Improving epidemiological surveys of sexual behaviour conducted by telephone

Charles F Turner,[1,2]* Alia Al-Tayyib,[2,3] Susan M Rogers,[2] Elizabeth Eggleston,[2] Maria A Villarroel,[2,4] Anthony M Roman,[5] James R Chromy[6] and Phillip C Cooley[7]

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Background	This study assesses the impact of Telephone Audio Computer-Assisted Self-Interviewing (T-ACASI) on the reporting of sensitive (mainly heterosexual) behaviours.
Methods	A randomized experiment was embedded in a telephone survey that drew probability samples of the populations of the USA ($N = 1543$) and Baltimore city ($N = 744$). Respondents were randomly assigned to have questions asked either by a T-ACASI computer or by a human telephone interviewer.
Results	Compared with interviewer-administered telephone surveys, T-ACASI obtained more frequent reporting of a range of mainly heterosexual behaviours that were presumed to be sensitive, including recency of anal sex [adjusted odds ratio (A-OR) = 2.00, $P < 0.001$), sex during menstrual period (A-OR = 1.49, $P < 0.001$), giving oral sex (A-OR = 1.40, $P = 0.001$) and receiving oral sex (A-OR = 1.36, $P = 0.002$), and sexual difficulties for the respondent (A-OR = 1.45, $P = 0.034$) and their main sex partner (A-OR = 1.48, $P = 0.0$). T-ACASI also obtained less frequent reporting that respondent had a 'main sex partner' (A-OR = 0.56, $P = 0.011$) and discussed contraception prior to first sex with that sex partner (A-OR = 0.82, $P = 0.094$). For both males and females, T-ACASI obtained more frequent reports of first vaginal sex occurring at early ages (before ages 12 through 15). 'For males only', T-ACASI also elicited more frequent reports that first vaginal sex had 'not' occurred at later ages (i.e. by ages 20 through 24).
Conclusion	T-ACASI increases the likelihood that survey respondents will report sensitive heterosexual behaviours.
Keywords	Population surveys, methodology, sexual behaviours, STD risk behaviours, T-ACASI, computerized surveys, sexually transmitted infections

[1] Queens College and the Graduate Center, City University of New York, Flushing, NY, USA.
[2] Program in Health and Behavior Measurement, Research Triangle Institute, Washington, DC, USA.
[3] Denver Public Health, Denver, CO, USA.
[4] Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA.
[5] Center for Survey Research, University of Massachusetts at Boston, Boston, MA, USA.
[6] Statistics and Epidemiology Division, Research Triangle Institute, Research Triangle Park, NC, USA.
[7] Research Computing Division, Research Triangle Institute, Research Triangle Park, NC, USA.
* Corresponding author. Queens College, City University of New York, Flushing, NY 11367, USA.
  E-mail: cfturner@popepi.org

Introduction

Because of the substantial costs associated with sending field interviewers to tens of thousands of households, the earliest comprehensive AIDS surveys in developed nations used 'telephone' survey techniques.[1–3] A growing body of evidence suggests, however, that telephone surveys are subject to non-trivial reporting biases because they require respondents to disclose sensitive, stigmatized or illicit behaviours to human interviewers.[4–6]

In 1996, we reported the first test of Telephone Audio Computer-Assisted Self-Interviewing (T-ACASI).[7] This technology asks questions by playing digitized voice files, and respondents provide answers using the keypad of their touchtone telephones. We found that T-ACASI interviews were feasible, well tolerated by respondents and they could reduce underreporting of sensitive or stigmatized sexual behaviours. This technology was subsequently tested in a randomized experiment embedded in the 1996–98 Urban Men's Health Survey (UMHS); it found that representative samples of men who have sex with men were more likely to report use of a range of illegal drugs, concern about their current drug use and exchange of money or drugs for sex when interviewed by T-ACASI rather than human telephone interviewers.[8] Subsequent work by our group and collaborators has found that T-ACASI increased reporting of sensitive and stigmatized behaviours including illicit (but not licit) drug use, same-gender sexual behaviours, STD histories and 'unpopular attitudes' in probability samples of the US population and teen smoking in a regional sample.[9–13]

Work by other researchers has yielded generally supportive evidence.[14–15] Of particular note is the independent development of T-ACASI technology by Lau and collaborators,[16] who conducted a randomized experiment in 2001 comparing T-ACASI with traditional interviewer-administered telephone interviewing in a survey of Hong Kong adults. Lau et al. reported that for the 13 questions asked of male respondents, T-ACASI elicited 'more frequent' reporting of sex in the last 6 months with female sex workers and non-regular female sex partners, lifetime experience of male–male sex, and 'less frequent' reporting of having a regular sex partner. Female respondents were asked 11 questions, and those interviewed in the T-ACASI mode were 'more likely' to report some risk or a high risk of contracting HIV from their husband and having a one-night stand or HIV test in the past 6 months; they were 'less likely' to report having a husband, having intercourse with their husband in the past 6 months and being able to insist that their husband use condoms if they suspected that he had sex with female sex workers.

