limitation on the findings presented here involves the relatively young, well-educated, and urban sample (see table 2 for statistics on the composition of the sample). It is certainly possible that CASI and ACASI will be less readily accepted by older respondents or other groups who have limited prior experience with laptop computers (Couper and Rowe 1995).

The results raise more general questions about the effects of the mode of data collection on the answers that are obtained. The modes compared here differ most obviously in two major respects. Neither CASI nor ACASI requires respondents to report the answers to an interviewer, whereas CAPI does; and both ACASI and CAPI use auditory presentation of the questions, whereas CASI uses only visual presentation. We believe that the two self-administered modes foster a greater sense of privacy of the collection process and that the two auditory modes make it easier for respondents to understand the questions and to complete the questionnaires. It is also possible that, by letting the respondent interact directly with the computer, ACASI and CASI help convince respondents of the legitimacy and scientific value of the study. Figure 4 depicts an overall model of the effects of mode of data collection, showing the links among the features of the different modes, the psychological variables affected by these features, and their consequences for data quality. Although our study has focused

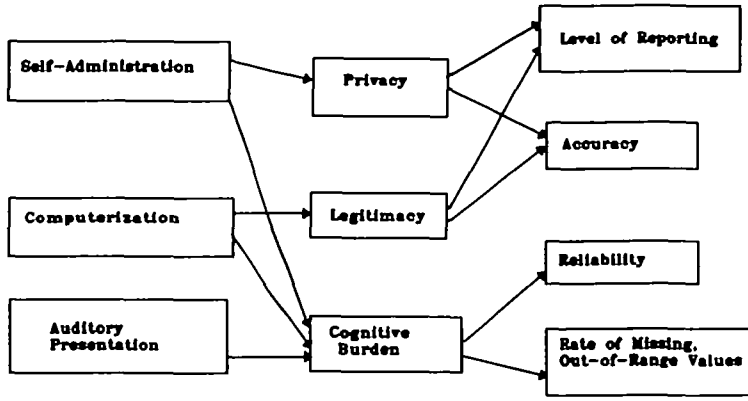

Figure 4. Overall model of mode effects

on computer-assisted modes of data collection and their effects on levels of reporting, we believe it is useful to try to relate the findings to a more comprehensive framework. According to the model, three key variables mediate the major effects of data collection mode on data quality—the degree of privacy permitted, the level of cognitive burden imposed, and the sense of legitimacy fostered. These psychological variables are affected by the method of data collection and in turn have a causal impact on one or more characteristics of the data obtained. Clearly, much further work is needed to test the model rigorously. In the meantime, however, it provides a handy summary of much of what is known thus far about how the method of data collection affects the data that are collected.

References

Aquilino, W. 1994. "Interview Mode Effects in Surveys of Drug and Alcohol Use." *Public Opinion Quarterly* 58:210–40.

Aquilino, W., and L. LoSciuto. 1990. "Effect of Interview Mode on Self-Reported Drug Use." *Public Opinion Quarterly* 54:362–95.

Baker, R. P., and N. M. Bradburn. 1991. "CAPI: Impacts on Data Quality and Survey Costs." Paper presented at the 1991 Public Health Conference on Records and Statistics, Washington, DC.

Baker, R. P., N. M. Bradburn, and R. Johnson. In press. "Computer-Assisted Personal Interviewing: An Experimental Evaluation of Data Quality and Survey Costs." *Journal of Official Statistics*.

Bishop, G., H. Hippler, N. Schwarz, and F. Strack. 1988. "A Comparison of Response Effects in Self-Administered and Telephone Surveys." In *Telephone Survey Methodology*, ed. R. Groves, P. Biemer, L. Lyberg, J. Massey, W. Nicholls, and J. Waksberg, pp. 321–40. New York: Wiley.

Bradburn, N. M. 1983. "Response Effects." In *Handbook of Survey Research*, ed. P. Rossi, J. Wright, and A. Anderson, pp. 289–328. New York: Academic Press.

Bradburn, N. M., M. R. Frankel, E. Hunt, J. Ingels, A. Schoua-Glusberg, M.

Wojcik, and M. R. Pergamit. 1991. "A Comparison of Computer-Assisted Personal Interviews with Personal Interviews in the National Longitudinal Survey of Labor Market Behavior—Youth Cohort." In *Proceedings of the U.S. Bureau of the Census Annual Research Conference*. Washington, DC: U.S. Bureau of the Census.

Bradburn, N., S. Sudman, and associates. 1979. *Improving Interview Method and Questionnaire Design: Response Effects to Threatening Questions in Survey Research*. San Francisco: Jossey-Bass.

Burton, S., and E. Blair. 1991. "Task Conditions, Response Formulation Processes, and Response Accuracy for Behavioral Frequency Questions in Surveys." *Public Opinion Quarterly* 55:50–79.

Card, W. I., M. Nicholson, G. P. Crean, G. E. Watkinson, C. R. Evans, and D. Russell. 1974. "A Comparison of Doctor and Computer Interrogation of Patients." *International Journal of Biomedical Computing* 5:175–87.

Catania, J., D. Gibson, D. Chitwood, and T. Coates. 1990. "Methodological Problems in AIDS Behavioral Research: Influences on Measurement Error and Participation Bias in Studies of Sexual Behavior." *Psychological Bulletin* 108:339–62.

Couper, M. P., and B. Rowe. 1995. "Evaluation of a Computer-Assisted Self-Interview (CASI) Component in a CAPI Survey." Paper presented at the annual meeting of the American Association for Public Opinion Research, Fort Lauderdale, FL.

