

ABSTRACT

Ideal auxiliary variables for use in post-survey nonresponse adjustments are associated with both survey variables of interest and response propensity. Auxiliary variables having these properties will generally reduce the bias and variance in survey estimates. Unfortunately, auxiliary variables available for both respondents and nonrespondents to a survey request seldom have strong associations with key survey variables in practice. As a result, large face-to-face household surveys have started to request that field interviewers record estimates and judgments about selected characteristics of all sampled housing units. Although these auxiliary variables may be associated with survey variables of interest in theory, they will be prone to measurement error. Large amounts of measurement error in these observations may have negative implications for survey estimators in terms of the bias and variance introduced by the nonresponse adjustments. Practical techniques for reducing the error in these observations are therefore needed in the field. This article presents results from an analysis of an intervention that was implemented prior to the 15th quarter of the recently completed Continuous National Survey of Family Growth (NSFG). The intervention was designed to provide field interviewers with observable predictors of a key auxiliary variable for which they were recording observations. Analysis of the intervention shows evidence of a significant improvement in the quality of the observations. The article concludes with a discussion of directions for future work in this area.

INTRODUCTION

Declining survey response rates continue to plague survey research organizations worldwide (Baruch and Holtom, 2008; Biener et al., 2004; Cull et al., 2005; Curtin et al., 2005; de Leeuw and de Heer, 2002; Tolonen et al., 2006). Fortunately, recent methodological work (Groves, 2006; Groves and Peytcheva, 2008; Keeter et al., 2000) has found that decreases in survey response rates do not necessarily lead to increases in the nonresponse bias of survey estimates. Instead, the bias in survey estimates introduced by nonresponse arises from correlations between the response propensities of individuals in a population and the survey variables of interest (Bethlehem, 2002). The most effective auxiliary variables for reducing the bias in survey estimates that arises from nonresponse therefore need to have three important properties: 1) they are available for both respondents and nonrespondents; 2) they are correlated with survey response propensities; and 3) they are correlated with survey variables of interest (Beaumont, 2005; Bethlehem, 2002; Groves, 2006; Lessler and Kalsbeek, 1992; Little and Vartivarian, 2005). Unfortunately, auxiliary variables available to survey researchers for both respondents and nonrespondents seldom satisfy the third condition (i.e., they have weak correlations with the survey variables).

Because of this problem, some surveys conducting in-person interviews have recently requested that field interviewers observe and record selected characteristics of all sampled households. Kreuter et al. (2010) present three examples: the American National Election Study (ANES), the Continuous National Survey of Family Growth (NSFG), and the European Social Survey (ESS). The recently completed seventh cycle of the NSFG, for instance, asked interviewers to judge whether households had children under the age of 15 present, based on observations of selected housing units made prior to screening interviews. In addition, NSFG interviewers were asked to judge (on the doorstep) whether potential respondents selected from completed screening interviews were currently sexually active (Groves et al., 2009). Preliminary work has shown that these two judgments are correlated with both propensity to respond to the main NSFG interview and multiple key NSFG variables (West, 2010). This makes these interviewer judgments attractive candidates for making post-survey nonresponse adjustments, and the NSFG currently uses these two judgments when computing nonresponse adjustments to base sampling weights (Lepkowski et al., 2010). These judgments are also used by NSFG managers to make adaptive design changes based on a responsive survey design framework (Groves and Heeringa, 2006).

Unfortunately, practice has outpaced the theory behind this methodology. Auxiliary variables used for making nonresponse adjustments in practice are typically characteristics of area sampling units (Lessler and Kalsbeek, 1992), which may not be related to survey variables and / or response propensity but are generally measured without error. Interviewer observations, on the other hand, generally rely on judgment and estimation and will thus be prone to measurement error. Measurement error in the interviewer observations could be one reason for the limited effectiveness of nonresponse adjustments based on the observations reported in the literature to date (Blom, 2009; Kreuter et al., 2010; Scholes et al., 2008), but the existing literature has only begun to study the error properties of these data.