The U.S.A. National STD and Behavior Measurement Experiment (NSBME) was designed to assess the impact of T-ACASI on reporting of a wide range of sensitive characteristics and behaviours in a probability sample of US adults aged 18–45. This article reports results for the 29 NSBME questions that asked respondents about their (mainly) heterosexual experiences, practices and problems.

Methods

The protocol for this research was approved and supervised by Institutional Review Boards for the Protection of Human Subjects at the Research Triangle Institute (RTI) and the University of Massachusetts at Boston.

Sample design and execution

The NSBME was embedded in a telephone survey of a probability sample of women and men aged 18–45 years residing in US households with working landline telephones. The survey was conducted between September 1999 and April 2000. Two sample strata were recruited for this survey measurement experiment: (i) a sample of the telephone-accessible US household population aged 18–45 (national stratum) and (ii) a parallel sample of the telephone-accessible population of the city of Baltimore, MD (Baltimore stratum). [In 2000, telephone service was available in 96.7% of US household and 93.0% of Baltimore households with a householder aged 18–45 (Tabulated from: 2000 Census Summary File 3, available at http://factfinder.census.gov).]

For the national stratum, 14 250 telephone numbers were generated, and 12 322 telephone numbers (86.5%) were successfully screened for eligibility. Of these screened telephone numbers, 2183 were found to be residential numbers with one or more eligible English-speaking respondents aged 18–45. One eligible household member of these households was randomly selected for participation in the survey (without substitution). Of the 2183 target respondents, 1452 in the national strata completed interviews (66.5%), and 91 respondents (4.2%) completed partial interviews that included at least one substantive questionnaire section. (Interviews were considered 'complete' if the respondent completed the 101st of 123 questions in the male version of the questionnaire and the 103rd of 125 questions in the female version, excluding closeout questions on reactions to the survey.) A maximum of 91 calls per household were made to screen households and complete an interview in the national stratum.

For the Baltimore stratum, 7498 telephone numbers were generated and 6326 (84.4%) were successfully screened for eligibility. Screening identified 1072 households with an eligible respondent, and 697 of these eligible respondents completed interviews (65.0%). An additional 47 respondents (4.4%) completed partial interviews. A maximum of 82 calls per household were made to screen households and complete an interview in the Baltimore stratum.

Using a professionally endorsed methodology,[17] we calculated the survey response rates for the NSBME to be 62% for the telephone interviewer-administered questioning (T-IAQ) condition and 53% for the T-ACASI condition in the national stratum. In the Baltimore stratum, these response rates were 56% for the T-IAQ condition and 50% for the T-ACASI condition (see ref.[18], pp. 23–29). These calculations take account of the joint effects of failures to: (i) reach households on the telephone, (ii) screen the households to identify all eligible adults and (iii) interview the randomly selected eligible adult. Additional details of NSBME survey sample design and execution have been published elsewhere.[10,18,19]

Interview modes
Telephone numbers were randomly assigned to the T-IAQ or T-ACASI conditions prior to their release to the telephone survey unit. Following screening and recruitment into the study, telephone interviewers at the Center for Survey Research (University of Massachusetts, Boston) conducted the survey either by asking the respondent questions and recording their answers (T-IAQ condition) or by transferring the respondent to a T-ACASI system developed by Cooley et al.[20,21]

Survey measurements
The NSBME included 125 questions of which 29 focused on sexual experience, sexual practices, condom use and problems with sexual satisfaction and sexual arousal. Most NSBME questions were adapted from past large-scale surveys of sexual behaviour in the United States and the UK. This was done to ensure the generalizability of NSBME results to contemporary research efforts. The complete wordings and sources of the survey questions used in this article can be found Appendix A1 (available as Supplementary Data at *IJE* online).

Heterosexual focus
To the extent possible given the survey questions, this article focuses on heterosexual behaviour. (We have previously reported NSBME results on same-gender sexual behaviors.[10]) Many questions reported in this article refer 'explicitly' to heterosexual experiences. Other questions—such as number of sex partners—do not explicitly restrict reporting to heterosexual experiences. To (imperfectly) focus our analyses, we exclude respondents who reported never having heterosexual vaginal sex and who also report that they were mostly or exclusively attracted to same-gender partners.

