



Response Timing and Coverage of Non-Internet Households: Data Quality in an Internet-Enabled Panel

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Autobiography: J. Michael Dennis is a Vice President and Managing Director at Knowledge Networks, Inc., a Menlo Park, California-based market research firm. Dr. Dennis is expert in online and RDD telephone survey methodology, and conducts methodological research on online surveys. He holds a B.A. and an M.A. from the University of Texas and a Ph.D. in Political Science from the University of Chicago.

Response Timing and Coverage of Non-Internet Households: Data Quality in an Internet-Enabled Panel

An Internet-Enabled Panel based on Random Digit Dialing (RDD) sampling appears to have several advantages over Internet-based and telephone-based survey research. This paper assesses whether two of these advantages translate into better survey data. The first advantage is that panel members choose when to complete surveys, in contrast to a CATI system and telephone center hours of operation which dictate the timing in most telephone surveys. The second advantage is about reduction of noncoverage bias: an Internet-enabled panel based on RDD recruitment includes both Internet and non-Internet households, in contrast to other online panels which essentially exclude the unconnected public.

What impact is there on study results by restricting survey participation between 9:00 am and 9:00 pm when telephone centers make calls to respondents? Would study conclusions change if respondents could respond at their convenience 24 hours a day?

Moreover, what about non-Internet households that are basically excluded from participating in Internet surveys? Would study conclusions change if interviews from non-Internet households were to be excluded?

To answer these questions, the paper provides basic information on the volume of surveys taken during times when phone centers tend to be closed and by adults in non-Internet households. Demographic and other correlates of response timing and survey completion are identified to help recognize the areas at risk for non-response bias. Finally, the paper notes substantive differences in survey data that result from survey participation outside the industry's telephone calling window of 9:00 am-9:00 pm (respondent local time) and from the participation of non-Internet households.

This paper does not directly address several related topics, including the sample composition of the Knowledge Networks Panel, the potential for panel effects, and the sampling and data collection methodology. These topics have been covered by other papers and are available by sending an email request to the author.

Methodology

The data for approximately 141,000 survey cases were assembled for this analysis. Each case represents a sampling event between March 2000 and April 2001 where a Knowledge Networks Panelist was requested to complete a survey using an Internet appliance. The survey cases are the entire samples drawn for a broad spectrum of general population surveys about political behavior and attitudes, household composition and possessions, computer and Internet usage, attitudes toward sensitive issues such as HIV, health-related behavior and outcomes, and awareness of attitudes toward new products. Each survey had a field period of 14 days or more, and standard routines were followed in their execution (i.e., no special actions were taken to

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improve the completion rate). The survey sampling and interview completion dates and times are transformed into respondents' local time, taking into account geographical variation in Daylight Savings Time. Each case also contains information on the computer-based Internet status (yes/no) of the household at the time of panel recruitment. Data on other access points to the Internet (work, libraries, etc.) are not available at the time of panel recruitment.

The sampling events are coded into "contact periods" (i.e., time windows) and home-Internet categories described below. Coding cases into contact periods facilitates "what-if" analyses that compare actual survey results to results that would have been obtained if case completion were limited to calling windows used by telephone centers. The paper does not make the claim that surveys completed on the Internet after 9:00 pm and before 9:00 am would have been "missed" by telephone centers. However, our customers have asked about the quality of data collected during unconventional time windows. It is interesting to speculate if some of the panelists who complete surveys outside the weekend and evening hours (when thousands of phone interviewers staff CATI stations) would be coded by phone studies as 'noncontacts' after N call attempts.

Below are the coding schemes for analysis of 141,000 sampling events.

- Contact Period: Survey Completion Date/Time (7 days a week)
 - Midnight to less than 9:00 am
 - 9:00 am to less than 5:00 pm
 - 5:00 pm to less than 7:00 pm
 - 7:00 pm to less than 9:00 pm
 - 9:00 pm to less than Midnight
- Contact Period: Mirroring "Expensive" Telephone-Based Data Collection (7 days a week)
 - 9:00 am to 9:00 pm
- Contact Period: Mirroring "Economical" Telephone-Based Data Collection (7 days a week)
 - 5:00 pm to 9:00 pm
- Home Internet Access at Time of Recruitment into the Panel (Yes/No)

These data are then merged with the substantive survey data sets on the topics mentioned above, enabling an assessment of the relationship between (i) substantive survey measures and (ii) both the survey environment (24-hour contact window for Internet surveys) and the inclusion of non-Internet households in the research panel.

