A FURTHER INVESTIGATION OF THE LAST-BIRTHDAY RESPONDENT SELECTION METHOD AND WITHIN-UNIT COVERAGE ERROR

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Within-unit selection of an eligible respondent has long been of interest to survey practitioners. The challenge is to utilize a technique that simultaneously (1) makes a random, thus representative, selection in units with more than one eligible person, (2) does not add to coverage error, and (3) does not add to nonresponse by "putting off" potential respondents by asking for too much "sensitive" information before the actual interview has begun.

In the 1980s, a new respondent selection technique began to be used primarily in RDD telephone surveys to choose one eligible respondent within a household. This approach capitalized on the fact that within households with multiple adults (i.e., more than one person who qualified to serve as a respondent), selecting one adult on the basis of which had the most recent birthday is a random process. This approach is very easy to use and requires little invasion of privacy in its execution.

Of note, this fact of the random nature of sampling on the last birthday is widely misunderstood within the community of survey researchers. For example, at the recent conference in Portland (OR) on nonresponse, one presenter maligned the technique as not being a randomized probability technique and contrasted it to the Kish selection technique, which the researcher appeared not to know is itself not a true probability selection technique due to it not covering all eligibles in very large units.

However, because the last-birthday technique is a true probability selection method in theory, does not mean that it works that way in practice. What is needed to assess the validity of the technique is research that gathers direct evidence of its execution in actual surveys. In one study that did this and was presented at AAPOR, it was estimated that in about 20-25% of the RDD households contacted the "wrong" person was interviewed; i.e., another adult than the one with the last birthday was interviewed (c.f., Lavrakas, Bauman, and Merkle, 1994).

The purpose of our paper is to report on evidence we have gathered about how well the last birthday method works as a within-unit respondent selection method and whether it contributes to within-unit coverage error.

METHOD

Our paper presents the results of three studies we conducted to investigate how well the last-birthday technique actually works to select the "correct" (random) respondent in a continuing monthly RDD study of the state of Ohio. The first of these surveys was conducted in December 1999 with 816 completed interviews. The second survey was conducted in March 2000 with 582 completed interviews. The third survey was conducted in April 2000 with 492 completed interviews. Each survey was conducted by the Center for Survey Research at Ohio State University. These were CATI surveys with the data gathered using the CASES software.

Selecting the Last Birthday Adult and Gathering Data about Dates of Birth

In each survey the introductory sequence used at the time of an interviewer's first contact with a household contained the following explanation of which person it was within the household that the interviewer needed to select as the designated respondent for the survey:

> *For this survey, I'd like to interview the person in your household who is at least 18 years of age and who had the last (i.e., most recent) birthday.*

Following the reading of this statement, the interviewer determined whether or not the adult who was being spoken to at the time was the adult household member with the last birthday. If it was, then the interviewer started the questionnaire. If someone else was the adult in the household with the last birthday, then the interviewer asked to speak to that other person. If the other person was unavailable, then the interviewer tried to determine the other person's first name and when the best day/time would be to call back to reach her/him.

Once the person (ostensibly) with the last birthday was on the telephone – which may have occurred as many as 30 days after the day of first contact with the household – the interviewer began to ask the substantive questions used in that month's questionnaire for approximately the first 15 minutes of the interview. Then the questionnaire transitioned into a series of approximately 20 demographic and background questions. Towards the end of this final series of questions the respondent was asked about the

total number of adults who resided in her/his household. Any respondent who said "1" (i.e., only one adult resided in the household) was skipped past a series of questions that then asked about the "patterns of birthdays among adults in the household." Thus, for all households with two or more adults, the respondent was then asked the Month and Day of her/his own birth and the Month and Day of birth for each of the other adults in the household. Remarkably, only one respondent, among the 1,890 who were interviewed in the three surveys, failed to provide the birthday information that was requested.