Statistical analysis
Our analyses of the NSBME are intended to determine whether T-ACASI increases the willingness of respondents to report sensitive, stigmatized or embarrassing behaviours. To address this research question, we combine the national and Baltimore sample strata. The combined sample strata are treated as a population that has been randomly allocated to one of two experimental conditions: T-ACASI or T-IAQ interview mode. Data in these analyses are unweighted, and our statistical analyses assess the likelihood that observed fluctuations in survey responses across the two interview modes arose by chance from the random allocation of respondents to one of the two experimental groups. (All estimates reported in this article are sample not population prevalences.)

The survey measurements reported in this article are either binary, ordinal or metric. Tests of the equivalence of the response distributions obtained in the T-ACASI and T-IAQ conditions were performed by fitting logit models to predict the binary measurements, ordered logit models to predict the ordinal measurements and multiple linear regression to predict the metric measurements. Our analyses present both raw coefficients representing the impact of T-ACASI (i.e. the experimental manipulation: T-ACASI vs T-IAQ) and adjusted coefficients that represent the impact of T-ACASI after incorporating statistical controls for a wide range of sociodemographic variables. Our final analyses tested for variation in the impact of T-ACASI on reporting by male and female respondents. For each measurement, we estimated (i) the impact of T-ACASI and female gender on response distributions and (ii) the impact of T-ACASI, female gender and the interaction of female-by-T-ACASI on response distributions. We report results for these analyses when the *P*-value of the coefficient for the interaction term was ⩽ 0.10.

All statistical analyses were carried out using Stata SE, versions 8 and 10.[22]

Results
Sample equivalence
Previously published analyses of the NSBME tested the equivalence of T-IAQ and T-ACASI samples by gender, age, marital status, education, race/ethnicity, region, urbanization and sample strata. No comparison produced evidence of non-equivalence with a *P*-value ⩽ 0.286.[19]

Reports of sexual experience
For the nine binary measurements shown in the top panel of Table 1, the odds ratios (ORs) indicate that T-ACASI obtained increased reporting of the presumed 'sensitive' answer, i.e. never having sex of any type or heterosexual vaginal sex, not having a main sex partner, and having one-night stands, coerced sex, paid sex, another sex partner while married or in a 'committed relationship' (extra-relationship sex). These results are statistically reliable for reports of never having sex of

Table 1 Sexual experience reported by subjects interviewed by T-ACASI or by T-IAQ

Measurement	T-ACASI (%)	T-IAQ (%)	ORs Crude	P	ORs Adjusted[a]	P
Binary variables						
Never 'had sex with anyone'	5.8	2.9	2.05	0.001	1.76	0.048
Never had heterosexual vaginal sex	3.4	2.9	1.17	>0.500	1.38	0.416
Currently have a main sex partner	89.0	93.8	0.53	<0.001	0.56	0.011
Ever had a one-night stand	45.4	37.3	1.40	<0.001	1.35	0.011
Had extramarital (or extra-relationship) sex partners during last marriage or committed relationship[b]	13.4	8.8	1.61	0.001	1.61	0.012
Ever forced to have sex	21.9	17.1	1.36	0.006	1.54	0.005
Ever forced someone to have sex	1.7	1.3	1.25	>0.500	1.83	0.253
Ever had sex with a prostitute[c]	7.2	5.9	1.23	0.251	1.24	0.412
Did someone ever pay you for sex	4.2	3.7	1.14	>0.500	1.34[d]	0.412
(Base N)	854–954	1036–1178				

Measurement	T-ACASI (%)	T-IAQ (%)	Regression coefficient Crude	P	Regression coefficient Adjusted[a]	P
Metric variables						
Number of lifetime sex partners (if not zero)[e]						
0	na	na	0.28	>0.50	1.06	0.27
1	14.1	14.4				
2–3	23.1	24.8				
4–5	20.1	19.2				
6–10	19.1	18.9				
11–20	12.4	11.4				
21–50	7.8	7.8				
51+	3.6	3.6				
(Base N)	897	1121				
Number of sex partners in the past year[e]						
0	9.8	8.1	−0.01	>0.50	0.10	0.244
1	68.4	76.5				
2	11.7	8.6				
3–4	7.1	3.6				
5+	3.0	3.2				
(Base N)	898	1136				
Number of sex partners in the past month[e,f]						
0	16.2	15.5	−0.01	>0.50	−0.01	>0.500
1	77.9	80.9				
2	4.8	2.3				
3+	1.1	1.3				
(Base N)	810	1041				
Number of new sex partners in the past year[e]						
0	59.9	76.7	0.34	<0.001	0.43	<0.001
1	24.2	14.2				
2	8.9	4.6				

(Continued)

