

OPTIMIZING THE TIME SCHEDULES AND RESPONSE RATES
IN TELEPHONE INTERVIEWS - A STUDY OF THE SEASONAL PATTERNS*

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Usage of telephone interviewing in social surveys has been increased substantially in recent years. Because of this, studies of various methodological problems associated with telephone interviews is increasingly popular (see Colombotos, 1965; Coombs and Freedman, 1964; Rogers, 1976; Groves, 1977; Falthzik, 1972, Vigderhous, 1978).

Amongst these various studies, perhaps the fundamental issue focuses on maximizing the response rate. Specifically, the problem involves an optimal utilization of all the resources such as human effort, time and cost to maximize the response rate. In the previous paper, Vigderhous (1978) has shown that by minimizing the number of call-backs that are necessary to reach certain respondents and by selecting a most convenient time for respondents to be interviewed, higher response rates can be achieved.

The purpose of this paper is a continuation of the research which can provide Surveys Analysts with empirical results from yearly data and assist them in optimizing telephone interviews. In particular, the following issues will be discussed.

- based on the yearly data, what is the "best" hour of the day to conduct telephone interviews?
- What is the "best" day of the week and the "best" month of the year to conduct telephone interviews?
- What is the difference in response rates between the morning, afternoon and evening hours?

Data Collection

The data collected in this study are based on the monthly telephone interviews which took place between February 1978 and January 1979 by the Telephone Company. The purpose of this survey was to obtain data on the perception of telephone subscribers on the quality of telephone service. The same set of questionnaires was used throughout the whole period.

Temporary and Final Non-Response

In order to study the distribution of different forms of responses to telephone interviews, we have to define the following terms - completed response, temporary and final non-response. By enumerating the common outcome of telephone interviews,¹ we can distinguish whether it belongs to anyone of the above three types.

Before discussing this problem in further detail, let us enumerate common outcomes of telephone interviews and define their terms.

- a) Busy: The number that the interviewer dialed was busy.
- b) Call-Back: Interviewer was asked to call back some other time because required person was not there or the required person was too busy to answer questions but would like to

- be called again at another time. (No attempt was made to set a specific time or day.)
- c) No Answer: The dialed number keeps on ringing up to 6 times with no answer.
- d) No Responsible Party: Any of the following groups of people:
 - child under 18
 - disabled (deaf)
 - drunk or incapable to reason, etc.
- e) Other Language: The interviewer was not able to communicate with the respondent because he was unable to speak the respondent's language.
- f) Partially Completed: Interview has been partially completed and future attempt is made to complete the interview.
- g) Quit: Respondent refused to proceed with the interview after hearing one or several questions.
- h) Refused to Start: Respondent refused to proceed with the interview.
- i) Disconnect: The particular telephone number has been disconnected.
- j) Completed: Interview was completed.
- k) Miscellaneous: All other reasons.

This list of outcomes of telephone interviews is not exhaustive but does represent most outcomes of telephone interviews. Outcomes A to F are identified as temporary non-response and outcomes G to I as non-response. During the survey a decision has to be made as to when a temporary non-response becomes a non-response.

The first general question of interest in analysing various forms of temporary non-response is the proportion of each event as computed from the total number of telephone dialings made in a given study.

- TABLE 1 ABOUT HERE -

Table 1 indicates that the most prominent problem of temporary non-response is due to "no answer" (about 40-50% of the total dialings). The second and third most frequent type of temporary non-responses are due to "call-back" (about 8%) and "busy" (about 7%). Given that these three types of temporary non-responses are the primary types of temporary non-responses that possibly result in lowering the response rate, the problem lies in minimizing these categories. To do that, we study the distribution of the type of response rate on hour of the day and day of the week and on months.

What is the "Optimal" Time of the Day to Conduct Telephone Interviews

To choose an optimal time for telephone interviews, we could either pick the time when the probability of temporary non-response is small or the proportion of successfully completed calls which is relatively large. Table 2 shows the distribution of completion rate over the time of the day for the twelve month period.

- TABLE 2 ABOUT HERE -

The table shows that the completion rate is the highest between 6:00 p.m. to 6:59 p.m. consistently over the twelve months with one or two

exceptions. The result is consistent with the previous findings (see Vigderhous, 1978).