Initial studies have suggested that the direct measurement error in these observations is by no means negligible. Preliminary analyses of NSFG data (Groves et al., 2007; West, 2010) have found that interviewer judgments of whether selected respondents are sexually active are only 75-80% accurate, when treating eventual respondent reports of sexual activity as “truth.” In addition, the errors tend to be variable rather than systematic (i.e., false positives and false negatives are equally likely). West (2010) has also shown that judgments of NSFG interviewers regarding the presence of young children under the age of 15 are only 73% accurate (when treating household roster information as “truth”). Initial studies of the direct measurement error in interviewer judgments on the presence of children and the presence of smokers in households from the Health Survey for England (HSE) have yielded similar accuracy rates of about 75% (Tipping and Sinibaldi, 2010). Analyzing tape recordings of doorstep interactions of interviewers with potential respondents, Campanelli et al. (1997, Chapter 4) found very low agreement (less than 50%) of information in the recordings with contact observation data entered by the interviewers following the interactions, attributing this to possible interviewer memory errors. Existing evidence therefore suggests that the error in these observations is by no means negligible. Given additional initial evidence of the negative implications of the measurement error in these observations for commonly used nonresponse adjustments (West, 2010), techniques designed to reduce the error in these observations are needed in the field.

This paper describes the effect of an intervention implemented in the recently completed continuous NSFG that was designed to help improve the accuracy of these interviewer observations. The basic idea of the intervention was to provide all interviewers with known predictors of the variable that they were trying to observe, prior to the onset of a new NSFG

data collection quarter. Importantly, these predictors also had to be available to the observation of the interviewers. This type of intervention is supported by the psychological theory that “...a personality trait can be accurately judged if the judge can manage to detect and correctly use behaviors that are relevant to the trait and available to his or her observation” (Funder, 1995, p. 658). Similar theories can also be found in the psychological literature on intelligence analysis techniques employed by organizations like the Central Intelligence Agency (CIA). The *mosaic theory* of intelligence analysis posits that once all relevant and accurate pieces of information have been put together, a clear picture of reality emerges that leads to accurate estimates (Heuer, 1999, p. 62). Judgment accuracy, however, depends on both the accuracy of the judge’s *mental model* (informed by which variables are most important for the judgment and how they relate to each other) and accuracy of the values attributed to variables included in the model (Heuer, 1999, p. 58-59). This underscores the need for interviewers to be informed about appropriate models of characteristics being judged and to accurately measure the relevant variables in these models prior to making their judgments. The impact of this type of intervention on the accuracy of one of the interviewer observations collected in the NSFG is considered in this paper.

DATA AND METHODS

Data from the first 10 completed quarters of the continuous NSFG ($n = 13,495$ respondents) were analyzed in this paper. Briefly, the NSFG collects data on fertility, sexual practices, and family characteristics from a continuously released, nationally representative sample of teens and adults ages 15-44 in the United States, and a screening interview is required to determine age-eligibility (for more information on the design of the NSFG, see Lepkowski et al., 2010). The interviewers working in the NSFG (all of whom are female) were requested to make a judgment about the perceived current sexual activity of a selected respondent immediately upon completion of the screening interview. Specifically, interviewers were asked the following question in the CAPI instrument upon completion of the screening interview and selection of an eligible respondent: “Do you think the selected respondent is in an active sexual relationship with an opposite-sex partner? (Yes/No)”

The NSFG also collects a variety of paradata or “data collection process information” (Beaumont, 2005; Couper, 1998; Couper and Lyberg, 2005) both *prior* to screening interviews (e.g., number of attempted calls, previous statements made by potential respondents,

neighborhood characteristics) and *during* the screening interviews (e.g., presence of a member of the opposite sex). These paradata were therefore available to the interviewers at the time that they were asked about the perceived sexual activity of the selected respondent. In the analysis presented in this paper, the various paradata were considered as predictors of *eventual survey reports* of current sexual activity with a member of the opposite sex (1 = Yes, 0 = No) in the main NSFG interview, in an effort to inform the observational efforts of the interviewers. Female respondents were coded as currently being sexually active if they reported having at least one sexual partner of the opposite sex in the past 12 months or currently having a sexual partner of the opposite sex in the CAPI portion of the main NSFG interview (the latter item was not asked in the male questionnaire). Male respondents were coded as currently being sexually active if they reported having at least one sexual partner of the opposite sex in the past 12 months in the CAPI portion of the main interview.

Specifically, the following variables were considered as predictors of eventual survey reports of sexual activity in a design-based (i.e., accounting for the complex sampling features of the NSFG) logistic regression model: urban/rural status of the selected segment; problems with accessing the housing unit (yes/no); neighborhood largely residential in nature (yes/no); evidence of language other than English being spoken (yes/no); evidence of Spanish being spoken (yes/no); interviewer safety concerns (yes/no); many units present in the housing structure (yes/no); physical impediments preventing access to the housing structure (yes/no); judgment of whether everyone in the house was over age 45 (yes/no); judgment of whether there are children under 15 in the household (yes/no); previous contact established with the household (yes/no); previous resistance from the household (yes/no); previous statements about the survey made by the household (yes/no); previous statements about the survey at last contact (yes/no); any previous questions about the survey (yes/no); questions about the survey at last contact (yes/no); number of previous calls; number of previous contacts; estimated eligibility of the household (yes/no); the household informant was also the selected respondent (yes/no); respondent age; presence of a member of the opposite sex (yes/no); and single-person household status (yes/no). All variables had complete data for all 13,495 respondents in the first 10 quarters, and backward variable selection was used to determine the most important predictors in the logistic regression model. The objective of estimating the relationships of these variables with respondent reports of current sexual activity was to

identify observable (and available) predictors of the respondent reports that could be provided to interviewers in later quarters in order to assist them with making their judgments.