Table 1 Continued

Measurement	T-ACASI (%)	T-IAQ (%)	Regression coefficient			
			Crude	P	Adjusted[a]	P
3–4	2.9	2.6				
5+	4.1	1.9				
(Base N)	805	1029				
Number of new sex partners in the past 5 years (if zero in the past year)[e]						
0	60.2	61.3	0.21	0.04	0.31	0.011
1	15.4	16.9				
2	9.1	11.1				
3–4	8.6	6.4				
5+	6.8	4.3				
(Base N)	573	876				
Frequency of heterosexual vaginal sex in the past 7 days[e]						
0	48.7	45.2	−0.02	>0.500	0.10	0.464
1	18.5	21.9				
2	14.9	13.1				
3–5	13.9	16.4				
6+	4.0	3.4				
(Base N)	827	1051				

Unweighted data from 2000 NSBME: national and Baltimore sample strata combined. Sample excludes respondents who report never having had heterosexual vaginal sex and who also report sexual attraction only or mostly to persons of the same gender.
[a]Adjusted odds ratios and regression coefficients were calculated by adding independent variables to control for gender, race (Black vs non-Black), Hispanic ethnicity, age in years, education in years, marital status (married or cohabiting vs not), region of the country (six regions), urbanicity (four categories: 21 largest metropolitan areas; jurisdictions with 85 000 or more households; 20 000–84 999 households, and less than 20 000 households), and sample strata (National vs Baltimore). The adjustment for sample strata was dropped during model estimation due to multicollinearity with the other adjustment variables.
[b]Excludes persons who were never married or involved in committed relationship.
[c]Men were much more likely than women to report paying for sex (15.4 vs 0.3%), but the T-ACASI effect for men was not statistically reliable (16.8% in T-ACASI vs 14.3% in T-IAQ; $P = 0.31$).
[d]Adjusted odds ratios and regression coefficients were estimated for pooled sample of male and female respondents. This estimated effect evidenced a statistically borderline interaction ($P = 0.06$) with gender, i.e. estimates for males and females were not equivalent. See the text for discussion.
[e]To conserve space, this table collapses categories for reporting of many partners (e.g. 50–99 and 100+ lifetime partners) since they were infrequently reported. Regression analysis used all response categories. For variables that were coded as ranges, e.g. '6–10' partners, respondents were assigned the midpoint of the interval. For final categories such as 100+ partners, respondents were assigned value of 120% of the highest value of base category, e.g. 100+ was coded to 120 partners for regression analysis.
[f]Subjects who reported no partners in the past year were not asked this question.

any type [adjusted OR (A-OR) = 1.76, $P = 0.048$], *not* having a 'main sex partner' (A-OR = 0.56, $P = 0.011$), having one-night stands (A-OR = 1.35, $P = 0.011$), extra-relationship sex (A-OR = 1.61, $P = 0.012$) and being forced to have sex (A-OR = 1.54, $P = 0.005$). For the six metric variables shown in the bottom panel of Table 1, T-ACASI had a statistically noteworthy impact only on reporting of 'new' sex partners in the past month (adjusted coefficient = 0.43 partners, $P < 0.001$) and past 5 years (adjusted coefficient = 0.31 partners, $P = 0.011$). Tests for variation in the T-ACASI mode effect between men and women yielded only one statistically borderline interaction from 15 tests, which is roughly consistent with expectations for the results of

15 independent tests of the null hypothesis (with $\alpha = 0.05$) when no true effects exist.

Age at sexual debut

Figure 1 plots the odds ratio (T-ACASI vs T-IAQ) that male and female respondents would report heterosexual intercourse before specific ages between 12 and 24 years, and it displays one of our major findings. For both men and women, T-ACASI respondents were significantly more likely to report that their heterosexual debut occurred before the ages of 12, 13, 14 and 15 years. For women, the odds ratios range from 2.74 ($P = 0.014$) for reporting sexual debut
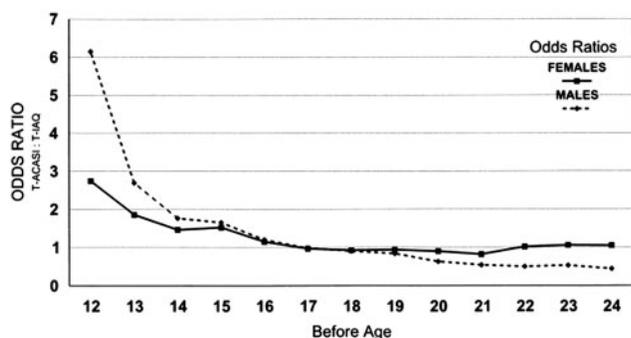
Figure 1 Odds ratio (T-ACASI: T-IAQ) for reporting of first heterosexual vaginal sex before specific ages by gender

