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The Impact of T-ACASI Interviewing on Reported Drug Use among Men Who Have Sex with Men

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ABSTRACT

Measurements of drug use and other illicit or stigmatized behaviors are subject to nontrivial underreporting biases. During in-person surveys, respondents are more likely to report such behaviors when interviewed using techniques that maximize interviewee privacy, e.g., use of paper SAQs and audio-CASI rather than questioning by human interviewers. Until recently, respondents in telephone surveys could not be offered similar privacy. A new technology, telephone audio computer-assisted self-interviewing (T-ACASI) overcomes this limitation of telephone surveys by allowing respondents to respond to a computer. A randomized experimental test of T-ACASI was embedded in the Urban Men's Health Study (UMHS). UMHS surveyed a probability sample of 2,881 men from four United States cities and who reported having sex with men. Respondents interviewed using T-ACASI reported a higher prevalence of drug use and drug-related behaviors than respondents

interviewed by human interviewers. However, survey respondents were more likely to break off an interview when the interview was conducted by a T-ACASI computer rather than by a human interviewer. [Translations are provided in the International Abstracts Section of this issue.]

Key words. Survey measurement; Drug use; Telephone audio-CASI (T-ACASI); Men who have sex with men; Interview mode; Probability sample

INTRODUCTION*

Although there has been a substantial decline in HIV risk behaviors among United States men who have sex with men, this group is still disproportionately affected by AIDS in the United States. In 1997, 60% of men who were diagnosed with AIDS were gay or bisexual (CDC, 1998). Patterns of high-risk behavior may have changed in recent years, but that change is uneven across segments of the gay and bisexual populations, and trends may be beginning to reverse. In fact, a recent study of gay men in San Francisco found that 39% reported having unprotected intercourse in 1997, which was up from 30% in 1994. The increase is even more striking among younger men, increasing from 35 to 52% over the same 3-year period (CDC, 1999). Patterns of high-risk behaviors may be changing because the threat of AIDS is now perceived differently by many due to the availability of drugs that allow many people with HIV to live at least a semblance of a normal life.

The Urban Men's Health Study (UMHS) was designed to provide a better understanding of a range of health-related behaviors and health care needs of men who have sex with men (MSMs). In this study, an MSM is defined as any male who reported same-sex contact since age 14 or who self-identified as a gay or bisexual man. To achieve the study's aims, data were collected from MSMs on demographic characteristics and involvement in the gay community, as well as several sensitive behaviors, including high- and low-risk sexual practices, use of drugs and alcohol, patterns of sexual mixing across social strata, HIV testing and status, HIV treatment regimens, use of health care services, and mental health problems, including depressive symptomatology, thoughts of suicide, and general sense of well-being.

In this paper we use the UMHS data to examine the effect of the mode of survey administration on the reported levels of drug use and drug-related behaviors among MSMs in four urban areas. Analysis of these data focus on the reporting differentials for these behaviors, comparing prevalence

* See Note 1.

estimates from data collected by two survey modes: standard telephone interviewing (referred to as CATI, or computer-assisted telephone interviewing) and a new technology for *self-interviewing* on the telephone, referred to as telephone audio computer-assisted self-interviewing or T-ACASI.

EVIDENCE OF SELF-DISCLOSURE BIAS IN SURVEYS OF DRUG USE

In-Person Surveys

A growing literature is examining self-disclosure bias in the context of in-person surveys of sensitive topics. Those studies demonstrate that such survey measurements are dramatically affected by the level of privacy afforded by the interview mode. Results from a large-scale, randomized experiment (1990 NHSDA Field Test; Turner et al., 1992b) indicate that measurements made with paper-and-pencil self-administered questionnaires (Paper SAQs) yield higher estimates of the prevalence of illicit drug use than those made using interviewer-administration of the same questionnaires (IAQs) (Turner et al., 1992a; Rogers et al., 1998; Gribble et al., 1998). The relative advantage of Paper SAQs in encouraging more complete reporting of drug use generally appears to be a direct function of the sensitivity of the behavior being reported. For example, in the NHSDA Field Test, the largest mode effect was for the reporting of recent cocaine use: prevalence estimates obtained using Paper SAQs were 2.4 times higher than estimates obtained with an interviewer-administered questioning (Turner et al., 1992a). Analyses of a parallel experiment embedded in the National Longitudinal Survey of Youth also found Paper SAQs to yield more frequent reports of illicit drug use than IAQs (Shober et al., 1992). Paper SAQs have the disadvantage of requiring that respondents be literate. Recent studies have demonstrated that new audio computer-assisted self-interviewing technologies yield parallel—and perhaps greater—reductions in reporting bias without requiring that respondents be literate (Turner et al., 1998b; Bloom, 1998; Des Jarlais et al., 1999; Gribble et al., 1998; Rogers et al., 1999).