RESULTS

Table 1 below presents estimates of the adjusted odds ratios (with design-based 95% confidence intervals) in the final logistic regression model for main survey reports of sexual activity.

Table 1: Estimates of adjusted odds ratios for predictors of reports of current sexual activity in the main NSFG interview.

Predictor	Adjusted Odds Ratio	95% CI	<i>p</i> -value
Intercept	N/A		
Urban	0.781	0.642, 0.948	0.013
Many Units	1.342	1.038, 1.734	0.025
Children Under 15	1.180	1.036, 1.346	0.013
HH ever contacted	0.758	0.639, 0.898	0.001
Statement at last contact	1.406	1.093, 1.810	0.008
Informant also selected respondent	1.701	1.386, 2.087	< 0.001
Age of respondent	1.132	1.113, 1.151	< 0.001
Presence of member of opposite sex	1.464	1.121, 1.911	0.005
Single-person HH	0.342	0.248, 0.471	< 0.001

* Notes: $n = 13,495$. Area under the curve (c-statistic) = 0.742.

These results indicate that rural areas, housing structures with many units, presence of children under 15, no previous establishment of contact, respondents making negative statements about the survey in immediate previous calls, selection of the informant as the respondent in the screening interview, older respondent age, presence of a member of the opposite sex, and multiple-adult households all significantly increase the odds that a respondent will report being currently sexually active in the main NSFG interview. These results suggest that this information, which again is available to the NSFG interviewers at the time that they make a judgment about the current sexual activity of a selected respondent, might be used to help the interviewers make a more informed (and potentially more accurate) judgment.

Preliminary testing of this idea was conducted in Quarter 15 of the NSFG (with data collection from January 2010 to March 2010). Prior to the start of Quarter 15, all interviewers were informed by NSFG staff about the predictors of sexual activity reports from Table 1, and reminded of them each time that they made their judgments concerning sexual activity in the CAPI application used for NSFG data collection. Specifically, interviewers received the following email at the beginning of Quarter 15 data collection:

Dear NSFG FRs,

Below are the promised details about the Sexually-Active Observation modification. I've also included an answer to a question that came up on one of last week's conference calls and a note about STrak communications on December 27th.

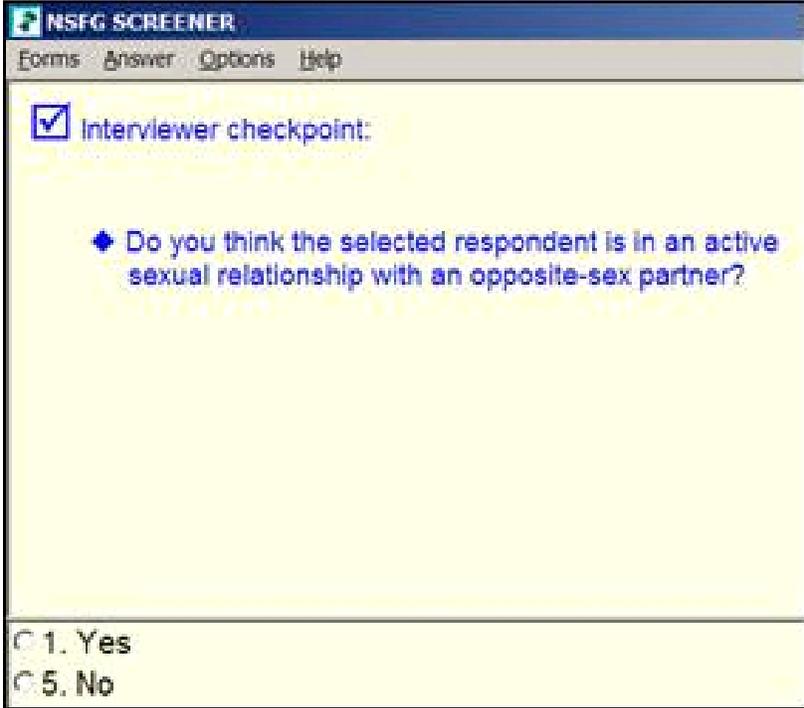
Note that there are 4 screenshots in this e-mail message. If you can't see them all please e-mail me ASAP. Thanks.