before age 12 to 1.52 ($P = 0.013$) for reporting sexual debut before age 15. For men these odds ratios range from 6.15 ($P < 0.001$) for debut before age 12 and 1.65 ($P = 0.004$) for sexual debut before age 15. For women, the range of odds ratios for reporting sexual debut before ages between 16 and 24 are statistically indistinguishable from 1.0 ($P = 0.24$–0.91). For men, however, T-ACASI also elicits significantly increased reporting of 'not' having had heterosexual vaginal sex by ages 20 through 24 (ORs = 0.44–0.63; $P = 0.016$–0.054). (To conserve journal space, additional details of these results are presented in Appendix A2, available as Supplementary Data at *IJE* online.)

Sexual practices

Table 2 presents results for 10 questions asking about respondents' sexual practices, condom use and sexual communication. T-ACASI elicited more frequent reporting of recent active and passive heterosexual oral sex, heterosexual anal sex and heterosexual vaginal sex during a woman's menstrual period (A-ORs = 1.36–2.00; $P = 0.002$ to <0.001). T-ACASI also decreased reporting of consistent condom use in the past month (OR = 0.80, $P = 0.012$), but the effect did not persist when the ordered logit model was expanded to include our sociodemographic controls (A-OR = 0.87, $P = 0.259$). We note, however, that respondents were more likely to tell a human interviewer that they used condoms 'every time' they had sex in the past month (8.4% in T-ACASI condition vs 16.4% in T-IAQ, A-OR = 0.44, $P < 0.001$). T-ACASI also elicited fewer reports that respondents had talked with their most recent sex partner about contraception and more reports that they had used withdrawal as a contraceptive method, although these results were of borderline statistical significance (A-ORs = 0.82 and 1.23, $P = 0.094$ and 0.076, respectively). Finally, we note that T-ACASI elicited reports of more frequent sharing of information about numbers of past sex partners with new sex partners acquired during the preceding year (A-OR = 1.82 for asking for information from new partner, $P = 0.007$; and A-OR = 1.57 for providing information to a new partner, $P = 0.031$).

There were also noteworthy variations in the impact of T-ACASI on male and female reporting of recency of giving oral sex to heterosexual partners and exchanging information on sexual partners (data not shown). T-ACASI elicited more reports from women of recently giving oral sex to a male partner (A-OR = 1.55, $P < 0.001$), while the parallel T-ACASI effect for males is smaller and statistically unreliable (A-OR = 1.16, $P = 0.24$). This result is seen clearly in the percentage of men and women reporting that they had 'never' given oral sex to a heterosexual partner. For women, T-ACASI decreased the reporting of 'never' giving oral sex from 27.2 to 14.9%, whereas for men the reduction was more modest, from 16.8 to 12.0%. T-ACASI also did not have a noteworthy impact on women's reports of sharing information on numbers of past partners with a new sex partner (OR = 0.89, $P > 0.50$ for asking; OR = 1.02, $P > 0.50$ for telling). T-ACASI, however, increased the odds that males would report more frequent sharing of this information with new sex partners (OR = 1.98, $P = 0.002$ for asking; OR = 1.76, $P = 0.008$ for telling). T-ACASI increased the percentage of men reporting 'always asking' new partners for this information from 14.1 to 30.0% and the percentage reporting 'always providing' this information from 17.2 to 28.3%.

Sexual problems

Table 3 describes the impact of T-ACASI on reporting of respondent's and partner's sexual problems and the respondent's ease or difficulty becoming sexually aroused when 'hav[ing] any kind of sex'. T-ACASI significantly increased the odds that respondents would report sexual problems for their partners (A-OR = 1.48, $P = 0.047$) and for themselves (A-OR = 1.45, $P = 0.034$). T-ACASI also shifted responses on ease of sexual arousal towards 'very easy' and away from 'very difficult' (A-OR = 0.59, $P < 0.001$). Thus, the percentage of respondents reporting that it is very easy for them to become sexually aroused increases from 39.6% when questioning is done by a human interviewer to 54.3% when questioning is done by a T-ACASI computer. Tests for gender-by-T-ACASI interaction indicate, however, that the impact of T-ACASI is stronger for males (A-OR = 0.38, $P < 0.001$) than for females (A-OR = 0.79, $P = 0.046$; with $P < 0.001$ for test of the interaction). This is seen most clearly in reporting that sexual arousal is 'very easy'. The percentage of males giving this answer increases from 53.6% in the T-IAQ condition to 76.2% in T-ACASI, whereas for females the parallel increase is from 29.8 to 38.5%.

