

SAMPLING INDIVIDUALS WITHIN HOUSEHOLDS IN TELEPHONE SURVEYS

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1. Introduction

In telephone surveys there is a need for an objective, yet quick and simple method for sampling individuals within households. Several methods have been implemented. The Kish (1949) procedure is based on a full listing of all persons in the household by age and gender. This method has long been regarded sound but time-consuming, and various suggestions have been made to reduce the number of introductory questions. Trolldahl and Carter (1964) suggested a procedure that needed only two questions, concerning the number of adults and the number of adult women living in the household. Earlier versions of the Kish and the Trolldahl-Carter procedures used a set of selection tables as a randomization instrument which did not generate an equal probability sample in all types of households. In computer assisted telephone interviewing, the randomization is conducted in a strictly correct manner by the computer. A third method, increasingly popular during the last two decades, is the birthday method, i.e., selecting the adult in the household who had the most recent birthday (or who has the next birthday).

Besides these procedures, there are procedures (such as interviewing the person who answers the phone, if eligible according to survey criteria) which do not aim at a probability sample of individuals. While such procedures may have advantages in terms of time and respondent burden, they are not considered in this study because of the potentially biased samples they generate.

The research reported here was conducted as a joint project by the Department of Statistics, University of Linköping and Svenska Institutet För Opinionsundersökningar, SIFO, a private opinion research company in Sweden.

A principal marketing and polling company, SIFO conducts every 2nd week an omnibus telephone survey on a sample of 1000 individuals (250 per day monday through thursday) from their telephone interview facility in Ronneby, southern Sweden.

The basic question for this research was: what is the best procedure for selecting a respondent within a household for the SIFO telephone omnibus survey? SIFO used a modified Kish (1949) procedure and wanted to explore other methods, which could be better in terms of interview time and refusal rates.

Comparisons of interview time are rare in the literature. Salmon and Nichols (1983) compare the average times for the total interview for the Next-birthday and Trolldahl-Carter procedures as well as two non-probability sampling procedures. They find that the average interview time is slightly shorter for the Next-birthday procedure than for the Trolldahl-Carter procedure. Many authors claim that the Kish method is slower than the Trolldahl-Carter and birthday procedures. This is certainly true for households with three or more adults, since then more questions are needed in the Kish procedure. However, the fact that this difference is not important in populations, such as that of Sweden, with predominant 1- and 2-adult households seems to have been generally overlooked.

Comparisons of refusal rates between the Kish and Last birthday procedures are reported by O'Rourke and Blair (1983) and Oldendik et al. (1988). The former paper resulted significantly in favour of the last birthday method, while the latter was slightly (not significantly) in favour of the Kish method. The different results may be explained by differences in population, field work procedures and interviewer training.

Our project was divided into three parts: (i) a mailed questionnaire interview of leading private opinion research companies on procedures used and

experiences in sampling individuals for telephone surveys; (ii) some demographic checks on the birthday procedure assumptions and (iii) comparisons of the Kish, Trolldahl-Carter, and birthday procedures, particularly with respect to time and refusal rate.

2. The SIFO Omnibus Survey

The omnibus surveys consist of a two-stage sample of individuals. In the first stage, a proportionally allocated stratified sample of telephone numbers is drawn from telephone directories. In the second sampling stage, one individual is chosen from each household.

The target population for the surveys is defined as the non-institutionalized civilians aged over 16 years. Directory sampling is used to generate 250 small banks or packs consisting of 10 telephone numbers: the number chosen plus the nine following numbers. This gives unlisted numbers a chance of being selected. We note, however, that what is obtained is not a strict probability sample of telephone numbers with precisely known inclusion probabilities. A geographic stratification of the sample - via the area codes - is implicit in the sampling method. Official population statistics are used to allocate sample numbers to directories in proportion to population numbers.

Nonrandom substitution is used in both stages. Only one phone number from each of the 250 blocks is contacted. This number is randomly chosen from the block. However, if there is no answer from the number first chosen, then another number from the same block is called, and so on, until an interview is conducted. After this interview, no other phone number in the block is contacted. The next day, another sample of 250 blocks of telephone numbers is used, and so on. In order to minimize nonresponse bias, not-at-homes from the previous omnibus week are mixed with the 2500 "new" phone numbers each day. Thereby underrepresentation of hard-to-contact households may be avoided. Whenever necessary, substitution of individuals within household is performed in the second stage. If the sample person is not at home, the youngest male is selected, the second choice is the youngest female, and the last choice is the person (if eligible) who answers the phone.

