Is Target Selection by Last Birthday 'Random Enough'? A Split-Ballot Test*

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Abstract: *An alternative to randomly selecting individuals within households is to ask that a questionnaire be completed by (or about) whoever most recently had a birthday. This has been found acceptably pseudo-random for adult household members. Its suitability for selecting household members of any age has not been examined. In a Wyoming telephone survey, 413 of the multi-person households were randomly designated to use the birthday approach; in another 421, CATI software selected a random target. The birthday approach significantly over-selected children, especially females, perhaps because a child's birthday celebration is typically more memorable.*
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To generalize to a population of individuals, surveys that first sample households must then sample individuals within households. When using CATI/CAPI software this is easily accomplished with a computerized random number generator, whether to select a random respondent or to designate a random target about whom the survey questions will be asked.

While easy for interview surveys, within-household selection presents difficulties for self-administered questionnaires. When enumerating and randomly selecting household members is not practicable, a common alternative is to ask that the questionnaire be completed by (or about) whoever most recently had a birthday. This approach has been found acceptably pseudo-random for selecting from adult household members. Its suitability for selecting a random interview target of any age has not been examined.

In Wyoming, a study of insurance coverage involved a mixed-mode survey (telephone/mail). The mail portion of necessity used the birthday approach to identify target individuals about whom the insurance questions were asked. To test whether that might bias the combined results, in the telephone portion half of the multi-person households were randomly designated to use the birthday approach; in the other half, CATI software selected a random target. The analyses here focus on whether the birthday approach over-selects children, since a child's birthday celebration may be more memorable than an adult's. Children are insured in higher proportion than adults, particularly compared to young adults, and so if the birthday approach over-represents children it would also overestimate the statewide rates of insurance coverage. If so, the resulting bias should be considered in drawing policy conclusions.

SELECTION WITHIN HOUSEHOLDS

Kish (1949:381) devised a randomizing table for interviewers to use that would "translate a sample of households into a sample of the adult population." Checked against Census data, the table as used in a telephone survey provided respondents with demographic characteristics similar to those found in the population as a whole. Males appeared to be underrepresented, perhaps because of their higher rate of non-response and because of unauthorized respondent-substitution by some interviewers.

Troldahl and Carter (1964) modified the Kish procedure using the sex and age of adult household members. This was less invasive and less time-consuming than asking for a full household listing. Selection of the wrong respondent did not appear systematic. Bryant (1975) revised the Troldahl-Carter method to address new sex distributions in the 1970 Census. Representativeness was improved, but males continued to be under-represented.

Despite simplifications in the Kish approach (especially since the availability of CATI and CAPI software to automate the random selection), it is still time-consuming. Without a professional interviewer, it is not merely cumbersome; it is wholly impractical. These issues have led researchers to use quasi-random alternatives in certain situations.

Among the simplest of these is identification of the individual who most recently had a birthday (or sometimes, the one who will have the next birthday). Birthdays are socially noteworthy, and hence it seems likely

that an arbitrary initial respondent would be able to identify who in the household most recently marked that occasion. While some months have more births than others, there is little or no scientific reason to expect that personal characteristics are linked to date of birth by anything other than random processes (Oldendick et al. 1988). Twins, who share a birthday, present a practical problem, but this affects only a small fraction of households.

Reviewing selection of adult respondents in surveys, Salmon and Nichols (1983) tested the use of "the next-birthday method" against three other established approaches: (1) Troldahl-Carter; (2) no selection; and (3) alternating sex of respondent. The next-birthday method produced a sample as representative as those generated by the other purposeful methods.

O'Rourke and Blair (1983) reported similar findings and indicated a birthday-based method has "a number of operational advantages relative to more invasive measures" (cited in Oldendick 1988:309). Likely advantages include cost savings, reductions in respondent burden and questionnaire length, ease of communication, efficiency, respect for privacy, engagement of cooperation, and reduced non-response.

Kennedy (1993) compareded seven methods of respondent selection, including most-recent-birthday, against Census data. Citing Zukin (1987) and Lavrakas (1987), he reported that the birthday method resulted in the "wrong" ultimate respondent being interviewed in about a quarter of the survey households. However, Kennedy (1993:5) also noted that "there were few differences between the methods in the distribution of responses to substantive questions." Oldendick's (1988) comparison of the Kish and "last-birthday" methods likewise found practical equivalence on sample composition and substantive response patterns.