Discussion

A growing number of studies report that computer-assisted self-interviewing (CASI) technologies obtain

Table 2 Heterosexual practices reported by subjects interviewed by T-ACASI and the T-IAQ

Measurement	T-ACASI (%)	T-IAQ (%)	ORs Crude	P	Adjusted[a]	P
Recency: gave oral sex						
Never	13.7	22.9	1.37	<0.001	1.40[b]	0.001
>5 years	5.1	5.4				
1–5 years	11.9	9.3				
6–12 months	8.4	7.0				
1–6 months	17.6	18.3				
8–30 days	18.8	16.9				
7 days	24.5	20.2				
(Base N)	(898)	(1092)				
Recency: received oral sex						
Never	8.9	15.2	1.31	0.001	1.36	0.002
>5 years	5.1	5.9				
1–5 years	11.0	11.5				
6–12 months	8.3	7.6				
1–6 months	21.1	19.2				
8–30 days	20.6	18.3				
7 days	25.0	22.3				
(Base N)	(900)	(1092)				
Recency: anal sex						
Never	63.3	74.6	1.7	<0.001	2.00	<0.001
>5 years	10.6	7.9				
1–5 years	9.3	7.6				
6–12 months	5.4	3.2				
1–6 months	5.3	3.2				
8–30 days	3.6	2.3				
7 days	2.4	1.3				
(Base N)	(900)	(1120)				
Recency: sex during menstrual period						
Past 30 days	38.9	47.1	1.43	<0.001	1.49	<0.001
1–3 months ago	23.7	23.7				
4–6 months ago	7.1	4.8				
7–12 months ago	6.5	5.7				
>12 months ago	10.1	10.4				
Never	13.8	8.3				
(Base N)	(893)	(1106)				
Condom use in the past month						
Never	58.0	56.1	0.80	0.012	0.87	0.259
Rarely	8.9	6.3				
Some of the times	9.5	6.0				
Half of the time	2.1	3.7				
Most of the times	8.8	5.1				
Almost every time	4.3	6.5				
Every time	8.4	16.4				
(Base N)	(810)	(1042)				

(continued)

Table 2 Continued

Measurement	T-ACASI (%)	T-IAQ (%)	ORs			
			Crude	P	Adjusted[a]	P
Ever a time you thought you should use a condom but did not, % Yes	35.2	38.7	0.86	0.100	0.88	0.273
(Base N)	(896)	(1134)				
Before you had intercourse with your current partner did you and partner talk about contraception? % Yes	56.1	60.0	0.85	0.073	0.82	0.094
(Base N)	(897)	(1126)				
Ever practice withdrawal as method of contraception? % Yes	59.9	58.9	1.04	>0.500	1.23	0.076
(Base N)	(890)	(1111)				
How often in the past year have you asked a new sex partner about the number of past sex partners he or she has had?						
Never	32.5	34.7	1.37	0.041	1.82[b]	0.007
Sometimes	16.4	28.9				
Almost always	15.5	8.4				
Always	35.6	28.0				
(Base N)	(323)	(239)				
How often in the past year have you told a new sex partner about the number of past sex partners you have had?						
Never	34.3	36.8	1.36	0.042	1.57[b]	0.031
Sometimes	16.9	27.2				
Almost always	13.9	9.6				
Always	34.9	26.4				
(Base N)	(367)	(239)				

Unweighted data from 2000 NSBME: National and Baltimore strata combined. Sample excludes respondents who report never having had heterosexual vaginal sex and who also report sexual attraction only or mostly to persons of the same gender.
[a]Adjusted odds ratios were calculated by adding independent variables to control for gender, race (Black vs non-Black), Hispanic ethnicity, age in years, education in years, marital status (married or cohabiting vs not), region of the country (six regions), urbanicity (four categories: 21 largest metropolitan areas; jurisdictions with 85 000 or more households; 20 000–84 999 households, and less than 20 000 households), and sample strata (National vs Baltimore). The adjustment for sample strata was dropped during model estimation due to multicollinearity with the other adjustment variables.
[b]Adjusted odds ratios were estimated for pooled sample of male and female respondents. These estimated effects evidenced a statistically significant or borderline interaction with gender, i.e. estimates for males and females were not equivalent. See text for discussion.