3. Reactions from Interviewed Pollsters

A questionnaire focusing on procedures for sampling within households was mailed to several companies in Sweden, Denmark, Germany, France, United Kingdom, the Netherlands, and the United States. 18 companies answered the questionnaire. Many of them use more than one method for sampling individuals within households; the choice depends on the topic of the survey or the clients' preferences.

Somewhat surprising was that as many as 14 of the 18 companies used the next or last birthday method on a regular basis. In general, the companies reported that this method worked well for their purposes. Some drawbacks with the procedure were, however, reported:

- A German company reported problems with people saying that "I am the person who has next (last) birthday" even if this was not true. The reason might be that some individuals believe that the selected person is going to get a birthday present (Biemer, 1993). This effect could lead to an overrepresentation of women in the sample, since women answer the phone more often than men.

- On the birthday method, a Dutch company pointed out that the overrepresentation of respondents with a close (recent) birthday can affect questions like "Are you planning a party in the near future?"

- One company used the next and last birthday procedures in combination on a 50 - 50 basis. This method is theoretically interesting since the respondents' birthdays will be less concentrated around the survey date than if solely one of the procedures were used (Biemer, 1993).

Other comments included:

- The Kish procedure was used by five companies. One company simply asked for the youngest man in the household (the second choice was the youngest woman), thereby abstaining from random selection.

- Quota sampling was used by all five English companies. This is possibly an effect of the relatively low telephone coverage rate in the United Kingdom.

- No company used the Trolldahl-Carter procedure.

- Most of the companies reported that young people were underrepresented in the samples, especially men

aged 18-24. Two German companies reported that elderly women (75+) may be underrepresented when the next birthday method is used. One of these companies said that this goes for men 75+ as well.

4. Demographic Checks on the Birthday Procedure Assumptions

The Kish and Troidahl-Carter methods generate equal probability samples of individuals, provided the selection questions have been answered correctly. This is not necessarily the case for the birthday method, since demographic factors could affect it. This motivated a check on the demographic basis for the birthday procedure in Sweden.

Distribution of birthdays is assumed a random process in the next (or last) birthday method. Thus, it is implicitly assumed that birthdays are evenly spread out over the year in the population. This is, however, not always the case. In Sweden, as can be seen in Table 1, total column, births are most frequent during the period March - May.

Table 1. Per Cent Births Per Month in Sweden 1921-1980.

	1921 -30	1931 -40	1941 -50	1951 -60	1961 -70	1971 -80	Total
Jan	8.4	8.1	7.9	8.1	8.1	8.4	8.2
Feb	8.0	7.8	7.7	7.9	8.0	8.2	7.9
Mar	9.2	9.2	9.3	9.4	9.6	9.6	9.4
Apr	8.9	8.9	9.2	9.4	9.7	9.6	9.3
May	9.1	9.1	9.3	9.3	9.2	9.2	9.2
Jun	8.4	8.5	8.6	8.5	8.3	8.4	8.4
Jul	8.4	8.5	8.5	8.4	8.2	8.4	8.4
Aug	8.1	8.3	8.1	8.0	7.9	8.1	8.1
Sep	8.4	8.3	8.3	8.2	8.1	8.1	8.2
Oct	7.8	7.8	7.9	7.8	8.0	7.8	7.8
Nov	7.4	7.4	7.4	7.4	7.4	7.1	7.4
Dec	7.9	8.5	7.8	7.7	7.6	7.2	7.8
Total	100	100	100	100	100	100	100

With a birthday distribution like in Table 1, the consequence for selecting a sample using the next or last birthday method is that there are more respondents with a close (recent) birthday if the survey is done in April than in November. This may affect the quality of estimates of characteristics related to birthdays.

Moreover, the pattern of Table 1, total column, is not stable over time. In Table 1 the birth pattern is also displayed for each decade. It can be seen that the sample age distribution will depend on the survey date. On the average, a survey conducted in spring generates a sample with younger individuals than a survey conducted in fall, since recent decades show considerable increases in births in the period March-April.