To analyze these data, a series of calculations were performed within SPSS for all cases with more than one adult living in the household so as to compare:

- the day/month the household was first spoken to by an interviewer,
- with the day/month of birth of the respondent,
- and the day(s)/month(s) of birth of the other adult(s) in the household.

In this way, it was determined whether the person who served as the respondent was in fact the person with the "last birthday" (i.e., had the most recent birthday prior to the day the household was first contacted and "screened" by an interviewer) and thus whether the person interviewed was the "correct" adult who was sampled within the household or if it were an "incorrect" adult who had been interviewed.

RESULTS

Accuracy of the Last Birthday Selection Method

As shown in Table 1, in each of our three surveys approximately 3 in 10 respondents reported that they were the only adult in their household, thus, by default, they had the last birthday among adults in the household and, therefore, they were the "correct" respondent. In approximately 5 in 10 of the households in each of the three surveys, there was more than one adult in the household and the interview was "correctly" conducted with the adult with the last birthday. Finally, in each of the three surveys, approximately 2 in 10 of the households had more than one adult and yet an "incorrect" adult was interviewed, i.e., not the adult with the last birthday.

Table 1

Accuracy of the Last-Birthday Method in Reaching Correct Adult Within the Household

	Dec 1999	Mar 2000	Apr 2000
Only One Adult in Household	31.1%	30.2%	31.5%
Correct Adult Interviewed (with Last Birthday)	49.1%	49.3%	47.2%
Incorrect Adult Interviewed (not Last Birthday)	19.7%	19.8%	21.3%
Sample Size	816	582	492

Across the three surveys there were a total of 126 interviewers who worked on at least one of the three studies. Of these, only 29 interviewers worked on two of the studies and only two interviewers worked on all three studies. Thus, for the most part, each survey was conducted by a different group of interviewers. This provides further evidence for the robust nature of the results in Table 1: that in about 4 in 5 of the cases the correct adult (the one with the last birthday) was the one who was interviewed and in about 1 in 5 cases it was an incorrect adult (someone other than the adult with the last birthday) who was interviewed.

Interviewers as a Possible Source of the Observed Errors in Selection

In investigating various reasons that might explain why an incorrect adult was interviewed, in about 20% of the households in each of the three surveys, we looked at whether individual interviewers were a possible cause of the selection errors.

In looking at the patterns of correctly vs. incorrectly selected respondents among all interviewers who completed at least 10 interviews, there was little evidence that any meaningful proportion of the total incorrect selections could be attributed disproportionately to specific interviewers not properly reading/explaining/applying the selection criteria. Albeit there were a few individual interviewers (< 5) who interviewed more incorrectly-selected respondents than they did correctly-selected respondents, but this accounted for a only small part of the overall 20% of mistakes in respondent selection.

Another analysis possible with our data was to look at whether there might be some consistency of selection errors associated with the gender of the interview and gender the selected respondent. It could be hypothesized that an interviewer might be more comfortable and would prefer to interview a respondent who is the same gender as the interviewer. To look into this possibility, we started by observing that, overall, there was no difference in the proportion of male vs. female respondents that male and female interviewers interviewed; i.e., across the three studies, 56% of the respondents interviewed by male interviewers were females and 57% of the respondents interviewed by female interviewers were female. Upon inspection of the proportion of "correctly" selected last-birthday respondents for male and female interviewers – which

was 70% and 71%, respectively – we have no evidence that the gender of the interviewer helped to explain the observed selection errors.

Respondents as a Possible Source of the Observed Errors in Selection

Next birthday explanation. If it does not appear to be the interviewers who were the major source of the incorrect selection, then a possible explanation is that the some respondents thought that the term "last (i.e., most recent) birthday" meant the person with the nearest birthday coming up in the future, i.e. the adult with the "next" birthday. If this, in fact, had happened, then the result would still yield a randomly selected group of respondents from within households. This follows because the person with the "next" birthday is as random an outcome as is the person with the "last" birthday (cf. Lavrakas et al, 1994). Thus, we explored our data to determine if this "next birthday" error was being made in the self-selection of certain respondents.