Survey methodologists generally agree that biases in the reporting of illicit or stigmatized behaviors in general population surveys should produce a net negative bias in prevalence estimates. This negative bias in prevalence estimates occurs because the number of respondents who deny engaging in stigmatized or sensitive behaviors that they in fact have engaged in is expected to be larger than the number who falsely report behaviors that they have not engaged in (Turner et al., 1992a; Catania et al., 1990; Miller et al., 2000; Bradburn and Sudman 1979). Thus, increased rates of reporting of sensitive behaviors under more private survey conditions are interpreted to

reflect a reduction in reporting bias and thereby an increase in the accuracy of the measurements.

Telephone Surveys

Fielding national, face-to-face surveys with sufficiently large samples to support subgroup analyses and respectable response rates is very expensive. To reduce these expense of collecting such data, telephone surveys have been adopted for some large-scale epidemiological studies. While offering the chance to increase sample size at a fraction of the cost of in-person interviews, telephone interviews are also not without problems.

In recent years, strongly suggestive evidence has become available concerning the measurement biases in telephone and other surveys that require respondents to report illicit or sensitive behaviors to human interviewers. That evidence is drawn from two major studies that have compared prevalence estimates of illicit drug use obtained from interviewer-administered telephone surveys to those obtained from SAQs used during in-person surveys. The two studies used unrestricted samples of the adult population.

The first study, conducted by Gfroerer and Hughes (1992), compared results from the 1988 NHSDA, an in-person survey using SAQs, to results from a 1988 national telephone survey conducted for the Food and Drug Administration (FDA). The FDA survey used questions modeled on the NHSDA, and Gfroerer and Hughes went to considerable lengths to match the composition of the two samples. With relatively large samples (Ns = 5.018 and 1,965), the SAQs yielded significantly and substantially higher estimates for the reporting of illicit drug use than telephone surveys. The relative increase in estimated prevalences ranged from 33% for reporting any lifetime use of marijuana to 121% for reporting use of cocaine in the past 12 months.

Aquilino (1994) has also reported similar results from an experiment in which respondents were randomly assigned to either a telephone survey, an in-person IAQ, or an in-person IAQ with SAQ. The experiment was embedded in a probability survey of households in the 37 largest metropolitan areas in the United States. For the purposes of screening and recruiting respondents, interviewers made an initial in-person household contact. Respondents were then randomly assigned to a survey mode. Households without telephones were excluded from these analyses. Aquilino's results are generally consistent with those obtained by Gfroerer and Hughes, although the estimated prevalences of drug use were higher and there was some variation in the observed mode differences. Overall, Aquilino found using SAQs during in-person surveys produced higher prevalence estimates for most measurements of drug use than telephone interview. For example, SAQs

produced a 32% relative increase in the reporting of any lifetime cocaine use.

The conditions under which survey data are collected can influence data quality. Although the telephone may reduce some of the concerns that respondents might have in a face-to-face interview, they may still not feel comfortable answering personal questions regarding sexual, drug use, and other sensitive behaviors. Telephone interviewers generally ask respondents if they have sufficient privacy and, if not, the respondent can reschedule the interview or move to another telephone. Such a procedure protects subjects' responses from being overheard by other household members, but it does not protect against self-disclosure to the interviewer. What is needed for that purpose is a telephone analogue of the self-administered questionnaire.

TELEPHONE AUDIO COMPUTER-ASSISTED SELF-INTERVIEWING (T-ACASI) SYSTEMS

During the winter of 1994–95, researchers at the Research Triangle Institute (RTI) developed a telephone-based, audio-computer-assisted, self-interviewing system (T-ACASI) (Cooley et al., in press; see also, Cooley and Turner, 1998; Turner et al., 1996, 1998a). As with other telephone interview surveys, the T-ACASI system uses a telephone interviewer to contact a targeted household and screen for eligible subjects. However, once the subject has been recruited and has completed the nonsensitive action of the interview, the phone call is transferred to the T-ACASI system, and computer-controlled, prerecorded questions are read to the subject. The subject provides responses by pressing keys on a touch-tone telephone. This process is entirely private. At the end of the interview, the respondent can be returned to the telephone interviewer to close out the interview.

