Impact of Computerized Screening on Selection Probabilities and Response Rates in the 1999 NHSDA

Joe Eyerman, Dawn Odom, and James Chromy, RTI International, and Joe Gfroerer, Substance Abuse and Mental Health Services Administration

Key Words: Computerized screening, selection rates, response rates, selection probabilities, sampling procedural error

The National Household Survey on Drug Abuse (NHSDA) is the federal government's primary source of information on the magnitude of substance use and abuse in the household population of the United States. Conducted since 1971, the survey collects data by administering questionnaires to a representative sample of persons aged 12 and older at their place of residence. The survey is administered by the Substance Abuse and Mental Health Services Administration (SAMHSA), with data collection done under contract. Since 1988, Research Triangle Institute (RTI) has been contracted to conduct the survey. Data from the survey are used by policymakers and researchers to measure the prevalence and correlates of licit and illicit drug use, to identify and monitor trends in substance use, and to analyze differences by population subgroups.

This paper discusses the transition made in 1999 from a paper screening instrument with printed selection tables, to a computerized screening instrument with programmed selection parameters. The impact of the transition on sampling procedural error is assessed by examining the selection rates and response rates for 1998 and 1999.

Background

Previous research has demonstrated a relationship between the process of listing members of a eligible household and the accuracy and completeness of the sample. In general, this research has focused on deliberate or inadvertent roster error introduced by the respondent. Respondents may deliberately fail to accurately or completely list the members of the household due to mistrust in the purpose of the survey or of the government in general. They may also introduce error through a misunderstanding of the rostering rules or the residency definitions (Hainer et. al. 1988, Martin et. al. 1994, Pausche 1995, Martin 1996). Complicated rostering procedures have been shown to introduce confusion among the interviewers as well (Fein, et. al. 1988, West et. al. 1996).

This paper examines an additional aspect of rostering error that could be introduced by the interviewers. It focuses on the deliberate falsification of the rostering process by the field staff to increase the success of their efforts.

Paper Screening Instrument

Prior to the 1999 survey, the NHSDA Field Interviewers used a paper screening instrument and printed selection tables to select the sampled persons within each household, as determined by the sample design. In households with two or more persons in the same age group, the printed tables determined who would be selected based on the order that they were recorded on the screening roster. The roster is worded as follows:

> "Now I need some general information about all of the other people in the household who are 12 years old or older and who (will live/lived) here for most of the time during the months of (REFERENCE MONTHS). Let's start with the oldest and work down to the youngest person 12 or over."

Interviewers were able to use the information contained in the printed tables to anticipate which persons would be selected from a household. It is possible that some of the interviewers manipulated the roster order to select the most convenient person within each age group. We expect this occurred most often in households with married adults, assuming that the females were more likely to be home than the males.

Computerized Screening Instrument

All of the 1999 screenings were conducted using a hand held computerized screening instrument called Newton. The Newton was programmed with the sample design and a screening script in order to standardize the process. The Field Interviewers did not have prior information about each household as they did with the paper screener, and therefore should not have been able to anticipate which persons would be selected. We expect that the Newton prevented convenient

sample selection manipulation. This should haveproduced a lower response rate in 1999 than in previous years because interviewers were not able to select the person who was readily available.

The research presented below evaluates the impact of the Newton in three ways. First, it examines the convenient selection hypothesis by examining differences in selection rates between 1998 (paper screener) and 1999 (Newton). Second, it evaluates the robustness of the convenient selection hypothesis by controlling for alternative explanations in a multivariate model. Finally, it applies the results of the multivariate model to the response rates in 1999 to generate an adjusted response rate. The adjusted response rate approximates the rates that would have been produced if interviewers were able to make convenient selections in 1999.

Analysis Design

This paper examines those households with more than one person in one of the age categories used by the screening instrument. These were the households that were vulnerable to the effects of the convenient selection process. In these households, the appropriate age group was determined by the sample design, but the selected person within each age group was determined by the order that Field Interviewer listed the persons on the household roster. In households with only one person per age group, the selection tables identified the appropriate person based on the sample design.