Despite these shortcomings of the birthday procedure, it is likely that the selection bias in survey estimates in most cases is moderate. Moreover, the increasing number of one-person households in many countries (especially in countries with a high telephone coverage!) reduces the selection bias problem, since sampling within households is not needed in these households. To illustrate, according to the Swedish 1990 Census, 42 % of all households were 1-person households (16+), see Forsman and Berg (1992).

5. Comparison of Three Methods

5.1 Research Design

The study was conducted as part of the regular SIFO omnibus surveys in December 1992, January 1993, and May 1993.

Three methods for selecting respondents were compared, each on a sample of 1000 households (i.e., one omnibus week):

i) The regular SIFO procedure, which we refer to as a "modified Kish" procedure, includes the questions

Q1. How many persons 16 years and older (including yourself) live in your house/apartment? (This is the first question in all procedures compared. Besides for respondent selection, the information is needed for weighting purposes.)

Q2. Who is the oldest one?

Q3. Who is the second oldest?

and so on until all household members are listed. Then the computer selects a respondent randomly.

ii) Next/Last birthday. Like the other procedures, the first question is

Q1. How many persons 16 years and older (including yourself) live in your house/apartment?

The second question identifies the respondent

Q2. In order to determine who to interview, could you tell me, of the people who currently live in your household who are 16 and older - including yourself - who had the most recent birthday?

In the study, the birthday procedure sample was split into two parts, 500 for next and 500 for last birthday.

iii) The third method is a version of the Troidahl-Carter (1964) method. After the question

Q1. How many persons 16 years and older (including yourself) live in your house/apartment?,

the interviewer asks

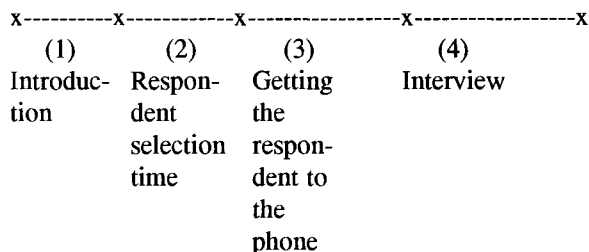
Q2. How many of them are women?

With the information given in Q1 and Q2, the computer was programmed to select a respondent with equal probability, specifying, e.g., "the oldest man" or "the second oldest woman".

Comparisons among the methods were made in three dimensions:

a) The time needed for selecting a respondent. This means the time spent in asking the specific respondent selection questions as described above. Figure 1 shows the interview components.

Figure 1:



The respondent selection time (2) is the time needed for asking the selection questions. This period was regarded as the most interesting of all composite time intervals. Note that time (3) includes the within-

household substitution procedure. The interview time (4) was not relevant for the comparisons since there were different questionnaires in the study weeks.

The measurement of time periods in a computer assisted interview can be conducted conveniently by the computer. The start and the stop must then be tied to registrations on the keyboard. The respondent selection time (2) was measured in the following way:

Time (2) starts when the interviewer keys in the answer to the very first question of the interview: "I would like to ask some questions about (the topic of study), will that be okay?" on the keyboard.

If the answer to the first selection question "How many persons 16 years and older (including yourself) live in your house/apartment?" is one, the selection process is over and the selection time stops at the moment the interviewer pushes a "1" at the board. If the answer is two or more, the specific selection questions follow. Once the respondent is determined, the interviewer says "I would like to interview "NN", is this person at home?". The respondent selection time is stopped when the answer to this question (yes/no) is registered on the keyboard by the interviewer.

Note 1: The time needed to get the respondent to the phone, once he/she is selected, is not included in the selection time.

Note 2: In one-person households, all procedures are identical.

b) The number of refusers in the selection phase of the interview (i.e., during the respondent selection time (2) defined above). The ratio of this number to the total number of persons being asked questions in the selection phase, may indicate how sensitive the selection questions are.

c) A third dimension is sample distributions over age, gender and other characteristics. In these comparisons, however, we could not separate the sampled respondents from those substituted within households. Thus, comparisons are difficult and we shall confine the presentation to the distribution of gender.