A plot of the average completion rate over the twelve month period on the time of the day indicates that in general, evening hours are better in terms of better completion rate. (See Figure 1).

- FIGURE 1 ABOUT HERE -

We can also look at the distribution of temporary non-response such as "no answer," "call-back" and "busy". The same preferred hour, 6:00-6:59 p.m., is evidenced by examining the lowest rate of "call-back" and "no answer". The examination of these proportions review the same conclusion as in Vigderhous, 1978.

What is the Preferred Time, Day, Month for Telephone Interviews - A Log-Linear Analysis

As indicated previously, the highest probability of reaching respondents occurred during the evening hours. The question arises whether there is a significant day effect (which day is more preferred) or day-hour interaction besides the hour effect. In other words, what is the effect of the hour of the day when a control for the day of the week is established. Is there any particular hour on a particular day which is significantly different from the others regarding the response rate. These questions can now be answered using a log-linear analysis. The results of these analyses are summarized in Table 3 and Table 4.

- TABLE 3 AND TABLE 4 ABOUT HERE -

The entire analysis is based on the total number of dialings.² A separate analysis is conducted for each month, using the number of completed interviews together with the incompleting (temporary or final non-response) calls. Perusal of Table 3 re-emphasizes that the hour of the day has the highest weight in predicting the proportion of completed telephone interviews. The next two significant hours are 4:00-4:59 p.m. and 7:00-7:59 p.m. With only a few exceptions, the estimates for those two hours are significant at $p < .05$. In general, most of the evening hours are significant.

To assess the effect of the day, we examine the estimates of the days. As in previous findings (Vigderhous, 1978), the effect of the day in predicting the proportion of completed telephone interviews varies from month to month. For instance, during February, March, April and August, there are no significant differences among the days. However, in December, Friday is very much different from any other days. Hence, no conclusion can be drawn regarding the importance of the day of the week in scheduling interviews since it depends on which month of the year is under consideration.

In carrying out the above analyses, two reference points are chosen, one for each variable. The hour between 9:00 a.m. to 10:59 a.m. is chosen as a reference point for time. Likewise, Friday is chosen for the day. The same set of reference points are chosen throughout the whole analysis. Hence, to interpret a positive coefficient, it means that the contribution towards the predictability of proportion of completed calls is larger for that category than the reference point. For example, the coefficient for the hour 6:00-6:59

p.m. in February is .503, which is essentially the difference between the effect of that hour and the referenced hour (9:00-10:59 a.m.). Therefore, each result should be assessed in relation to the reference point or the omitted category.

The chi-square and maximum likelihood chi-square statistics are included as an assessment to the fitness of the log-linear models which may (or may not) include interaction terms as indicated in Table 4. It is interesting to note that interaction terms do not appear uniformly over the months. Some of the reasons may be attributed to seasonal patterns and holiday schedules. For instance, Christmas shopping spree is affecting the postulated model. However, the fact that it changes from month to month leads to another analysis of the monthly effect. Table 5 summarizes the result of the analysis on months.

- TABLE 5 ABOUT HERE -

Because we are mainly interested in the monthly effect, we simplify the analysis by reclassifying the time into 3 sessions; morning hours (9:00 a.m. to 1:59 p.m.), afternoon hours (2:00 p.m. to 4:59 p.m.) and evening hours (5:00 p.m. to 8:59 p.m.). The result in Table 5 reviews that January, February, March and April are the "best" months to conduct telephone interviews; June, July and August are less preferable and December is considered to be the worst month. The reference point for month is January and for time session is afternoon. Again, the result supports the argument which states the evening hours are "better". Among the interesting interactions, December evening hours carries the largest negative value. This implies that evening hours in December are exceptionally low regarding the response rate.

- FIGURE 2 ABOUT HERE -

The percentage of completion with respect to the definition of morning, afternoon and evening hours defined as above are plotted over twelve months as shown in Figure 2. The graph on Figure 2 depicts the changes of completion rate over the months consistent with results from log-linear analysis. In general, it is better in the early part of the year and slowly declines in summer months, then it picks up again and drops at the end of the year.

Which Season is the "best" for Conducting Telephone Interviews

We have learned from Figure 2 that there is a systematic change of completion rate, the next question of interest is to find out which is the "best" season. To do that, we arbitrarily group the months into Spring (March, April, May), Summer (June, July, August), Fall (September, October, November) and Winter (December, January, February). Of the four seasons, we learn that spring is probably the "best" time of the year to do the telephone interviews.