Cynamon, M., and D. Camburn. 1992. "Employing a New Technique to Ask Questions on Sensitive Topics." Paper presented at the annual meeting of the National Field Directors Conference, St. Petersburg, FL.

Erdman, H., M. H. Klein, and J. H. Greist. 1983. "The Reliability of a Computer Interview for Drug Use/Abuse Information." *Behavior Research Methods and Instrumentation* 15:66–68.

Hochstim, J. 1967. "A Critical Comparison of Three Strategies of Collecting Data from Households." *Journal of the American Statistical Association* 62:976–89.

Jobe, J. B., W. F. Pratt, R. Tourangeau, A. Baldwin, and K. Rasinski. In press. "Effects of Interview Mode on Sensitive Questions in a Fertility Survey." In *Survey Measurement and Process Quality*, ed. L. Lyberg et al. New York: Wiley.

Johnston, J., and C. Walton 1992. *MacInterview: A Computer-Administered Self-Interview Program with Audio Capabilities: Phase I Final Report*. Ann Arbor: University of Michigan, Institute for Social Research.

Jones, E., and J. Forrest. 1992. "Underreporting of Abortions in Surveys of U.S. Women: 1976 to 1988." *Demography* 29:113–26.

Krosnick, J., and D. Alwin. 1987. "An Evaluation of a Cognitive Theory of Response Order Effects in Survey Measurement." *Public Opinion Quarterly* 52:526–38.

Locke, S. E., H. B. Kowaloff, R. G. Hoff, C. Safran, M. A. Popovsky, D. J. Cotton, D. M. Finkelstein, P. L. Page, and W. V. Slack. 1992. "Computer-Based Interview for Screening Blood-Donors for Risk of HIV Transmission." *Journal of the American Medical Association* 29:1301–5.

London, K., and L. Williams. 1990. "A Comparison of Abortion Underreporting in an In-Person Interview and Self-Administered Questionnaire." Paper presented at the annual meeting of the Population Association of America, Toronto.

Lucas, R. W., P. J. Mullen, C. B. X. Luna, and D. C. McInroy. 1977. "Psychiatrist and Computer Interrogators of Patients with Alcohol-Related Illnesses: A Comparison." *British Journal of Psychiatry* 131:160–67.

Mosher, W. D., and A. P. Duffer, Jr. 1994. "Experiments in Survey Data Collection: The National Survey of Family Growth Pretest." Paper presented at the meeting of the Population Association of America, Miami.

Mott, F. 1985. "Evaluation of Fertility Data and Preliminary Analytic Results from the 1983 Survey of the National Longitudinal Surveys of Work Experience of Youth." A report to the National Institute of Child Health and Human Development by the Center for Human Resources Research. Columbus, OH: Center for Human Resources Research.

O'Reilly, J., M. Hubbard, J. Lessler, P. Biemer, and C. Turner. 1994. "Audio and

Video Computer Assisted Self-Interviewing: Preliminary Tests of New Technology for Data Collection." *Journal of Official Statistics* 10:197–214.

Rieger, S., D. Judkins, and S. Sperry. 1991. *National Survey of Family Growth: Cycle IV CATI Phase: Final Report*. Hyattsville, MD: National Center for Health Statistics.

Robinson, R., and R. West. 1992. "A Comparison of Computer and Questionnaire Methods of History-Taking in a Genito-Urinary Clinic." *Psychology and Health* 6: 77–84.

Schober, S., M. F. Caces, M. Pergamit, and L. Branden. 1992. "Effects of Mode of Administration on Reporting of Drug Use in the National Longitudinal Survey." In Turner, Lessler, and Gfroerer 1992, pp. 267–76.

Schwarz, N., and H. Hippler. 1987. "What Response Scales May Tell Your Respondents: Informative Functions of Response Alternatives." In *Social Information Processing and Survey Methodology*, ed. H. Hippler, N. Schwarz, and S. Sudman. New York: Springer-Verlag.

Shah, B., B. Barnwell, N. Hunt, and L. LaVange. 1993. *SUDAAN User's Manual, Release 6.34*. Research Triangle Park, NC: Research Triangle Institute.

Smith, T. 1992a. "Discrepancies between Men and Women in Reporting Number of Sexual Partners: A Summary from Four Countries." *Social Biology* 39:203–11.

———. 1992b. "Thoughts on the Nature of Context Effects." In *Context Effects in Social and Psychological Research*, ed. N. Schwarz and S. Sudman. New York: Springer-Verlag.

Sudman, S., N. Bradburn, E. Blair, and C. Stocking. 1977. "Modest Expectations: The Effects of Interviewers' Prior Expectations on Responses." *Sociological Methods and Research* 6:177–82.

Tourangeau, R., and K. Rasinski. 1988. "Cognitive Processes Underlying Context Effects in Attitude Measurement." *Psychological Bulletin* 103:299–314.

Tourangeau, R., K. Rasinski, J. Jobe, T. Smith, and W. Pratt. 1995. *Sources of Error in a Survey on Sexual Behavior*. Washington, DC: National Opinion Research Center.

Turner, C. F., J. T. Lessler, and J. W. Devore. 1992. "Effects of Mode of Administration and Wording on Reporting of Drug Use." In Turner, Lessler, and Gfroerer 1992, pp. 177–220.

Turner, C. F., J. T. Lessler, and J. C. Gfroerer, eds. 1992. *Survey Measurement of Drug Use: Methodological Studies*. Rockville, MD: National Institute on Drug Abuse.

Waterton, J., and J. Duffy. 1984. "A Comparison of Computer Interviewing Techniques and Traditional Methods for the Collection of Self-Report Alcohol Consumption Data in a Field Survey." *International Statistical Review* 52:173–82.