T-ACASI interviewing affords privacy for subjects who do not wish to disclose sensitive information to interviewers and for those who may worry about being overheard answering sensitive questions by other people in their household. T-ACASI also offers the traditional advantages of computer-assisted survey technologies, including computer-controlled branching through complex questionnaires, automated consistency (see Note 2) and range checking, and automatic production of data files. Furthermore, T-ACASI also provides a completely standardized measurement system; every respondent hears the same questions asked in exactly the same way.

DATA AND METHODS

Between October 1996 and March 1998, RTI researchers collaborated with scientists from UCSF (Catania, 1994; Turner et al., 1995) in fielding a national telephone survey of AIDS risk and health behaviors among probability samples of MSMs residing in San Francisco, New York, Los Angeles, and Chicago. The data were collected using a fully randomized experimental design embedded within the UMHS sample design. Most questions in the UMHS survey were administered as computer-assisted telephone interviews (CATI). In a CATI interview an interviewer (prompted by a computer) asks the questions, listens to a respondent's answers, and then types those answers into a computer. For a section of the UMHS questionnaire which took approximately 30 minutes to complete (see Note 3), a randomly selected subset of respondents was administered questions using T-ACASI interviewing. Participants randomized to T-ACASI were temporarily switched to a computer on which a prerecorded voice asked questions and respondents recorded their answers directly into the computer using the keypad on their touch-tone telephones. (The human interviewers were disconnected from these T-ACASI interviews so that respondents could provide their answers in complete privacy.)

Sample Design

The UMHS was conducted in four cities that represent the largest and densest concentrations of MSMs in the United States (San Francisco, Los Angeles, New York, and Chicago). In general, the sampling process for the UMHS involved the identification of appropriate geographic areas and associated telephone exchanges for sampling (Binson et al., 1996), the use of disproportionate sampling techniques (Kalton, 1993), and an adaptive sampling approach (Blair, 1999) to construct a sampling plan for each city. (More details on the qualitative and quantitative aspects of the sample design are available in Catania et al., 1999, and Mills et al., 1998.)

More specifically, earlier work had identified ZIP codes within the geographic city limits of each city with moderate-to-high density of MSM through mapping MSM-relevant health, commercial, and census data sources. The estimated prevalence of MSM households ranged from 1.6 to 4.0% in low density ZIP codes. These areas were deemed costly to sample and so were excluded from the sample. The remaining ZIP codes had estimated MSM prevalences ranging from 4.1 to 33.6%. These selected ZIP codes accounted for an estimated majority of all MSM households in each city (51% in Los Angeles, 60% in Chicago, 66% in New York, and

85% in San Francisco). The telephone exchanges associated with the selected ZIP codes were then identified, thus creating the sampling frame. The exchanges were stratified by estimated cost per interview. Those strata were sampled disproportionately, with higher portions of the sample drawn from lower cost strata. The relative proportions were adjusted over time as estimated costs and contact rates gave way to actual data. Telephone numbers within the selected exchanges were randomly selected, and only households residing in the designated ZIP codes were retained in the study.

Sample Execution

Over 195,000 telephone numbers were called, over 60,000 households were screened, and 2,881 interviews with MSMs were obtained, which constituted 78% of all identified eligible households. Of the 2,881 interviews that were conducted, 697 were randomized to T-ACASI and 2,184 were randomized to CATI. A total of 17 CATI interviews were conducted in Spanish and have been excluded from this analysis because T-ACASI was available only in English.

Interview Procedure

All respondents began the interview with a live interviewer. The first part of the interview included questions about involvement in the gay community, demographics, extensive sexual behavior assessment, including global questions about partners and specific behaviors, as well as partner-by-partner assessments for up to four sexual partners. After completing those questions, which comprise between one-third and one-half of the interview, English speakers with a touch-tone phone could be randomized into the T-ACASI condition. The T-ACASI section included questions on sexual development, antigay victimization, sexual coercion, access to medical care, sexual problems, depressive symptomatology and suicidal feelings, alcohol and drug use in the past 6 months, feelings of well-being, losses connected to HIV, caregiving connected to HIV, and additional demographics. The questions on drug use and drug-related behaviors are in the second half of the interview and the later part of the T-ACASI interview. For each type of drug (11 were included in the questionnaire), respondents were asked if they had ever used that drug, followed by how many times they had used it in the past 6 months (see Note 4). After those drug use questions, respondents were asked about injecting drugs, concern about drug use, and payment for sex with drugs.