All of these studies refer to selection of an adult, leaving open the question of how the birthday method works for selecting a target household member of any age.

A SPLIT-BALLOT TEST

A test of target selection methods was conducted as part of a large-scale mixed-mode study of health insurance in Wyoming (Leighty and Grandjean, 2003). In an RDD telephone survey of 1196 households, an early screener question asked the adult respondent how many people lived in the household, including all adults, children, and infants. Immediately thereafter, WinCATI software randomly determined whether each multi-person household was assigned to either the "randomized" or the "birthday" condition. In the former, WinCATI selected a target subject, based on computerized randomization, in each of 413 multi-person households (e.g., "second-oldest female"). The most-recent birthday method was used to identify a target subject in the remaining subset of 421 multi-person households. Naturally, no selection at all was done within one-person households; their results are excluded here.

The sample was disproportionately stratified by county so as to produce approximately equal numbers of respondents in each of Wyoming's 23 counties. The results reported here have not been weighted to compensate for this aspect of the design, but have been weighted to adjust for the expected over-sampling of households with more than one landline telephone number.

BIVARIATE RESULTS

A manipulation check to verify the randomness of assignment was conducted on household-level variables. Since household characteristics were in essence fixed once the household agreed to participate (hence, before assignment to one or the other condition), only chance differences in household characteristics should exist between the two conditions. As expected, there were no differences by household size ($p = 0.474$), children under 19 ($p = 0.892$), household income ($p = 0.272$), or item non-response on income ($p = 0.546$).

If the birthday method is over- or under-representing some types of household members, differences should be apparent between the two conditions in the individual-level characteristics of the selected target. And indeed, chi-square tests show differences between the two methods on several key individual-level variables. Target's *age, insurance status, public insurance coverage, and gender* were all sampled differently by the randomized and birthday conditions, at statistically significant levels.

Targets selected by birthday were about a year and half younger, on average, than those selected strictly at random. **(See Table 1.)** Though a t-test on the difference in means is not significant ($p = 0.272$), the categorized age distributions do differ significantly in a chi-square test ($p = 0.008$). The birthday method identified more children, especially more in the pre-school age category, but fewer young adults.

Above age 40, the two methods yielded very similar distributions.

These results contrast with the literature indicating the birthday method is similar to pure random selection. Earlier studies were limited to selection of an adult, whereas here both adults and children were eligible for selection. Children's birthdays may have more social salience for household members. When a telephone respondent is asked to identify the household member who recently had a birthday, a birthday celebration for a child may more readily come to mind than an adult's low-key marking of the date, even if the latter occurred more recently.

A related finding is that the birthday target was significantly more likely ($p = .012$) to have health insurance coverage (91.3%) than the CATI-selected target (86.2%). Statewide, children are slightly more likely to be covered than all adults, and much more likely to be covered than young adults. The difference in age distributions between the two methods probably accounts for most of the coverage difference. In addition, the context of the survey, introduced as relating to health insurance, may prime respondents to think first of those with coverage when asked for the most recent birthday, whereas the computerized randomization negates any such priming effect by eliminating respondent choice in the identification of a target.

On sex of target, where the methods also differed significantly ($p = 0.010$), the birthday method appears to have over-represented female targets. That approach produced a sample in which 56% of the identified target subjects were females. Strict randomization, in contrast, found more males than females by a margin of 52% to 48%.

In contrast to the significant differences just discussed, the reported health of targets did not differ appreciably ($p = 0.694$) between the two methods of target selection. Since health does not seem relevant to the social salience of birthdays, this finding of non-significance perhaps adds credence to the suggestion that those difference that are significant may be due to such salience.

MULTIVARIATE RESULTS

Given the over-representation of children in birthday selection, further analysis was directed at multivariate modeling of a dichotomous dependent variable: target is a child vs. target is an adult. The aim of the modeling was two-fold: to determine if the apparent difference between the two conditions would survive multivariate controls for possible confounding variables, and to search for characteristics of the respondent and of the household that predict whether a child target will be selected.

The dichotomous dependent variable suggests the use of logistic regression. The lack of a strong theoretical literature identifying likely predictor variables suggests an exploratory approach to the modeling, using stepwise procedures. Accordingly, an inventory of household and respondent characteristics was made available to the SPSS algorithm for binary logistic regression (forward stepwise, likelihood-ratio criterion).