- TABLE 6 ABOUT HERE -

The months in fall are the second choices to spring. Also, it is interesting to learn that summer mornings are the least favoured time.

Summary and Conclusions

The result from this study shows that for telephone interviews, evening hours are preferred

with peak hour between 6:00 p.m. to 6:59 p.m. There is no difference on which day of the week. However, it makes some difference on which month of the year the telephone interviews take place. Schedules in spring and fall are generally better than in summer and winter.

The result supports the general conclusions made by Falzhzik (1972) which indicated that the rate of completion in telephone interviews is dependent upon the time of the day. However, Falzhzik's (1972) findings, that 9:00-12:00 a.m. is the best time, is not supported. In addition, dependency on the day of the week was not supported either.

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FOOTNOTES

- 1 The same set of terminology are used for the outcome of telephone interviews as in Vigderhous (1978).
- 2 Total dialings was used instead of only the first dialing in the analysis which is based on the fact that when the interviews are conducted, arrangement for "call-backs" are usually in alternating schedules. For instance, if the outcome of the first contact in the morning results in a "call-back", arrangement is usually made in the evening for a subsequent recall. Another problem related with this is that, from a practical point of view, day-shift interviewers usually made the first contact to the respondents.
- 3 The grouping of the months is conventional according to the climate of the place where the telephone interviewing takes place.

TABLE 1

Outcome Of Telephone Interview By Month (Proportion Of Total Dialings)

OUTCOME	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
A. Busy	.0817	.0771	.0694	.0704	.0648	.0475	.0560	.0491	.0597	.0697	.0603	.0572
B. Call Back	.1064	.0994	.1015	.0843	.0807	.0812	.0763	.0764	.0878	.0811	.0570	.0753
C. No Answer	.4064	.4206	.4198	.4601	.5014	.4901	.4801	.4410	.4377	.4224	.4613	.4405
D. No Responsible Party	.0524	.0479	.0481	.0458	.0474	.0583	.0592	.0616	.0620	.0646	.0721	.0662
E. Other Language	.0163	.0164	.0199	.0210	.0255	.0382	.0464	.0410	.0396	.0470	.0475	.0462
F. Partially Complete	.0005	.0013	.0007	.0007	.0017	.0012	.0010	.0015	.0007	.0020	.0007	.0008
G. Quit	.0062	.0069	.0061	.0065	.0103	.0117	.0108	.0106	.0102	.0121	.0092	.0084
H. Refused To Start	.0053	.0095	.0081	.0080	.0077	.0091	.0093	.0103	.0152	.0171	.0128	.0118
I. Disconnect	.0033	.0052	.0024	.0037	.0029	.0043	.0046	.0053	.0052	.0051	.0058	.0060
J. Completed	.2828	.2903	.2940	.2692	.2366	.2400	.2376	.2107	.2680	.2606	.2081	.2684
K. Miscellaneous	.0387	.0254	.0300	.0303	.0210	.0184	.0187	.0924	.0139	.0183	.0653	.0192
Total Number Of Dialings	5519	5381	5421	6134	5168	5834	7023	6764	6697	6845	5560	6189
Sample Size	2453	2427	2469	2694	2191	2589	3142	3216	3143	3258	2833	2953
% Response	63.64	64.36	64.56	61.28	55.82	54.07	53.12	44.32	57.10	54.75	40.84	56.25

TABLE 2

Completion Rate of Telephone Interviews
By Time of the Day and Months
(Proportions of Total Dialings)

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	AVERAGE
9:00-10:59 p.m.	.284	.353	.310	.394	.269	.218	.229	.239	.310	.273	.227	.244	.279
11:00- 1:59 p.m.	.351	.333	.340	.293	.259	.266	.199	.291	.322	.310	.268	.387	.302
2:00- 2:59 p.m.	.420	.370	.430	.403	.344	.318	.253	.286	.334	.374	.243	.279	.388
3:00- 3:59 p.m.	.349	.466	.464	.313	.272	.284	.283	.297	.332	.340	.251	.345	.333
4:00- 4:59 p.m.	.553	.514	.443	.373	.305	.369	.373	.387	.352	.391	.324	.302	.391
5:00- 5:59 p.m.	.459	.331	.430	.378	.294	.396	.286	.331	.425	.302	.286	.307	.352
6:00- 6:59 p.m.	.479	.505	.514	.456	.379	.350	.414	.425	.496	.419	.306	.484	.436
7:00- 7:59 p.m.	.543	.401	.457	.388	.340	.346	.451	.432	.444	.323	.357	.404	.407
8:00- 8:59 p.m.	.441	.451	.500	.432	.393	.390	.410	.526	.368	.408	.118	.511	.412