In order to isolate only those cases where screener manipulation could occur, the data were subset in three ways. As stated above, only those cases whose household contained two or more eligible people in an age group were used in the analysis. In addition, the data were limited to cases where the number of eligible persons in the age group did not equal the number of selected persons in the age group. For example, if two people were selected from an age group where only two people were eligible, the FI would not have the opportunity to manipulate the household roster. We also required that at least one male and one female be present in the age group since a roster with only one gender represented in an age group could not be manipulated based on gender.

The following definitions are used throughout this section of the chapter:

- Multiples - households in which there are more than one eligible person per age group. These are the critical cases for this analysis because they could be manipulated with the paper screener but not with the Newton.
- Convenient household members - persons at home when the interviewer conducts the screening.
- Age group - the age groups used are 12-17, 18-25, 26-34, 35-49, 50+.
- Selection probability (P) - the theoretical probability that a sample element has of being selected. Since the analysis is limited to comparing males to females in multiples, the selection probability is determined by the number of persons within each age group.

[1]

$$P = \frac{\#\ selected}{\#\ eligible}$$

- Selection event (A) - the observed selection event for a sample element. If a person is selected A = 1, 0 otherwise.
- Difference (W) - the difference between the selection probability and the observed selection events. This is the dependent variable in the multivariate models presented in Tables 3-4. The expected value of W is 0, see Table 1 below.

[2]

$$W = A - P$$

Table 1 **Possible values for W.**

# Persons in Age Group	Selection Event (A)	Selection Prob. (P)	Differ-ence (W)
2	0	.50	-.50
2	1	.50	.50
3	1	.33	.66
3	0	.33	-.33
3	0	.33	-.33

Convenient Selection Hypothesis

The convenient selection hypothesis states that interviewers were more likely to select the available person by manipulating the roster in households with multiple eligible persons in the same age group. Specifically, the hypothesis states that adult females will be selected more often in households with eligible males and females in the same age group. This is based on the assumption that most multiple adult households are comprised of married couples, and that the male is more likely to be employed outside of the home, making the female more convenient.

> *Interviewers are more likely to select females in households with more than one eligible person per age group if the groups contains at least one male and one female.*

Table 2 P-values from P^2 Analysis Comparing the Gender Distribution of the Selected and Non-Selected Persons Per Age Group.

	Year/Mode of Survey		
	1998	**1999 PAPI**	**1999 CAI**
Age			
12-17	0.43	0.84	0.41
18-25	0.01	0.12	0.48
26-34	0.00	0.23	0.08
35-49	0.00	0.29	0.92
50+	0.06	0.78	0.09

Table 2 summarizes a series of comparisons of the expected and actual distribution of males and females from multiple households within each age group. A weighted Chi-Square statistic was calculated for each comparison, the cells of the table contains the probability associated with the Chi-Square test.

The results support the convenient selection hypothesis. With the exception of the youngest age group, the actual distribution was always statistically different than the expected distribution in 1998 ($p < .05$). This difference is not present in the comparisons for 1999 PAPI and 1999 CAI. This suggests that the selection process was biased on gender measures for adults in 1998, but was not in 1999.

Multivariate Evaluation

The transition to the Newton was only one of a large number of changes to the NHSDA in 1999. The results in Table 2 demonstrate that there is a difference between the selection process in 1998 and 1999. However, it is possible that the difference between the two years could be explained by other changes between the two years.

This possibility is addressed with a multivariate comparison of the selection probabilities and selection events for 1998 and 1999. The multivariate model controls for the other known correlates of nonresponse response. These correlates were revealed through an extended analysis of the patterns of nonresponse in the 1998 and 1999 NHSDA. They include: respondent age, race, and gender; interviewer age, race, gender, and level of experience; and, sample segment population density, census region, and quarter of the year (SAMHSA 2000). The results are listed in Tables 3 and 4. The unadjusted mean row contains the selection rate estimates controlling for the age and gender of the respondent. The adjusted mean row contains the estimates controlling for the other correlates of nonresponse.