Have a wonderful break!

Shonda.

Screener Sexually-Active Observation Modifications

The question currently reads:



The screenshot shows a window titled "NSFG SCREENER" with a menu bar containing "Forms", "Answer", "Options", and "Help". The main content area has a yellow background and contains the following text:

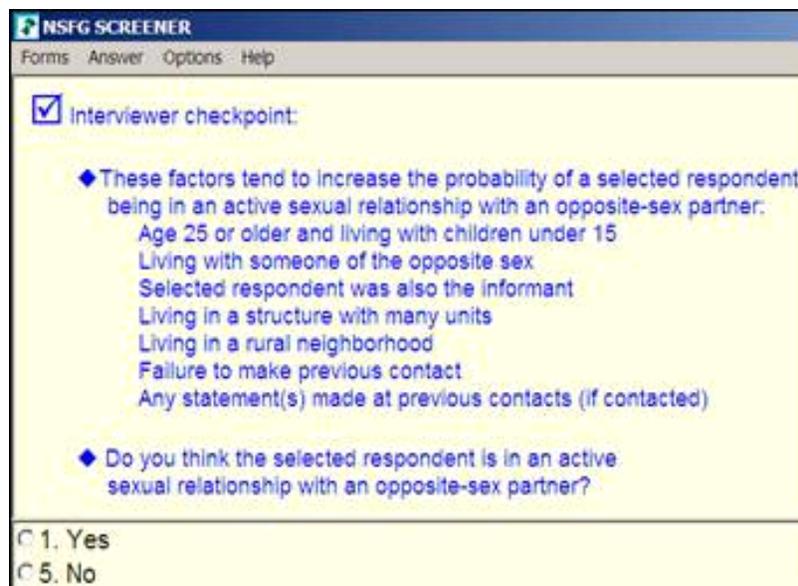
Interviewer checkpoint:

◆ Do you think the selected respondent is in an active sexual relationship with an opposite-sex partner?

At the bottom of the window, there are two radio button options:

1. Yes
 5. No

The new version will be:



The screenshot shows a software window titled "NSFG SCREENER" with a menu bar containing "Forms", "Answer", "Options", and "Help". The main content area has a yellow background and contains the following text:

Interviewer checkpoint:

- ◆ These factors tend to increase the probability of a selected respondent being in an active sexual relationship with an opposite-sex partner:
 - Age 25 or older and living with children under 15
 - Living with someone of the opposite sex
 - Selected respondent was also the informant
 - Living in a structure with many units
 - Living in a rural neighborhood
 - Failure to make previous contact
 - Any statement(s) made at previous contacts (if contacted)
- ◆ Do you think the selected respondent is in an active sexual relationship with an opposite-sex partner?

At the bottom of the window, there are two radio button options:

1. Yes
 5. No

Please contact Shonda via e-mail if you have any questions about the new version of the observation. Note that the factors now listed on the screen are included because they were identified via statistical modeling to increase the probability of the selected R being in an active sexual relationship with an opposite-sex partner. The model does not indicate *why* these factors might be important.

After these changes were implemented and data collection was completed in Quarter 15, cross-tabulations of interviewer judgments of sexual activity with actual survey reports of sexual activity were examined, and compared with the same cross-tabulations in Quarter 14 (using a chi-square test for comparing Kappa statistics computed on independent samples). Table 2 presents the cross-tabulation for Quarter 14 (prior to notification of the interviewers), while Table 3 presents the cross-tabulation for Quarter 15 (after notification of the interviewers).

Table 2: Case counts and overall percentages indicating measurement error properties of interviewer judgments of whether selected respondents were sexually active (Quarter 14, Continuous NSFG)

	Main NSFG Interview: Selected R Sexually Active		
Interviewer Judgment: Selected R Sexually Active	No	Yes	Totals
No	78 (5.71%)	142 (10.39%)	220 (16.09%)
Yes	130 (9.51%)	1,017 (74.40%)	1,147 (83.91%)
Totals	208 (15.22%)	1,159 (84.78%)	1,367 (100.00%)

* Note: Kappa Statistic = 0.2466, 95% CI = (0.1813, 0.3120).