increased reporting of sensitive and stigmatized behaviours and, more recently, attitudes and opinions. The present study provides a substantial demonstration of the superiority of T-ACASI to traditional telephone interviewing in obtaining reports of sensitive behaviours. For 18 of 29 measurements of (mainly) heterosexual behaviours, T-ACASI obtained statistically reliable or borderline differences in the response distributions from the measurements made by human telephone interviewers. In the vast majority of cases, T-ACASI elicited more frequent reporting of the behaviours presumed to be more sensitive. So, for example, the percentage of respondents reporting ever having heterosexual anal sex increased from 25.5%

when questioning was done by human telephone interviewers to 36.7% when questioning was done by a T-ACASI computer (OR = 1.70, $P < 0.001$). T-ACASI also elicited: (i) more frequent reporting of recent active and passive heterosexual oral sex, and of heterosexual vaginal sex during a woman's menstrual period; (ii) reporting of a larger number of 'new' sexual partners in the past month and past year; (iii) reporting an earlier age of sexual debut; (iv) more frequent reporting of one-night stands, forced sex, sexual problems of respondents and their partners, and additional sex partners while married or in a 'committed relationship'; (v) more frequent reporting of a lack of sexual experience of any kind

Table 3 Heterosexual problems reported by subjects interviewed by T-ACASI and the T-IAQ

Measurement	T-ACASI (%)	T-IAQ (%)	ORs			
			Crude	P	Adjusted[a]	P
Physically or emotionally difficult for partner to have satisfying sex?[b]	10.7	8.5	1.29	0.097	1.48	0.047
(Base N)	(869)	(1062)				
Physically or emotionally difficult for you to have satisfying sex?	13.2	9.7	1.42	0.011	1.45	0.034
(Base N)	(952)	(1136)				
Easy or difficult for you to get sexually aroused?						
Very easy	54.3	39.6	0.62	<0.001	0.59[c]	<0.001
Somewhat easy	35.8	52.0				
Somewhat difficult	8.3	6.3				
Very difficult	1.6	2.1				
(Base N)	(866)	(988)				

Unweighted data from 2000 NSBME: national and Baltimore strata combined.
[a]Adjusted odds ratios were calculated by adding independent variables to control for gender, race (Black vs non-Black), Hispanic ethnicity, age in years, education in years, marital status (married or cohabiting vs not), region of the country (six regions), urbanicity (four categories: 21 largest metropolitan areas; jurisdictions with 85 000 or more households; 20 000–84 999 households, and less than 20 000 households), and sample strata (National vs Baltimore). The adjustment for sample strata was dropped during model estimation due to multicollinearity with the other adjustment variables.
[b]This question refers to either the respondent's current 'main sex partner' or—if there was no main sex partner—'the last partner with whom you had an ongoing sexual relationship that lasted at least a month'.
[c]Adjusted odds ratios were estimated for pooled sample of male and female respondents. This estimated effects evidenced a statistically significant ($P < 0.001$) with gender, i.e. estimates for males and females were not equivalent. See the text for discussion.

by men and women; (vi) inexperience with heterosexual vaginal sex among men aged $\geqslant 20$; and (vii) less frequent reporting that condoms were used 'every time' respondents had sex in the past month.

The foregoing results are generally consistent with the investigators' expectation that the privacy afforded by T-ACASI would increase reporting of potentially sensitive or embarrassing behaviours (e.g. extramarital sex) and decrease reporting of socially approved behaviours (e.g. consistent condom use).

Two results, however, were inconsistent with our initial expectations. With the deluge of advertising for medications to treat erectile dysfunction, we had expected T-ACASI to elicit more frequent reporting of problems with sexual arousal. We found, however, that T-ACASI substantially increased the odds that men would report that it was easy for them to become aroused. (A parallel effect was not found for females.) On reflection, we suspect that our initial expectation caused us to overlook the relative youth of our sample (ages 18–45) and the potential negative aspects of either having or admitting to having a low threshold for sexual arousal (e.g. embarrassing erections at inappropriate times or worries about being perceived as sexually impulsive).

We were also surprised and remain perplexed that T-ACASI increased the odds that men would report sharing their sexual histories with their last new sex partner. Since having a large number of sex partners

is a risk factor for STIs, it is often recommended that this information be shared in new sexual partnerships. Our result would suggest that T-ACASI induced respondents to provide a 'more socially desirable' response. This result is, however, consistent with another NSBME finding reported elsewhere that respondents in T-ACASI reported 'more frequent discussions' of their sex life with their main partner.[11] It is possible that our surprise at these results is due to our own misunderstanding of the social dynamics of reporting on the frequency of sexual communications. Reporting such sexual communication—rather than the absence of such communication—may be the more sensitive or embarrassing response for the majority of the population. This is obviously speculation on our part, but the topic should merit further research in the future.

Supplementary Data

Supplementary data are available at *IJE* online.

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References

[1] Catania JA, Coates TJ, Stall R *et al*. Prevalence of AIDS-related risk factors and condom use in the United States. *Science* 1992;**258**:1101–6.

[2] ACSF Investigators. AIDS and sexual behaviour in France. *Nature* 1992;**360**:407–9.