The cells under the **male** and **female** headings represent the difference between the expected probability of selection and the observed selection rates. The cells under the **estimate** heading represent the difference between the males and the females. For example, in 1998 the observed selection rates for males 18-25 was .036 points lower than expected by the sample design, and the females were .038 points higher, for a combined difference of .074, which is statistically significant ($p = .021$). If this result were applied to a household with one male and one female age 18-25, the probability of selecting a male would be .464 (.500 - .036 = .464), the probability of selecting a female from the same household would be .538 (.500 + .038 = .538).

The unadjusted difference between males and females is statistically significant for all age groups in 1998, except for group 12-17. This is consistent with the convenience selection hypothesis and mirrors the results in Table 2. When the control measures are entered the multivariate model the difference remains significant for age groups 26-34 and 35-49 (marginal at $p= .059$). This suggests that the difference for age groups 18-25 and 50+ may have been a function of the control variables, but that the difference for 26-34 and

Table 3 Differences between Expected and Actual Probability of Selection for Males and Females by Age Group for 1998 - Weighted Linear Regression

1998	Change to Expected Probability (W)		Difference from Females to Males	
	Male	**Female**	**Estimate**	**P-Value**
12-17				
Un-adjusted mean	-0.018	0.017	-0.035	0.377
Adjusted			-0.014	0.866
18-25				
Un-adjusted mean	-0.036	0.038	-0.074	0.021
Adjusted			0.036	0.586
26-34				
Un-adjusted mean	-.056	0.058	-0.113	0.001
Adjusted			-0.160	0.027
35-49				
Un-adjusted mean	-0.088	0.089	-0.177	0.000
Adjusted			-0.118	0.059
50+				
Un-adjusted mean	-0.028	0.028	-0.056	0.053
Adjusted			0.075	0.153

Table 4 Differences between Expected and Actual Probability of Selection for Males and Females by Age Group for 1999 - Weighted Linear Regression

1999	Change to Expected Probability (W)		Difference from Females to Males	
	Male	**Female**	**Estimate**	**P-Value**
12-17				
Un-adjusted mean	0.009	-0.009	0.019	0.382
Adjusted			0.011	0.645
18-25				
Un-adjusted mean	-0.007	0.007	-0.013	0.523
Adjusted			0.007	0.750
26-34				
Un-adjusted mean	-0.014	0.014	-0.028	0.093
Adjusted			-0.018	0.358
35-49				
Un-adjusted mean	0.001	-0.001	0.002	0.901
Adjusted			-0.002	0.923
50+				
Un-adjusted mean	-0.017	0.017	-0.034	0.060
Adjusted			-0.052	0.009

35-49 is likely a product of the convenient selection process. This is consistent with expectations because these age groups should contain the most married couples.

As shown in Table 4, the difference between males and females is not significant for any age groups in 1999 for CAI, except for the adjusted CAI 50+. Although not presented, a similar analysis was conducted for PAPI with similar results. The absence of relationship holds for models with and without the control variables. This suggests that convenient selection process did not occur in 1999 when the Newton was used.

Impact on Response Rates

Field Interviewer manipulation of the selection routine resulted in an over-selection of females in 1998. This would have inflated the response rates in 1998 because females are more cooperative than males. This inflation would not have occurred in 1999 because the Newton prevented the convenient selection of females.

Table 6 contains the response rates for 1999 that would been achieved if the Field Interviewers were able to manipulate the selection process as they did in 1998. The table is based on three assumptions. First, we assumed that the observed differences between the probability of selection and the observed selection rate in 1998 would have applied if we did not use the Newton in 1999. Second, we assumed that the observed response rates in 1999 would be the same if the number selected were adjusted using the 1998 probability of selection. Third, we assumed the response rate for the additional females selected in 1999 would be the same as the actual response rate for females in 1999.