Interview Break Offs

A technological hurdle in implementing the T-ACASI interviewing arose from the fact that the survey interviewers were based on San Francisco and the T-ACASI system was located in Research Triangle Park, North Carolina. Participants randomized to T-ACASI had to be transferred from San Francisco to RTI's T-ACASI system and then switched back to the interviewer in San Francisco for the portion of the interview that was interviewer administered. Despite the "newness" of T-ACASI and the complexities of the hybrid system unique to the UMHS study, the technical problems encountered—while nontrivial—were not insurmountable.

"Dropped connections" were encountered but they were not so frequent as to disrupt the progress of the study. To deal with these problems, the hardware interface was modified to better adapt to the telephone switching system environment in which it was working (i.e., the electronic characteristics of the telephone lines when they "hang up," generate flash tones, busy signals, etc.). (Note, however, that dropped connections that could not be remedied by recontacting respondents to complete the interview do raise questions about the impact of T-ACASI on the representativeness of the resultant samples. Data on this issue are presented subsequently.)

One cause of break offs during T-ACASI interviews was respondents' use of call-waiting. Participants would sometimes put the T-ACASI computer on hold for an extended period of time in order to take another call. The T-ACASI program activates a "time out" function when it detects no respondent activity for a specified time interval, and it then disconnects the call. When break offs occurred, the T-ACASI system in North Carolinia notified the interviewers in San Francisco and attempts were made to reconnect with the study participant. Upon recontact, the interview began at the beginning of the section where the break off occurred. If recontact could not be made or the respondent did not wish to continue at that time the case was placed in the survey queue for recontact.

Frequency of Break Offs

Of the 2,881 interview that were begun, 697 were randomly assigned to T-ACASI. Of those, 83 either would not or could not be interviewed by T-ACASI and 48 were unsuccessfully transferred to the T-ACASI system (due, we believe, to technical problems). Both of these groups were interviewed with CATI. A total of 566 interviews were begun in T-ACASI; however, due to break offs, not all of them were completed. The T-ACASI interview was composed of five sections: one practice section (Section A) and four sensitive

sections (Sections B, C, D, and E). Of the 566 who began the T-ACASI interview and completed Section A, 476 completed Section B. Thus, 90 participants randomized to T-ACASI broke off during Section B, of which 67 continued the interview in CATI and 23 did not complete the interview. During the subsequent three sections, 47 breakoffs occurred, of which 29 continued the interview in CATI and 17 did not complete the interview. A total of 437 completed the questions on drug use, which are analyzed here, and a total of 429 completed the full T-ACASI interview.

Statistical Procedures

The analyses reported in this paper begin by examining the demographic and social characteristics of respondents who completed the T-ACASI and CATI versions of the UMHS drug questions. We then test the effect of mode of survey administration on reported drug use and drug-related behaviors using chi-square statistics obtained from 2-way cross-tabulations. Crude odds ratios and their 95% confidence intervals are also calculated. Adjusted odds ratios are then estimated with logistic regression procedures. Controls for age, education, city of residence, household income, and race are included in these models.

We selected the logistic regression model because the outcome variables of interest are all dichotomous. The effects of age are estimated using three dummy variables (18–29 years, 30–39 years, and 40–49 years; respondents over age 49 constitute the reference group). Education is modeled with two dummy variables (high school graduate or less, and college graduate; respondents with a graduate degree serve as the reference group). The effect of city of residence is estimated with three dummy variables (San Francisco, New York, and Los Angeles; respondents in Chicago serve as the reference group.) Household income is modeled with two dummy variables (less than $20,000, and $20,001 to 60,000; household with an income of more than $60,000 serve as the reference group). Race is included in the model as non-White (White respondents are the reference group). Odds ratios (and 95% confidence intervals for ORs) based on logistic regression parameter estimate are presented for 17 drug-related outcome variables. The final step of the analysis includes interaction terms between mode and the control variables in the logistic regression models to determine whether the mode effect varied across age, education, city, income, or age groups.

Since our primary purpose in conducting these analyses is to assess the results of the mode experiment, the data presented in this paper are unweighted. Thus our prevalence estimates reflect the prevalence of drug

use *within our sample*; they should not be generalized to the MSM population of the cities where the data were collected or the nation as a whole.

