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Nonresponse bias in a longitudinal measurement design examining substance use across the transition out of high school

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ABSTRACT

Background: Intensive longitudinal methods are used to study the daily-level, within-person associations between substance use and its predictors and consequences. By definition, these designs require greater respondent effort than more traditional longitudinal designs, the result of which may be increased unit nonresponse and, more importantly, nonresponse bias. The present study contrasts the nonresponse properties of a measurement burst design with those of a single 1-year follow-up ("control") design, with a particular emphasis on the retention of young adults who did not plan to graduate from college.
Methods: High school seniors ($N = 318$) from three Midwestern schools completed an in-school baseline survey in spring 2012. Respondents were then randomized into a measurement burst or control group. Four, eight, and twelve months after baseline, young adults in the measurement burst group received a 30-min follow-up web survey, followed by 14 days of web-based daily surveys. Young adults in the control group received only a 30-min follow-up web survey 12 months after baseline. Response rates, predictors of nonresponse, and relative nonresponse biases for measures of sociodemographics, college plans, and substance use were compared between the two measurement groups.
Results: Compared to the control design, the measurement burst design had greater relative nonresponse bias for statistics measuring substance use, but lower relative nonresponse bias for the statistic measuring college plans.
Conclusion: Intensive longitudinal methods have the potential to retain non-college attending young adults during the transition to adulthood. Nonresponse adjustment weights should be used to correct for any detected bias.

1. Introduction

The popularity of intensive longitudinal methods has dramatically increased in recent years (Bolger and Laurenceau, 2013). Such methods are appealing because they permit the study of daily life in real-world settings, reduce the effects of recall bias, and permit the study of within-person variation and change (in addition to between-person variation; Bolger and Laurenceau, 2013; Moskowitz et al., 2009; Leigh, 2000; Schwarz, 2012; Stone et al., 1991). Measurement burst designs (Nesselroade, 1991; Sliwinski, 2008) are a particular type of intensive longitudinal design in which short-term longitudinal designs (e.g., daily diaries) are combined with long-term longitudinal designs (e.g., quarterly follow-up).

Substance use researchers use intensive longitudinal methods to examine the within-person associations between substance use and its predictors and consequences. For example, researchers have documented associations between substance use and sexual behaviors (e.g., Kiene et al., 2009; Patrick, 2013; Patrick and Maggs, 2009), affect (e.g., Armeli et al., 2000; Rankin and Maggs, 2006; Simons et al., 2010), and leisure activities (e.g., Finlay et al., 2012). Several of these studies have focused on substance use between the ages of 18 and 25, an important developmental period during which rates of substance use peak (Johnston et al., 2013; Park et al., 2006; Substance Abuse and Mental Health Services Administration (SAMHSA), 2013). Much of the research on substance use during the transition to adulthood applies primarily to young adults who are enrolled full-time at 4-year colleges and universities; however, studies that have surveyed more representative samples of young adults have found that substance use varies by college enrollment. For example, in cross-sectional or less intensive longitudinal designs, alcohol use has been found to be greater among college students (Johnston et al., 2013; SAMHSA, 2013; White et al., 2005) whereas marijuana use (Bachman et al., 1997; Gfroerer et al., 1997; Johnston et al., 2013) and cigarette use (SAMHSA, 2013)

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have been found to be greater among non-students. Thus, it is important that studies of young adults—including studies of daily-level associations—consider young adults on all educational paths in order to get a more complete understanding of substance use during this developmental stage.

By definition, intensive measurement designs place a greater burden on participants than do cross-sectional or less intensive longitudinal designs (Bolger and Laurenceau, 2013; Sliwinski, 2008); thus, it is particularly important to evaluate the effects of these designs on nonresponse. Until recently, achieving a high response rate has been considered synonymous with having high-quality data. Unfortunately, response rates have been declining for some time (Biener et al., 2004; De Leeuw and de Heer, 2002). More importantly, studies have since demonstrated that a high response rate does not guarantee that a given sample represents the target population, nor does a low response rate indicate that a given sample fails to represent the target population (Groves, 2006; Groves and Peytcheva, 2008). Therefore, a study with a very high response rate might still produce biased results if respondents and nonrespondents differ markedly on key characteristics.

A key measure of sample representativeness is nonresponse bias, which is a characteristic of a specific survey statistic (e.g., proportion of participants using alcohol) that is a function of the proportion of nonrespondents (i.e., the nonresponse rate) and the difference between respondents and nonrespondents on the variables used to create the statistic of interest (Groves, 1989). For example, when respondents and nonrespondents report meaningfully different rates of alcohol use *and* when the nonresponse rate is high, the estimated proportion of people using alcohol will be biased.

Several studies have considered issues related to nonresponse in intensive measurement studies about substance use (e.g., Gerstel et al., 1980; Litt et al., 1998); cross-sectional studies of substance use (e.g., Maclennan et al., 2012); and traditional longitudinal studies of substance use among the general population (e.g., Studer et al., 2013), among college students (e.g., Cranford et al., 2008), and among young adults in the U.S. military (Cunradi et al., 2005). In this body of related literature, however, no study has included an experimental manipulation permitting the evaluation of a measurement burst design in a study of substance use among young adults regardless of their college plans.