First we note that if there are two adults in a household and the person with the last birthday is *not* interviewed, then the person who *is* interviewed, by default, will be the one with the next birthday. Because this automatically will happen in a two-adult household, looking at households in which a selection error was made between two-adults is not a fair test of whether the "next birthday" misunderstanding caused an appreciable portion of the selection errors in our three studies. Instead, one must look only at households with three or more adults.

Across our three surveys there were 78 households with three adults in which the "wrong" person was interviewed and 33 such households with four adults. There were only two households each with five and six adults in which the wrong person was interviewed and there were no households with seven or more adults. In the following analysis we chose to focus our attention on households with three or four adults (n = 111 households) in which the wrong person was interviewed.

Table 2 presents a summary of who (in terms of birthday) was interviewed in households with three or four adults in which the person interviewed did not have the last birthday. The table shows the Expected Number of households in which the "next birthday" adult was chosen that would occur *merely by chance* assuming that the respondent selected to be interviewed was selected at random from those who did not have the last birthday. In a household having three adults with the wrong adult being interviewed, there are two incorrect adults who could be interviewed. If one of these is chosen essentially at random (i.e., the next-birthday choice is not being consciously made) then each of these two adults would be selected with probability of .50. Thus the person with the next birthday would be chosen, merely by chance, 1/2 of the time. Of the 77 households with three adults in which the wrong person was interviewed, we would expect the person with the next birthday to be selected by chance 77/2 = 38.5 times (the remaining 38.5 interviews would be conducted with persons having some other birthday – neither the next or last). Similarly, if there are four persons in a household and the wrong person is interviewed, we would expect the person with the next birthday to be interviewed by chance 1/3 of the time. Thus, out of the 33 households with four adults in which the wrong person was interviewed, we would expect the person with the next birthday to be selected by chance 33/3 = 11 times (the remaining 23 interviews would be conducted with some other person).

Table 2

Next Birthday vs. Other Birthday Selection Errors Within Households with 3 or 4 Adults (n = 111)

	Next Birthday		Other Birthday	
	Observed	Expected	Observed	Expected
Three Adult Household	36	38.5	41	38.5
Four Adult Household	10	11.0	23	22.0

Note. There was one household with 3 adults in which the order of all birthdays could not be determined although it was clear that the person with the last birthday had not been interviewed.

As shown in Table 2, our data come extremely close to what would be expected to happen merely by chance. Clearly, there is no evidence in our data that it was disproportionately the respondent with the *next* birthday who was being selected instead of the person with the last birthday. As such, the "next birthday" hypothesis does not help to explain any meaningful proportion of our observed selection errors.

Other respondent-level factors. With this in mind, we then explored whether there might be some other type of systematic respondent-level factors associated with the errors in selection.

To do this, we compared major respondent-level demographic factors (gender, age, race, education, income, and number of adults in the household) for those households with two or more adults to learn if any of these factors were reliably associated with the selection errors. As shown in Table 3, neither gender, age, household income, nor race, show any relationship to whether or not the last birthday respondent was interviewed. However, the number of adults in the household and the respondent's education were significantly related to this outcome. Specifically, as the number of adults per household increased so did the proportion of incorrect selections made using the last birthday scheme. This is consistent with the simple

Table 3
Demographic Factors and Within Household Selection Errors.
For Multiple Adult Households

Respondent Characteristics	Selection of Last-Birthday Respondent	Selection of Other (Incorrect) Respondent
Gender:		
Female	71%	29%
Male	70%	30%
Age:		
< 30 yrs	68%	32%
30-44 yrs	72%	28%
45-59 yrs	71%	29%
> 59 yrs	70%	30%
Education:*		
Not HS Grad	66%	34%
HS Grad, No College	68%	32%
Some College	68%	32%
College Grad	77%	23%
Household Income:		
<$20K	70%	30%
$20K-$30K	72%	28%
$30K-$50K	69%	31%
$50K-$75K	70%	30%
>$75K	73%	27%
Race:		
White	71%	29%
Other	71%	29%
Number of Adults:**		
Two	74%	26%
Three	60%	40%
Four	47%	47%
Five or Six	43%	57%
n	920	381