RESULTS

Sample Characteristics

In this analysis we include only respondents who completed the drug-related questions in the mode to which they were assigned. Respondents who were randomized to T-ACASI and completed the drug-related questions in CATI, regardless of the reason for doing so, are excluded from the analysis. The background characteristics of the UMHS sample population are summarized in Table 1. The age of respondents ranged from 18 to 89, with approximately 40% falling between ages 30 and 39. Overall, the sample had high educational attainment, with almost half being college graduates and another quarter having a graduate degree. Approximately 80% of the sample was White and 8% was Hispanic; African Americans represented about 5% of the total sample. Respondents from San Francisco comprised about one-third of the sample, with Los Angeles and New York each being the place of residence of slightly more than a quarter of the respondents. More than one-third of the sample reported a household income of more than $60,000, while only approximately 15% reported incomes of less than $20,000. Differences in the background characteristics of respondents randomized to the two modes were not significant, except for household income. The household incomes reported by T-ACASI respondents were significantly lower than the incomes reported by respondents interviewed by a human interviewer. It should be noted that income (unlike age, education, race, and city of residence) was asked as a T-ACASI question for respondents assigned to that mode. While we will treat the difference in reported incomes as real variation in the composition of the samples and control for it in our analyses, it is also possible that this result reflects a mode effect, i.e., that respondents claim higher incomes when responding to a human interviewer than to a computer. The adjusted odds ratios presented below include controls for all of these sociodemographic variables.

Impact of Survey Mode on Reported Drug Use

Table 2 presents estimates of the reported prevalence of use of crack cocaine, poppers (or inhalants, such as amyl, butyl, or isopropyl nitrite), downers (including barbiturates, tranquilizers like Valium, or sedatives like Quaaludes), and opiates (such as heroin, or painkillers like Demerol) by mode of survey administration. We also examined use of marijuana/hashish,

Table 1

Selected Demographic Characteristics of Respondents in the Urban Men's Health Study (UMHS)[a]

Characteristic	Interviewer		
	Human (%)	T-ACASI (%)	*p*
Age:			
18–29	19	15	N.S.
30–39	38	42	
40–49	27	25	
50–89	16	18	
Education:			
High school graduate or less	30	27	N.S.
College graduate	45	49	
Graduate degree	26	25	
Race/ethnicity:			
White	79	82	N.S.
African American	5	3	
Hispanic	8	9	
Asian/Pacific Islander	4	4	
Native American	3	2	
Other	1	1	
City of residence:			
San Francisco	34	30	N.S.
New York	27	28	
Los Angeles	24	28	
Chicago	14	14	
Annual household income:			
< $20,000	14	19	0.01
$20,001–60,000	48	47	
Over $60,000	38	33	

[a] CATI sample size = 1,919; T-ACASI sample size for questions on drug use = 437. *p*-values are for chi-square test of independence in cross-tabulation of sociodemographic characteristics by Sample (Human vs T-ACASI).

psychedelics, uppers, ecstasy, cocaine, party drugs, and use of three or more drugs, but none of those mode effects was significant. Although some of the drugs included in the UMHS questionnaire can be obtained and used for valid medical reasons, in the UMHS questionnaire respondents were asked if they had used these drugs for "recreational purposes." Thus, reporting the use of any of these drugs, whether they be legal or illegal substances, is likely to be subject to some degree of reporting bias.

The reported drug-specific prevalence varied greatly as expected, but the modal distributions were quite similar across CATI and T-ACASI. Marijuana was the most commonly used drug, followed by poppers. When considering the effect of survey mode, a consistent pattern (8 of the

Table 2

Estimated Prevalence of Drug Use and Drug-Related Behaviors by Survey Mode[a]