Table 3: Case counts and overall percentages indicating measurement error properties of interviewer judgments of whether selected respondents were sexually active (Quarter 15, Continuous NSFG)

	Main NSFG Interview: Selected R Sexually Active		
Interviewer Judgment: Selected R Sexually Active	No	Yes	Totals
No	116 (8.89%)	164 (12.57%)	280 (21.46%)
Yes	87 (6.67%)	938 (71.88%)	1,025 (78.54%)
Totals	203 (15.56%)	1,102 (84.44%)	1,305 (100.00%)

* Note: Kappa Statistic = 0.3660, 95% CI = (0.3035, 0.4284).

These results present evidence of significant positive changes in overall agreement between interviewer judgments and survey reports from Quarter 14 to Quarter 15 [Quarter 14 Kappa = 0.247, 95% CI = (0.181, 0.312); Quarter 15 Kappa = 0.366, 95% CI = (0.304, 0.428); $\chi^2_1 = 6.696$, $p < 0.01$]¹ and a reduction in false positives (from 9.51% of observations to 6.67%). In fact, the false positive rate, or the proportion of respondents reporting that they are not currently sexually active who are judged to be sexually active, declined from 0.625 to 0.429. These preliminary results provide initial support for the practical idea of supplying interviewers with relevant (and available) predictors of traits being judged to improve judgment accuracy.

¹ There were 31 interviewers working in both Quarters 14 and 15 of the NSFG, introducing the possibility of correlated observations across the two quarters within these interviewers (despite the fact that information was collected on two independent random samples). Interviewer-specific Kappa statistics were computed for each of these 31 interviewers, and these measures of agreement did not have a significant correlation across the two quarters ($r = 0.1335$, $p = 0.4741$). The assumptions behind this chi-square test of equal Kappa coefficients for two independent samples therefore seem reasonable.

DISCUSSION

This paper has presented initial evidence in support of a practical technique that could be used in the field to improve interviewer observation accuracy. Necessary ingredients for this methodology include: 1) a prior predictive model of “true” values on auxiliary variables that interviewers will be estimating or judging (possibly using similar data collections that have already been completed; previous quarters in the NSFG provide an ideal example), and 2) predictors that will be readily available to the interviewer at the time that they are making an observation (e.g., the paradata in the NSFG). The important predictors can then be shared with the interviews to aid with their observations, and potentially reduce the amount of error in the observations.

Importantly, predictors of sexual activity were not provided to a *random* subsample of interviewers in Quarter 15; they were provided to *all* interviewers employed for that particular quarter. This introduces the possibility that other confounding variables (including gains in experience from Quarter 14 to Quarter 15) may be impacting judgment accuracy aside from the intervention itself. Additional research is underway to evaluate the effect of this intervention on accuracy while controlling for other potential confounders, both at the respondent and interviewer levels. In addition, planning is underway to embed a randomized experiment in a new survey data collection and test the effect of this intervention on the accuracy of interviewer observations more generally. In Wave 5 of the PASS² survey conducted in Germany (with data collection to begin in early 2011), nearly 100 CAPI interviewers will be asked to judge the unemployment benefit receipt status (i.e., is anyone in the household presently receiving unemployment benefits) and income bracket (three categories) of sampled households, as these auxiliary variables (if measured without error) are important correlates of several key variables in this economic survey. Based on models of these two auxiliary variables from a previous PASS wave, using a variety of auxiliary data available to the interviewers at the time of making these observations as predictors, a random subsample of PASS interviewers will be notified about the significant predictors of each observation. The accuracy of their observations (based on eventual respondent reports in the main PASS interview) will then be compared between the two groups of interviewers.

² PASS: Panel Arbeitsmarkt und Soziale Sicherung; translation = Labor Market and Social Security. The web site for this survey is <http://www.iab.de/en/befragungen.aspx>.

A natural question that arises about this technique is whether predicted probabilities or predicted values of the auxiliary variables of interest based on the models could be used for subsequent nonresponse adjustments, rather than the interviewer observations themselves. Practically speaking, interviewers are the eyes and ears of the survey organization in the field, and their observations may be based on information that could not be predicted by a model (which represents at best an approximation of reality). Analyzing the same data from this paper, the bivariate correlation of the predicted probabilities of current sexual activity based on the final model in Table 1 and the binary interviewer *judgments* of current sexual activity was examined. This correlation was only $r = 0.33$, suggesting that the interviewers may in fact be picking up information about current sexual activity that would not be predicted by the model (e.g., mention of a partner by the informant or selected respondent). Additional research that is both quantitative and qualitative in nature, including debriefing interviews with interviewers to assess whether this technique is helpful and how (if at all) it helps with their observational tasks, is certainly needed.

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