5.2 Results

Table 2 shows the average selection times in seconds for various household sizes and selection methods.

Table 2. Average Selection Times

	Household Size (16+)				Total
	1	2	3	4+	
Troldahl-Carter	20	39	46	57	34
Sample size	310	540	110	35	995
Kish	25	45	68	83	41
Sample size	341	541	86	26	994
Birthday	22	45	49	52	38
Sample Size	327	549	81	33	990

As expected, for one- and two-person households the times are rather equal since few questions are asked in all procedures. For 3-person and bigger households, the Kish method has more questions than the other procedures and consequently takes most time. Note that almost 90 % of the households are small (one or two persons). This explains why the total average times are fairly similar for the three procedures.

If expressed in terms of costs, the differences between the total average times for the three procedures are almost negligible.

We could see no difference between the next and last birthday procedures.

Table 3 displays the number of refusers during the selection questions

Table 3. Number of Refusers

Method	Number of		Percent $100x(1)/(2)$
	refusers during selection phase	respondents being asked selection questions	
	(1)	(2)	(3)
Troldahl-Carter	40	1093	3.6
Kish	47	1067	4.4
Birthday	47	1084	4.3

The Troldahl-Carter method produced fewer refusers than the other procedures in this study. The difference is, however, not significant. The almost negligible difference between the Kish and birthday methods is consistent with the findings by Oldendik et al. (1988).

Sample distributions over gender were also compared. However, these comparisons were not a major concern in the study. The results should be interpreted with caution since substitutes could not be separated from the originally selected respondents. Substitution within households is usually done in 15-20 % of all sampled households.

Table 4. Sample Distributions of Gender for the Three Methods and Official Statistics, in Percent.

	Male	Female
Troldahl-Carter	49,6	50,4
Kish	48,8	51,2
Birthday	45,2	54,8
Official Statistics	48,9	51,1

The distributions for the Troldahl-Carter and the Kish methods are surprisingly close to official statistics. We can see an oversampling of women in the birthday method. This is consistent with the hypothesis discussed in Section 3.

5.3 The Interviewers' Comments

The interviewers had no difficulty in mastering the procedures of study. Some interviewers reported, however, a negative reaction to the birthday procedure from the respondents, who did not understand the reason for the birthday question. This negative attitude affected the entire interview. By and large, the interviewers felt that the Troldahl-Carter and the Kish procedures worked better. Problems with the Troldahl-Carter procedure encountered in the United States, (Salmon and Nichols, 1983) were not found in our study.

The interviewer training did not seem to have an important effect on the results. The interviewers were familiar with the Kish procedure but had no experience with the Troldahl-Carter and birthday procedures. However, since they all had long experience in asking new questions every survey day, they felt no problem working with the new procedures.

6. Concluding remarks

The research presented here shows that demographic checks should be done when selecting a procedure for sampling individuals within households. Our principal finding is that, when choosing among the Kish, Troldahl-Carter, and birthday procedures, selection time is not an important factor if the proportion of households with more than two adults is small.

In theory, each procedure studied here can generate a probability sample of individuals. However, they all suffer from the weakness of being dependent on correct answers to initial questions about the household composition. Thus, the possibility of response errors in the selection questions should be taken into account when choosing a method. Response errors have not been studied in this research but a problem with the birthday procedure was reported: the person answering the phone may give an incorrect answer in order to be interviewed.

Demographic aspects are important in the birthday method, since it assumes that births are evenly distributed over the year. A drawback with the birthday method is that it generates a sample with too many respondents having their birthdays close to the survey date. This may lead to an added bias in any variable related to birthday. Since, in our study, some respondents had problems with the birthday method, it will not be further considered for the SIFO omnibus. It should be noted, however, that the birthday procedure is frequently used in international practice and, despite the drawbacks mentioned, it appears to be a good alternative for respondent selection in many cases.

Although the Troldahl-Carter procedure was slightly better than the Kish procedure in this study, we found no evidence that this would be the case in the long run. Thus, we see no reason to recommend a change from the present use of the Kish procedure.

To choose between the Kish and the Troldahl-Carter procedures, further evaluations regarding response errors in the selection questions as well as comparisons of sample distributions over various characteristics are recommended.

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