Measurement	Estimated prevalence (%)				Crude odds ratio (95% CI)	*P*	Adjusted odds ratio (95% CI)	*P*
	Human	(Base *N*)	T-ACASI	(Base *N*)				
Drug use in past 6 months:								
Crack	2.5	(1,913)	4.6	(435)	1.91 (1.12, 3.26)	0.015	1.88 (1.08, 3.28)	0.026
Poppers	20.5	(1,913)	26.5	(437)	1.40 (1.10, 1.78)	0.006	1.44 (1.13, 1.83)	0.004
Downers	8.7	(1,902)	13.6	(433)	1.66 (1.21, 2.28)	0.002	1.76 (1.27, 2.43)	0.001
Opiates/painkillers	3.1	(1,902)	5.3	(434)	1.75 (1.07, 2.86)	0.025	1.71 (1.03, 2.85)	0.039
Marijuana/hashish	43.1	(1,916)	42.1	(435)	0.96 (0.78, 1.18)	N.S.	1.00 (0.81, 1.24)	N.S.
Psychedelics	4.1	(1,904)	2.8	(434)	0.66 (0.35, 1.22)	0.178	0.71 (0.38, 1.34)	N.S.
Methamphetamines	9.7	(1,908)	10.3	(435)	1.07 (0.76, 1.52)	N.S.	1.11 (0.78, 1.58)	N.S.
Other amphetamines	1.9	(1,900)	1.6	(435)	0.85 (0.37, 1.92)	N.S.	0.96 (0.42, 2.19)	N.S.
Ecstasy	10.5	(1,904)	10.1	(435)	0.96 (0.68, 1.35)	N.S.	0.99 (0.69, 1.42)	N.S.
Cocaine	12.7	(1,908)	14.7	(435)	1.19 (0.88, 1.60)	N.S.	1.20 (0.88, 1.64)	N.S.
Party drugs	6.2	(1,899)	8.1	(434)	1.32 (0.89, 1.96)	0.160	1.34 (0.89, 2.03)	0.170
Use of 3 or more drugs	16.9	(1,906)	18.9	(435)	1.14 (0.87, 1.49)	N.S.	1.20 (0.91, 1.58)	0.190
Drug-related behaviors:								
Ever concerned	27.6	(1,920)	24.4	(434)	0.85 (0.67, 1.08)	0.178	0.82 (0.64, 1.06)	0.125
Still concerned	32.8	(528)	50.5	(105)	2.09 (1.37, 3.19)	0.001	2.13 (1.36, 2.85)	0.001
Received drugs/money for sex (past year)	1.9	(1,923)	4.1	(434)	2.27 (1.28, 4.03)	0.004	2.20 (1.22, 3.99)	0.009
Gave drugs/money for sex (past year)	5.6	(1,923)	8.5	(434)	1.58 (1.07, 2.33)	0.020	1.61 (1.08, 2.40)	0.018
Ever injected	8.4	(1,921)	9.7	(434)	1.16 (0.81, 1.66)	N.S.	1.10 (0.76, 1.61)	N.S.

[a] Adjusted odds ratios include controls for age (18–29, 30–39, 40–49, 50 +), education (high school or less, college degree, graduate degree), city (San Francisco, New York, Los Angeles, Chicago), income ($20,000 or less, $20,001–60,000, over $60,000), and race (non-White, White). Respondents were asked the "still concerned" question only if they responded that they were "ever concerned" about their use of drugs.

12 categories) emerged when examining the overall prevalence estimates; higher levels of use were reported with T-ACASI than with human interviewers. Among the four drug categories with a significant mode effect, the relative difference in the estimated prevalences was as high as 84% for crack (2.5% with human interviewers versus 4.6% with T-ACASI).

For the drugs in which no significant mode effect was noted, reported drug use varied across mode. With marijuana, which had the highest prevalence, the higher reported use with CATI may suggest that it is not a sensitive behavior. Cocaine use, on the other hand, was more frequently reported with T-ACASI, although the difference was not significant. For some drug categories, such as psychedelics and other amphetamines, a mode effect may be difficult to detect because of the relatively low levels of reported use.

The statistically significant crude odds ratios demonstrate the effect of T-ACASI in eliciting higher reported levels of recreational drug use. The odds of reporting crack use in the past 6 months with T-ACASI were 1.91 times the odds of reporting crack use to a human interviewer. The odds ratios decrease slightly, but remain relatively high for reported use of opiates and downers. The odds of reporting use of poppers with T-ACASI were 1.40 times the odds of reporting use to a human interviewer. Given both the popularity and the lower stigma associated with use of poppers relative to the other drugs, it is not surprising that this odds ratio is substantially lower.

To control for the potential confounding effects of sociodemographic effects, we estimated adjusted odds ratios using logistic regression models. Including controls for income as well as age, education, city of residence, and race had only a minor effect on the odds ratios. In two cases where significant mode effects were detected, the adjusted odds ratios were slightly higher than the crude odds ratios; this was also the pattern for drug categories in which no significant mode effect was detected.

Impact of Survey Mode on Reporting of Other Drug-Related Behaviors

The UMHS questionnaire also asked about a number of drug-related issues. All respondents, regardless of their history of drug use, were asked if they had *ever been concerned* about their use of recreational drugs. Respondents who answered positively were then asked if they were *still concerned* about their use of drugs. Questions were also included about giving and receiving drugs or money in exchange for sex during the past 12 months and ever injecting drugs. The bottom panel of Table 2 presents the estimated prevalences for these behaviors by mode, and the crude and

adjusted odds ratios. T-ACASI interviewing yielded higher prevalence estimates of these behaviors in four of the five cases, three of which were statistically significant.