The purpose of the current study was to examine the nonresponse properties of two measurement designs: (a) a measurement burst design and (b) a 1-year follow-up ("control") design. Specifically, response rates, predictors of nonresponse, and relative nonresponse biases for measures of sociodemographics, college plans, and substance use were compared between designs. The study had five aims. We began by evaluating earlier phases of the study's design that had the potential to affect the interpretation of the relative nonresponse bias results: (Aim 1) differential participation in the longitudinal phase of the study and (Aim 2) baseline equivalence of measurement groups after randomization. We then compared (Aim 3) response rates, (Aim 4) predictors of nonresponse, and (Aim 5) relative nonresponse biases between designs. We hypothesized that (1) Wave 3 response rates would be lowest in the measurement burst group; (2) men and students with greater substance use would be more likely to drop out of the study, regardless of design; and (3) the measurement burst design would do a better job than the control design of retaining young adults who did not plan to attend college.

2. Methods

2.1. Enrollment procedures, information, and consent

The study began with the administration of a paper-and-pencil baseline survey to all participants. In March, 2012, three high schools in the Midwest, selected to represent urban, suburban, and rural communities, were recruited. All schools received an honorarium. Principals received study information and worked with study staff to select 12th grade classrooms based on study guidelines and finalize plans for the in-school group administration of the baseline questionnaire. Schools sent parents/guardians information on the study and provided the opportunity for them to deny permission for their children to participate in the study. Immediately after administration of the baseline survey, participants were asked to provide their contact information in order to be invited into the longitudinal phase of the study.

After administration of the baseline survey, study staff randomized approximately two thirds of baseline participants into the measurement burst group and the remaining into the control group. Groups were disproportionately assigned so that there would be greater power to evaluate within-person associations between substance use and its predictors and consequences. In addition to the methodological questions described in the current paper, the substantive questions of interest were key aims of the broader study. Four, eight, and twelve months after baseline (Wave 1: September 2012, Wave 2: January 2013, and Wave 3: May 2013, respectively), young adults in the measurement burst group received a 30-min follow-up web survey, followed by 14 days of web-based daily surveys. Young adults in the control group were invited to participate in only the final 30-min follow-up web survey administered in May 2013 (Wave 3).

Follow-up surveys were sent only to participants who were at least 18 years of age at the time of each follow-up survey. Study staff made reminder telephone calls to nonrespondents. Participants in the measurement burst group received the following post-paid incentives for the successful completion of each component of the study: $20 for completing the Wave 1 follow-up survey, $20 for completing the Wave 2 follow-up survey, $25 for completing the Wave 3 follow-up survey, and $2 for completing each diary day with a $2 completion bonus for completing all days within a 14-day measurement burst. Participants in the control group received a $25 post-paid incentive for completing the Wave 3 follow-up survey. All procedures were approved by the university's IRB.

Table 1
Response rates.[a]

	Baseline	Wave 1[b]	Wave 2[c]	Wave 3[d]
Measurement burst group		45.1%	34.8%	34.2%
Control group				40.2%
Overall	72.3%			36.1%

[a] Response rate (RR2) = number of complete interviews divided by the number of eligible participants (American Association for Public Opinion Research, 2009)

[b] The denominator for the response rate calculation is 193 and reflects the fact that nine baseline participants were not eligible to participate because they were under age 18.

[c] The denominator for the response rate calculation is 201 and reflects the fact that one baseline participant was not eligible to participate because he/she was under age 18. Note that the seven participants who refused participation during Wave 1 are included in the denominator.

[d] The denominator for the intensive measurement response rate calculation is 202. Note that seven participants who refused participation during Wave 1 and the four participants who refused participation during Wave 2 are included in the denominator. The denominator for the control group response rate calculation is 97 and reflects the fact that one baseline control group participant was deceased and was thus not eligible for participation in Wave 3.

2.2. Setting and participants

Of the 440 students eligible to participate in the baseline survey, 318 (72.3%) completed it, 104 (23.6%) were absent on the day of baseline administration, 3 refused (0.7%), and 15 of their parents refused (3.4%). Of the 318 baseline survey respondents, 300 provided their contact information on a separate form so that they were eligible to participate in the longitudinal phase of the study. Approximately two thirds of baseline participants ($n = 202$) were randomized into the measurement burst group and the remaining ($n = 98$)[2] were randomized into the control group. Response rates for the baseline survey and all follow-ups are shown in Table 1. Among baseline respondents eligible for the follow-up data collection ($N = 299$), 42.8% were male ($n = 6$ missing sex), 74.6% were White ($n = 1$ missing race/ethnicity), 64.2% had parents with at least some college education, 50.5% were from a rural school, 33.8% were from a suburban school, and 15.7% were from an urban school. (One baseline participant was deceased (and thus ineligible) at the time of the Wave 3 follow-up.)

The average age at baseline was 18.3 years (SD = 0.53). Because we were interested in how well the survey design retained young adults with and without plans to graduate from college, it is relevant to note that, at baseline, 46.5% ($n = 14$ missing) said they definitely would graduate from a 4-year college.

2.3. Measures

2.3.1. College plans. By definition, actual Wave 3 college status is not known for Wave 3 nonrespondents; thus, a baseline measure was used as a proxy. Specifically,