FIGURE 1

Average Percentage of Completion of
Telephone Interviews By Time of Day

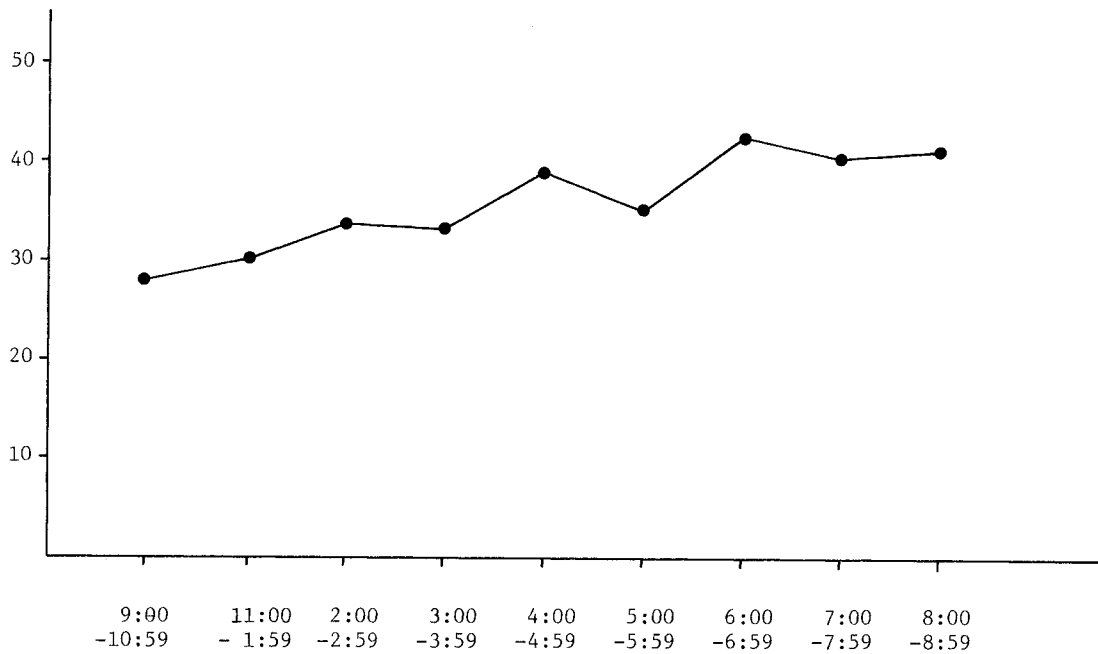


TABLE 3

Log-Linear Analysis of Completed Telephone Interviews (Out of Total Dialings)