The two UMHS questions regarding concern about drug use yielded different results. The one question with a nonsignificant mode effect asked respondents if they were "ever concerned about drug use." It can be argued that this question is asking about a normative behavior and hence a behavior that is likely to be over-reported. It is thus not surprising that among respondents who reported some past history of drug use, many would report that they had been concerned about their drug use. Decreased reporting of this concern in T-ACASI interviews would be consistent with our expectations for a normative behavior (i.e., a more private interview mode will *decrease overreporting* of normative behaviors). The data indicate a suggestive trend in this direction. Among T-ACASI respondents, 24.4% report a past concern about drug use versus 27.6% among respondents interviewed by a human interviewer (adjusted OR = 0.82, $p = .125$).

The follow-up question asked about a behavior that should be sensitive and counternormative, i.e., having concerns about a *current* drug problem. For this question we would expect an underreporting bias and, if T-ACASI were effective in eliciting more accurate responses, a higher estimated prevalence from T-ACASI than from standard telephone interview procedures. The data are consistent with this prediction. Among T-ACASI respondents, 50.5% report concern about current drug use versus 32.8% of respondents interviewed by a human interviewer (adjusted OR = 2.13, $p = .001$).

The questions on receiving or giving money/drugs in exchange for sex and ever injecting drugs follow a pattern similar to questions about many sensitive behaviors. Respondents answering with T-ACASI were more likely to report those three behaviors than respondents interviewed by a human interviewer. In fact, the relative difference between the two modes was as high as 116% for reporting having received drugs or money in exchange for sex (1.9% with a human interviewer versus 4.1 with T-ACASI).

The crude odds ratios further illustrate these mode effects. The odds ratios show the relative effect of survey mode on people's willingness to report these drug-related behaviors. The odds ratio for "ever concerned about drug use" was less than unity, indicating more frequent reporting with a human interviewer. (However, the 95% confidence interval indicates that the mode effect was not statistically significant.) The odds ratios for the other four behaviors substantiate the higher reported prevalence when questions are administered using T-ACASI rather than human interviewers. The odds for reporting receiving drugs or money in exchange for sex with T-ACASI were 2.27 times the odds of reporting the behavior to a human

interviewer—a statistically significant difference. Similarly, the odds ratio of 2.09 for "still concerned about drug use" demonstrates the significantly greater willingness of T-ACASI respondents to report these concerns than respondents interviewed by human interviewers.

The adjusted odds ratios control for any potential effects attributable to variation in the sociodemographic composition of samples completing T-ACASI versus standard telephone interviews. The results from the multivariate logistic regressions were no different from the bivariate analyses: the significant odds ratios for reporting giving or receiving drugs or money in exchange for sex and still being concerned about a drug problem indicate higher prevalence of those behaviors among T-ACASI respondents than respondents interviewed by a human interviewer. The adjusted odds ratio for "ever concerned about drug use" and "ever injecting drugs" continued to be nonsignificant.

Variation in Effects of T-ACASI across Subpopulations

Does the effect of survey mode vary systematically across subgroups of the sampled population? To answer this question we expanded our logistic regression model to include interactions of survey mode and five sociodemographic control variables: Age, Education, Race, Income, and City of Residence. Our search for variations in the mode effect across subpopulations produced little evidence beyond what would be expected to occur by chance.

DISCUSSION

The Urban Men's Health Study provides estimates of a range of behaviors of men who have sex with men based on probability samples drawn from the population of MSMs in four cities. Much of the data obtained in the UMHS focuses on risk behaviors associated with HIV. Although the use of most drugs is not a direct source of HIV transmission, the data examined here provide prevalence estimates of behaviors which have been shown to be associated with sexual risk taking (Stall et al., 1986; see also Paul et al., 1994; Stall and Leigh, 1994). It is in that light that the prevalence of "reported" drug use—and estimates of the effect of reporting bias on such estimates—are important factors in understanding the current risks of HIV infection encountered by men who have sex with men.

Telephone interviews have become an increasingly popular method of data collection for large-scale epidemiological and evaluation research studies (see, for example, Beveridge et al. in this issue) (see Note 5).

Although telephone interviewing avoids the face-to-face encounter that occurs during an in-person interview, estimates of sensitive behaviors obtained in telephone interviews have been shown to be subject to substantial reporting biases (Gfroerer and Hughes, 1992; Aquilino, 1994). By creating an environment in which participants do not have to respond to another human, T-ACASI has the potential to reduce those biases.

The mode effects noted in this paper illustrate the extent to which individuals may avoid reporting embarrassing, stigmatizing, or illegal behaviors to another person. The adjusted odds ratios indicate that even after controlling for potentially confounding factors, respondents who were questioned using T-ACASI were more likely to report drug use and other drug-related behaviors than respondents who were administered a traditional telephone interview. The higher prevalence of drug use and drug-related behaviors reported with T-ACASI may provide a more accurate picture of the degree to which segments of the MSM population engage in these behaviors.