* Chi-Square (3) = 9.8, p < .02.
** Chi-Square (3) = 37.0, p < .001.

logic that as the number of adults in a living unit increases it becomes progressively more difficult for any one of them to accurately know (and/or remember) the dates of births of all the others. In addition, in those households in which the respondent had graduated from college, significantly fewer mistakes of selection were made. This is consistent with the hypothesis that higher education leads to a better (more accurate) understanding of the "last birthday" concept and thus the lower percentage of selection errors observed in such households. (Of note, a logistic regression analysis using the six demographic factors as independent variables confirmed that the number of adults and education were the only variables among the six that were significantly related to selection accuracy.)

Selection Errors and Within Unit Coverage Bias

Thus far, we have shown that there are errors of respondent selection made in approximately 1 in 5 households interviewed in our three RDD surveys. And we have shown that there are some basic demographic factors that appear related to these errors. However, the larger issue of concern is whether or not these selection errors have contributed to any meaningful level of within-unit coverage bias. Only by knowing this can we fairly and fully evaluate the strengths and weaknesses of the last birthday selection method.

The first survey we conducted for this research focused on a number of political issues. Table 4 presents a comparison, within households with two or more adults, of data gathered from the group of last birthday respondents (i.e., those correctly selected)

Table 4
Political Variables between Correctly and Incorrectly Selected Respondents within Households with Two or More Adults.
12/99 survey

Political Variables	Selection of Last-Birthday Respondent	Selection of Other (Incorrect) Respondent
Reported to Be Registered to Vote	89%	86%
	Significance: p>.10	
Would Vote for Bush	50%	46%
Would Vote for Gore	33%	36%
	Significance: p>.10	
Republican	36%	30%
Democrat	32%	42%
Independent	33%	29%
	Significance: p < .09	
Liberal	28%	31%
Moderate	24%	25%
Conservative	48%	44%
	Significance: p>.10	
Abortion remain legal as now	27%	24%
Abortion legal but more limits	20%	25%
Abortion illegal except Under special circumstances	39%	42%
Abortion not permitted	11%	6%
	Significance: p>.10	
Range of n	357-401	138-161

versus the group of non-last birthday respondents (i.e., those incorrectly selected). In this table we use political data from the December 1999 survey. Here it can be seen that for registration status, presidential candidate preference, political ideology, and attitude towards abortion there were no significant differences between the two groups. Thus, there was no statistically significant within-unit coverage bias associated with the group of incorrectly selected respondents. However, for party affiliation, there was a marginally significant

difference ($p < .09$) with more of the incorrectly selected respondents reporting to be Democrats than among respondents in the group that was correctly selected. The size of this difference also was rather large (10 percentage points).[1]

The second two surveys we conducted focused on a number of economic behaviors and attitudes. Table 5 presents a comparison, within households with two or more adults, of data gathered from the group of last birthday respondents (i.e., those correctly selected) versus the group of non-last birthday respondents (i.e., those incorrectly selected). In this table we use economic data gathered in the March and April 2000 surveys. Here it can be seen that none of the economic attitudinal variables or behavioral variables show any statistically significant differences between the data provided by the correctly selected respondents and that provided by the incorrectly selected respondents. Therefore, these data provide no indication that the incorrectly selected respondents contributed any within-unit coverage error (bias) on these economic variables.