		1978											1979
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
INTERCEPT		-1.219	-1.025	-1.206	-1.443	-1.480	-1.623	-1.092	-1.327	-1.289	-1.213	-1.129	-1.608
		REFERENCED											
1.	9:00 - 10:59 a.m.												
2.	11:00 - 1:59 p.m.	.192	-.070	.087	-.021	-.023	.160	-.106	-.003	.038	.009	.024	.434**
3.	2:00 - 2:59 p.m.	.482**	-.067	.322**	.141	.270**	.366**	-.214	.085	.083	.133	.019	.114
4.	3:00 - 3:59 p.m.	.208	.273**	.408**	.077	.045	.234	.060	.042	.072	.025	-.016	.348**
5.	4:00 - 4:59 p.m.	.675**	.391**	.370**	.296**	.144	.517**	.479**	.218**	.124	.100	.101	.204
6.	5:00 - 5:59 p.m.	.463**	-.001	.325	-.065	-.086	.571**	.407**	.492**	.295**	.331**	.301	.203
7.	6:00 - 6:59 p.m.	.503**	.340**	.502**	.517**	.357**	.608**	.690**	.857**	.465**	.646**	.401**	.686**
8.	7:00 - 7:59 p.m.	.760**	.110	.394**	.382**	.461**	.456**	.370**	.668**	.357**	.424**	.276**	.504**
9.	8:00 - 8:59 p.m.	.442**	.259	.502**	.282	.398**	.565**	.635**	.571**	.186	.474**	.270**	.723**
		REFERENCED											
10.	Monday	-.092	-.110	.040	.281**	.343**	.219	.088	.166**	.142	.151**	.076	.269**
11.	Tuesday	.021	.062	.038	.383**	.191	.056	-.021	.281**	.265**	.043	.043	.328**
12.	Wednesday	-.031	.103	.155	1.257**	.173	.040	.090	.065	.220**	.178**	.089	.308**
13.	Thursday	.021	-.135	-.021	.157	.096	.268**	.073	.264**	.005	.075	-.123**	.133
14.	Friday												
Chi-Square		32.89	32.71	33.35	34.72	27.85	34.47	21.48	27.57	28.11	35.90	36.75	32.94
ML Chi-Square		33.54	32.75	33.81	34.58	27.96	34.37	21.81	27.46	28.06	35.83	36.44	33.29
D.F.		30	31	32	24	30	29	27	26	32	30	28	32

** Significant at $p < .05$.

TABLE 4

Log-Linear Analysis of Completed Telephone
Interviews (Out of Total Dialings)
Estimates of the Interactions

INTERACTIONS	FEB		MAR		APR		MAY		JUN		JUL	
		9 x 11 3 x 13	-.679** -.521**	3 x 13	.558**			2 x 12 4 x 12 5 x 12 7 x 12 8 x 12 6 x 13 7 x 13 8 x 13	-.909** -.942** -1.588** -.790** -.866** 1.351** -.526** -.775**	6 x 10 7 x 12	1.223** -.875**	4 x 11 4 x 12 7 x 13
INTERACTIONS	AUG		SEP		OCT		NOV		DEC		JAN	
	3 x 10 6 x 12 8 x 12 6 x 13 9 x 13	.741** .893** -1.117** .745** 1.203**	2 x 10 6 x 10 9 x 11 7 x 13 8 x 13 9 x 13	-.288** .463** .483** -.486** -.515** -.438**			5 x 11 6 x 11	.346** .499**	6 x 10 3 x 11 6 x 12 6 x 13	-3.077** -.515** -.397** .498**		

** Significant at $p < .05$.

TABLE 5

Log Linear Analysis on Completion Rate of Telephone Interviews (Analysis by Total Dialing)

LOG LINEAR ESTIMATES	MONTHLY DATA
1. Intercept	-1.053
2. February	.117**
3. March	.182**
4. April	.159**
5. May	.035
6. June	-.149**
7. July	-.147**
8. August	-.100**
9. September	-.083
10. October	.020
11. November	.024
12. December	-.209**
13. January	Referenced
14. 9:00 - 1:59 p.m.	-.154**
15. 2:00 - 4:59 p.m.	Referenced
16. 5:00 - 8:59 p.m.	.214**
INTERACTION	ESTIMATES
2 x 15	-.131**
7 x 13	-.258**
8 x 15	.116**
10 x 15	-.159**
11 x 15	-.341**
Chi-square	26.26
ML Chi-square	26.30
D.F.	17

**Significant at 5% level.

TABLE 6

Log Linear Analysis of Completion Rate of Telephone Interviews (Analysis by Seasons)

LOG LINEAR ESTIMATES	SEASONAL DATA
1. Intercept	-1.099
2. Spring	.158**
3. Summer	-.068
4. Fall	.031**
5. Winter	Referenced
6. Morning	-.139**
7. Afternoon	Referenced
8. Evening	.192**
INTERACTION (3 x 6)	-.127**
D.F.	5
Chi-square	8.795
ML Chi-square	8.790

** Significant at the 5% level.

Key: Spring - March, April, May
 Summer - June, July, August
 Fall - September, October, November
 Winter - December, January, February
 Morning - 9:00 - 1:59
 Afternoon - 2:00 - 4:59
 Evening - 5:00 - 8:59

FIGURE 2

Percentage of Completion by Month and Time of Day