T-ACASI and other recently developed technologies that provide complete privacy to respondents without requiring literacy are being used in a growing range of studies that require accurate measurements of sensitive behaviors. Thus far, it has been a general finding that people report significantly higher levels of stigmatized or illicit activities and lower levels of normative behavior when interviewed using these technologies.

The foregoing results are both satisfying and frustrating. On the one hand, it does appear that T-ACASI technology can improve the reporting of sensitive behaviors—at least among the population of urban men who have sex with men in the United States. Illicit drug use and stigmatized drug-related behaviors, such as receiving money or drugs for sex, are more likely to be reported when respondents respond to a computer in a T-ACASI interview than when they answer questions posed by a human interviewer. Since telephone surveys previously could not offer such a private mode of interview, T-ACASI technology proffers a potentially important benefit to researchers who wish to (or who must for economic reasons) study such behaviors using telephone surveys.

On the other hand, the UMHS data provide perplexing and inadequately understood results regarding respondents acceptance of T-ACASI technology. In contrast to two smaller-scale studies conducted previously (Turner et al., 1996; Cooley et al., in press), the UMHS had a relatively high rate of subject attrition in the T-ACASI condition. A substantial portion of this loss occurred prior to the onset of T-ACASI interviewing. Twelve percent (83 of 697) of T-ACASI cases either refused or could not be interviewed using T-ACASI, and were then interviewed in CATI. An additional 7% (48 of 697) of cases were lost during transfer to T-ACASI. While we believe that

the latter loss of cases reflects transient problems with the hybrid T-ACASI system used for this study, we lack convincing evidence that this was the case.

There was a further substantial loss of cases due to break offs during the T-ACASI interview. Of the 566 who completed some portion of T-ACASI interview, 129 broke off the T-ACASI interview before completing the drug section and an additional 8 respondents terminated before completing the remaining T-ACASI questions. Since only 2% of respondents interviewed by a human interviewer discontinued the interview during these sections, it appears that respondents may have fewer inhibitions about hanging up on a computer than on a human interviewer. (It is also possible that some of this loss is attributable to either undiagnosed technical problems or to the automatic "time-out" feature used to terminate calls after a period of inactivity due, perhaps, to use of call waiting.) While attempts were made to recontact respondents who broke off the interview, these were not always successful. However, among those who were recontacted, common reasons for the break offs were losing connection with the T-ACASI system and length of the questionnaire.

In addition, two operational issues with T-ACASI need to be mentioned. More than half of the respondents (58%) indicated that the buttons on their phones were on the handset rather than the base. This arrangement can create frustration by having the respondent constantly moving the phone away from his ear in order to respond to the question. The constant movement can also contribute to errors in entering responses because the phone is not next to the respondent's ear and he cannot hear the touch tones. Consequently, he is unable to "confirm" what he has entered. Another operational issue related to the telephone was the variability in signals. Given the range in telephone systems that are available, the T-ACASI system may not have been able to detect all signals equally well. Portable phones (having a stationary base and a portable handset) may be particularly problematic because the strength of the signal may vary as the respondent moves around his home.

Overall, our conclusions are thus mixed. The UMHS data suggest that T-ACASI does appear to reduce the reporting bias that afflicts telephone measurements of drug use and other sensitive behaviors—at least among men who have sex with men. However, the ultimate value of this technology for use in probability surveys will depend upon our ability to better understand and reduce the T-ACASI sample attrition experienced in this research. We are hopeful that the national T-ACASI survey experiment we are presently conducting will provide some of the needed answers.

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NOTES

1. In this review we draw extensively on the contributions of authors to jointly authored works including Gribble et al. (1998), Turner et al. (1995, 1996, 1997, 1998a, 1998b), Rogers et al. (1998) and Miller et al. (1998). With the exception of this statement, we do not note the numerous places in which we have drawn on these works.
2. Checking for response consistency across questions does require that respondents be queried about inconsistencies and asked to resolve them. While feasible on a limited basis, extensive checking across questions might make an interview overly long and tedious for respondents.
3. This is median time it took for respondents to complete a T-ACASI administration of this section of the UMHS questionnaire.
4. Initiating the questions on drug use varied slightly across modes. In CATI, a screening question allowed respondents to skip the individual drug questions if they indicated they had not used any drugs in the previous 6 months. In T-ACASI, no screening question was used and all respondents were asked about each type of drug.
5. However, one of the inherent limitations of telephone interviewing is that not everyone has a telephone, which may lead to an underrepresentation of some high-risk groups.

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