The adjusted weighted response rates are better than the unadjusted. That is, the response rates would have been higher in 1999 if the Newton was not used for the screening. However, the rate would have been only slightly higher (68.68% vs. 68.55%). Although the impact of the convenient selection factor was very large in some cases, the impact on response rates was fairly small for the full project. For example females age 35-49 selection rate was 17.7% higher than would be expected by the sample design, but the yield in overall response rate for that age group is only one-third of a percentage point (.0033). This is because the opportunity for convenient selection only occurs in the households with more than person in a selected age group. This represents a small share of the overall sample, and therefore has little impact on the overall response rates.

Table 6 Adjusted 1999 Weighted Response Rates using 1998 Convenient Selection Inflation Factor

CAI	Weighted		
Age Group	1999 Rate	Adj. Rate	Difference(%)
12-17	78.07%	78.07%	00.00
18-25	71.21%	71.23%	00.01
26-34	69.45%	69.59%	00.14
35-49	67.75%	68.08%	00.33
50+	64.63%	64.70%	00.07
Total	68.55%	68.68%	00.14

Summary and Conclusions

Before the 1999 NHSDA, a paper screener was used for the selection algorithim. This paper screener provided a way for the interviewer to manipulate the roster and select the most convienient persons in the household. The introduction of the computerized screening instrument in the 1999 NHSDA survey reduced sampling bias by removing interviewer effects from the screening routine.

Our analysis focus on multiples, that is households with more than one person in an age group with at least one male and one female. We use females as a surrogate for the most convenient person in our analysis. Our findings show that for the persons aged 26-49 more females were being selected than males based on the expectation that the two genders should have equal probability of selection. Our analysis also shows that this over-selection of females was removed in 1999. The differential gender selection probability had a small effect on the response rates. More specifically, by removing this selection bias, the 1999 response rates showed a slight negative effect.

References

Groves, R.M., and Couper, M.P. (1998). *Nonresponse in household surveys.* New York: Wiley.

Substance Abuse and Mental Health Services Administration (2000). *National Household Survey on Drug Abuse Series: H-12. Summary of Findings from the 1999 National Household Survey on Drug Abuse.* Office of Applied Studies, Aug. 2000. DHHS Pub. No. (SMA) 00-3466.

Fein, David J. and West, Kirsten K. Towards a Theory of Coverage Error An Exploratory Assessment of

Data from the 1986 Los Angeles Test Census. *Bureau of the Census Fourth Annual Research Conference*. Arlington, VA. Washington, DCU.S. Department of Commerce, 1988, pp. 540-562.

Hainer, Peter; Hines, Catherine; Martin, Elizabeth, and Shapiro, Gary. Research on Improving Coverage in Household Surveys. *Bureau of the Census Fourth Annual Research Conference.* Arlington, VA. Washington, DCU.S. Department of Commerce, 1988, pp. 513-539.

Martin, Elizabeth and Griffin, Deborah. The Role of Questionnaire Design in Reducing Census Coverage Error. *American Statistical Association 1994 Proceedings of the Section on Survey Research Methods.* Alexandria, Virginia: American Statistical Association, pp. 736-741.

Martin, Elizabeth. Household Attachment and Survey Coverage. *American Statistical Association 1996 Proceedings of the Section on Survey Research Methods.* Alexandria, Virginia: American Statistical Association, pp. 526-531.

Pausche, Joan M. 1994 National Census Test Quantitative Comparisons of Coverage. *American Statistical Association 1994 Proceedings of the Section on Survey Research Methods.* Alexandria, Virginia: American Statistical Association, pp. 313-318.

West, Kristen and Richard R. Griffiths. Results from the 1995 Integrated Coverage Measuarement Evaluation Interview. *American Statistical Association 1994 Proceedings of the Section on Survey Research Methods.* Alexandria, Virginia: American Statistical Association, pp. 830-835.