Table 5
Economic Variables between Correctly and Incorrectly Selected Respondents within Households with Two or More Adults, 03/00 and 04/00 surveys

Economic Variables	Selection of Last-Birthday Respondent	Selection of Other (Incorrect) Respondent
Household Better Off Than Year Ago	57%	55%
Household Worse Off Than Year Ago	17%	20%
	Significance: p>.10	
Expect Good Times In Next Year	52%	51%
Expect Bad Times In Next Year	14%	17%
	Significance: p>.10	
Working Full-Time	56%	57%
Working Part-Time	8%	10%
Retired	14%	13%
	Significance: p>.10	
Quite or Greatly Stressed by Debts	12%	15%
Not At All Stressed by Debts	31%	31%
	Significance: p>.10	
Have at Least One Credit Card	81%	81%
	Significance: p>.10	
Average Amt. Charged Last Month on Credit Cards	$1,033	$1,034
	Significance: p>.10	
Average Amt. Paid Last Month on Credit Cards	$953	$813
	Significance: p>.10	
Range of n	252-519	98-220

DISCUSSION

The discussion that follows is directed at the last birthday selection method as tested in the three studies we present in this paper. However, we have no reason to suspect that had we employed the "next" birthday method instead of the "last" that we would have found any different levels of accuracy or different patterns of correlates than what has been presented here.

The last birthday within-unit respondent selection method has been utilized by many survey research organizations since the early 1980s. The attraction of this method is that it takes little time to administer, is non-intrusive and, in theory, provides a true random selection of one adult within a multiple adult household. That it is both brief and nonintrusive are important attributes at a time when survey nonresponse is a growing concern within the industry. Other respondent selection methods that ask questions of the household within the introductory spiel – e.g., how many men live there? – are more likely to lead to nonresponse due to several practical reasons. Therefore, within a total survey error perspective, survey researchers need to be concerned with the trade-off in survey error due to possible within-unit coverage error versus that due to possible nonresponse error.

The present studies have shown that the last birthday method, at least as operationalized in its

[1] This difference was related to the observed demographic differences in education and household size between the two groups shown in Table 3. This is because college graduates and persons who live in household with fewer than three adults, both of which were proportionately more represented in the correctly selected group, are less likely to be Democrats than those with less education and who live in households with three of more adults. Of note, this difference in party affiliation between the correctly and incorrectly selected groups was not even marginally significant in the other two surveys we have included in this research. However the trends in the data in those surveys were similar to what was observed in the December survey.

typical fashion as was done in our research, does not work accurately in about 1 in 5 RDD households. Our findings also have shown that the mistakes associated with its application are systematically related to its somewhat abstract meaning and to the fact that it becomes increasingly more complicated to apply as household size increases. Thus, our findings indicate that it works *more* accurately in households with residents with higher educational attainment and that it works *less* accurately as the number of adults in the household increases. Of note, we found little evidence that interviewers contributed any appreciable amount to the selection errors.

A clear implication of these findings is that any survey that is gathering data on variables that correlate with education and/or with household size may need to consider the possibility that some bias in the data may result due to selection errors with the last birthday method. Although our comparisons of the substantive data provided by the correctly selected groups and by the incorrectly selected groups showed little meaningful differences, it is possible that had we tested the effects in a survey that measured some other variable domain, we may have found more striking differences between the groups, and thereby more evidence for coverage error.

An immediate practical implication of these findings is that the last birthday method will not be accurately applied by about 1 in 5 household in the manner in which it typically is operationalized. That suggests that a more careful articulation of what the "last birthday" concept means might yield fewer selection errors. Of course the length to which a surveyor might go to have interviewers explain the concept is limited by the realistic concern that added length of explanation may increase nonresponse. Future research could use carefully controlled experiments that vary the extent to which the selection spiel tries to explain the concept and/or uses some reliability check to document the household member's understanding of the concept. These experiments should have interviewers randomly assigned to administer only one condition of wording for the selection method, and this ideally should be done in a manner that keeps interviewers blind to the on-going experiment.

Only with additional and more targeted research will we learn what the practical limits of accuracy are for the last birthday method and whether its selection errors contribute enough coverage bias to out-weigh its other attractive features.

References

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