Two key variables were forced into the model: method of target selection (birthday vs. randomized), and proportion of the household members who are children. The first is, of course, the predictor variable of primary interest. The second is an essential control variable, since obviously the probability of a child being the selected target rises with the proportion of children in the household. However, logistic regression does not directly model probabilities; rather, it models the natural log of the odds (the logit). Whereas the proportion of children in the household would be related linearly to the probability of a child target, its association with the logit should be non-linear. Therefore, the model also includes a quadratic term, the squared proportion of children, so as to capture the expected non-linearity. As expected, both the linear and quadratic terms for proportion children are significant in all models ($p<.05$).

With these variables in the model, the other significant predictors ($p<.05$) included by the stepwise procedure included respondent's age category (not target's age, which is implicit in the dependent variable), continuity of the household's phone service (yes or no, household experienced a phone outage of 7 days or more in the past year), and ethnicity (yes or no, household is Hispanic, non-white, and/or foreign). The age effect is discussed in more detail below. The effects of minority status and telephone outages may result from household socioeconomic status, but the precise mechanism is uncertain.

Other variables available for stepwise inclusion that proved not to be significant ($p>.25$) were respondent's gender, county category (urban, rural, or frontier), household income, item non-response on income (yes or no,

income question answered), welfare eligibility, presence of dedicated fax or computer line, presence of a cell phone, and household insurance (yes or no, at least one adult in the household has health insurance).

The additive model with all significant predictors from the stepwise procedure fits well, based on the Hosmer-Lemeshow test (p>.25). However, the substantive focus of this research suggests also examining the two-way interactions between method of target selection and all the significant predictors. Only one of them proved to be significant, namely the interaction with respondent's age category. This model provides a very good fit by the Hosmer-Lemeshow test (p>.75).

In both the additive and interaction models, respondents in the oldest category were least likely to select a child target, presumably because they would be least likely to have young children in the household. Notably, however, in the interaction model age of respondent makes very little difference under randomized selection, whereas under the birthday method, the youngest respondents have far and away the greatest likelihood of selecting a child target. Such respondents would tend to have the youngest children in their households – precisely the children whose birthday celebrations would be most memorable. This supports the social salience argument presented earlier.

In general, the results confirm that the birthday method selects child targets at a higher rate than randomized selection. **(Table 2.)** With no statistical controls, the raw odds ratio is 1.65. Controlling only for the proportion of the household that is made up of children, the odds of selecting a child target under the birthday method climb to more than double the odds of a child target under the random method. The odds ratio climbs again in the additive model with multivariate controls. And in the interaction model, for the youngest respondents the odds of a child target are more than 7 times greater by the birthday method than by random selection.

Summary and Conclusions

This comparative test of respondent selection methods showed significant differences on variables of particular concern to a health insurance study. Selection by birthday identified more children and more females as targets, and more targets with insurance coverage than when the selection was driven by CATI randomization software.

Arguably, such differences might be greater in a telephone interview setting, where the respondent has less time to think about who had the most recent birthday, than in a self-administered mode. Still, there is clearly a need for a practicable alternative to the birthday method for household-based mailout surveys when the aim is to generalize to a population of individuals of all ages.

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Table 1. Target's Age, by Method of Target Selection

Target's Age	Birthday	Random	Difference (B-R)
Newborn to 5 years old	8.1%	4.3%	**+3.8%**
6 to 18 years old	17.5%	13.0%	**+4.5%**
19 to 24 years old	4.8%	8.2%	**-3.4%**
25 to 39 years old	16.9%	21.2%	**-4.3%**
40 to 64 years old	43.3%	43.1%	**+0.2%**
65 or older	9.4%	10.1%	**-0.7%**
Total	100%	100%	
Chi-square = 15.765, df =5			p = 0.008
Mean Age	37.39	38.83	**-1.44**
t = 1.098			p = 0.272

Table 2. Percents, Odds, and Odds Ratios for Child Target, by Method of Target Selection

Percent child targets:	
Birthday method	**25.6%**
Random method	**17.3%**
Odds of child target:	
Birthday method (25.6/74.4)	**.344**
Random method (17.3/82.7)	**.209**
Odds ratios for method of target selection:	
Raw (.344/.209)	**1.646**
Net of % children in HH	**2.203**
Net of all additive controls	**2.309**
Interaction odds ratios, method of target selection by:	
Respondent 18 to 24 years old	**7.395**
Respondent 25 to 34 years old	**4.833**
Respondent 35 to 44 years old	**2.347**
Respondent 45 to 54 years old	**0.783**
Respondent 55 years or older	**0.679**