[3] Davis PB, Yee RL, Chetwynd J, McMillan N. The New Zealand partner relations survey: methodological results of a national telephone survey. *AIDS* 1993;**7**:1509–16.

[4] Turner CF, Forsyth BH, O'Reilly J *et al*. Automated self-interviewing and the survey measurement of sensitive behaviors. In: Couper M, Baker R, Bethlehem J *et al*. (eds). *Computer-Assisted Survey Information Collection*. New York: Wiley, 1998.

[5] Tourangeau R, Smith TW. Asking sensitive questions: the impact of data collection mode, question format, and question context. *Public Opin Q* 1996;**60**:275–304.

[6] Turner CF, Ku L, Rogers SM, Lindberg LD, Pleck JH, Sonenstein FL. Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. *Science* 1998;**280**:867–73.

[7] Turner CF, Miller HG, Smith TK, Cooley PC, Rogers SM. Telephone audio computer-assisted self-interviewing (T-ACASI) and survey measurements of sensitive behaviors: preliminary results. In: Banks R, Fairgrieve J, Gerrard L (eds). *Survey and Statistical Computing*. Chesham, Bucks, UK: Association for Survey Computing, 1996.

[8] Gribble JN, Miller HG, Cooley PC, Catania JA, Pollack L, Turner CF. The impact of T-ACASI interviewing on reported drug use among men who have sex with men. *Subst Use Misuse* 2000;**35**:869–90.

[9] Turner CF, Villarroel MA, Rogers SM *et al*. Reducing bias in telephone survey estimates of the prevalence of drug use: a randomized trial of telephone audio-CASI. *Addiction* 2005;**100**:1432–44.

[10] Villarroel MA, Turner CF, Eggleston EE *et al*. Same-gender sex in the USA: impact of T-ACASI on prevalence estimates. *Public Opin Q* 2006;**70**:166–96.

[11] Villarroel MA, Turner CF, Rogers SM *et al*. T-ACASI reduces bias in STD measurements: the National STD and Behavior Measurement Experiment. *Sex Transm Dis* 2008;**35**:499–506.

[12] Harmon T, Turner CF, Rogers SM *et al*. Impact of T-ACASI on survey measurements of subjective phenomena. *Public Opin Q* (in press).

[13] Currivan DB, Nyman AL, Turner CF, Biener L. Does telephone audio computer-assisted self-interviewing improve the accuracy of prevalence estimates of youth smoking? Evidence from the UMass Tobacco Study. *Public Opin Q* 2004;**68**:542–64.

[14] Moskowitz JM. Assessment of cigarette smoking and smoking susceptibility among youth: telephone computer-assisted self-interviews versus computer-assisted telephone interviews. *Public Opin Q* 2004;**68**:565–87.

[15] Corkey R, Parkinson L. A comparison of four computer-based telephone interviewing methods: getting answers to sensitive questions. *Behav Res Methods Instrum Comput* 2002;**34**:354–63.

[16] Lau JT, Tsui HY, Wang QS. Effects of two telephone survey methods on the level of reported risk behaviours. *Sex Transm Inf* 2003;**79**:325–31.

[17] American Association for Public Opinion Research [AAPOR] (2006). *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates, 4th edn*. Lenexa, KSs: AAPOR.

[18] Roman A. Survey of AIDS and other social issues: field report, August 2000. *Technical Papers in Health and Behavior Measurement, No. 82*. Washington DC: Program in Health and Behavior Measurement, Research Triangle Institute, 2008. Available at: http://dragon.soc.qc.cuny.edu/Staff/turner/TechPDFs/82_NSBME_FieldReport.pdf (1 May 2009, date last accessed).

[19] Villarroel MA, Turner CF, Eggleston EE *et al*. Sample design and demographic characteristics of respondents in the 1999–2000 National STD and Behavior Measurement Experiment (NSBME). Published as *Technical Papers in Health and Behavior Measurement, No. 69*, Washington DC: Program in Health and Behavior Measurement, Research Triangle Institute, 2006. Available at: http://dragon.soc.qc.cuny.edu/Staff/turner/TechPDFs/69_NSBMEsample.pdf (1 May 2009, date last accessed).

[20] Cooley PC, Miller HG, Gribble JN, Turner CF. Automating telephone surveys: using T-ACASI to obtain data on sensitive topics. *Comput Hum Behav* 2000;**16**:1–11.

[21] Cooley PC, Turner CF. Implementing audio-CASI on Windows platforms. *Comput Hum Behav* 1998;**14**:195–207.

[22] StataCorp. *STATA Statistical Software for Windows, Versions 6.0 & 8.0*. College Station, TX: StataCorp, 2000 & 2003.