The analyses of the substantive measures such as political party ID and attitudes towards HIV are weighted inversely to the probabilities of selection. Because panel recruitment is based on RDD sampling (1+ list-assisted method), the probabilities of selection are known at each stage and are incorporated into the sample design weights. The range in the sample design weights is small (from approximately .5 to 2).

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An obvious data limitation of this study is that it measures the Internet status of panelists at the time of recruitment and does not update that status post-recruitment (from non-Internet to Internet status, and vice versa, depending upon the disposition of Internet technology in the home). In general, this limitation should lead to underestimates of the role of non-Internet households in terms of enriching the sample since more households are gaining Internet access than losing Internet access over time. The cases classified as non-Internet households are certain to be more diluted with households recently acquiring Internet access than *vice versa*.

The Survey Environment for Knowledge Networks Panelists

The survey and panelists' demographic data for this study are from Knowledge Networks, Inc. The results of this study, therefore, reflect the specific panel recruitment and panel management policies and procedures of Knowledge Networks, which maintains the only Web-based survey system that collects data from a scientifically representative sample of the entire U.S. population on an ongoing basis. Below are relevant practices at Knowledge Networks that define the panelists' survey environment:

- **Probability-Based Panel Recruitment:** Panel recruitment is based on list-assisted, Random-Digit Dialing (RDD) telephone methodology. Entire households are recruited into the panel, and persons age 18 and over are enrolled. No quota sampling is practiced.
- **Inclusion of Non-Internet Households:** Panel recruitment includes both households with and without household Internet access.
- **Use of Internet Appliance:** Knowledge Networks provides each recruited household an Internet appliance and Internet Service Provider services.
- **Constant Data Collection Platform:** With rare exceptions, all surveys are administered via the Internet appliance.
- **Weekly Survey Participation:** Three to four times a month, panelists receive an email invitation with a hyperlink to a short, Web-enabled survey. Panelists may complete the survey at their convenience. Frequently, the surveys include multimedia content (audio, video, and still photos).
- **Panel Management:** Survey sampling is controlled so that panelists are not assigned more than one survey on the same or similar topic in a three-month period. New panelists are given non-client surveys in their first two weeks to assure that panelists are adequately prepared to use the survey system.

While the practices of other companies will not be reviewed here, it is important to acknowledge that the results in this paper reflect the Knowledge Networks paradigm.

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When Panelists Participate in Research

Approximately 62 percent of interviews conducted by our research panelists occur during the working hours of the more expensive telephone centers, and approximately 25 percent occur during working hours of other phone centers that dial only when contact rates are highest. Research panelists are electing to participate in research when many telephone centers are closed: about 38 percent of the survey completions occur outside the 9:00 am-9:00 pm respondent local time window and 75 percent occur outside the 5:00 pm-9:00 pm respondent local time window.

Exhibit 1: Completed Interviews by Contact Periods for Selected Surveys

	No. Completed Interviews	Percent of All Completes
Expensive Phone (9 am – 9pm)	67,197	62%
Economical Phone (5 pm – 9pm)	27,426	25%
All Interviews	107,999	100%

Selected Findings:

- 20% of interviews are completed between 9:00 pm and Midnight
- 18% of interviews are completed between Midnight and 9:00 am
- 46% of interviews are completed on the weekend

Undoubtedly a factor in the high weekend participation rate is that 70 percent of the sample events took place on a Friday or Saturday (for the surveys selected for study). As the median length of time to survey completion is less than three days, most of the survey-taking on the weekend is simply lagging the survey sampling schedule by one to two days.

It is striking that panelists are often deciding to participate in research when typical telephone centers are not dialing cases. Panelists have taken advantage of the opportunity to participate when it is convenient for them. Later, this paper presents some evidence that the interviews self-administered outside the typical calling windows can have an impact on substantive measures, although limited to a special instance.

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The Participation Share of Non-Internet Households

Enriching the panel are households that did not have access to the Internet from home prior to recruitment into the panel. In the surveys selected for study, the non-Internet panelists were emailed 34 percent of all of the requests for survey participation (i.e., “sampling events”). Because of their relatively high completion rate as a group, the non-Internet panelists completed almost half of the interviews.

Exhibit 2: Sampling Events and Interviews, by Home Internet Access at Time of Panel Recruitment

Sampling/Interviews	Home Internet Access at Recruitment		Total
	Yes	No	
Sampling Events	66%	34%	100%
Interviews Completed	53%	47%	100%

How Often Panelists Participate in Research and Predictors of Response

When asked to do so three to four times a month, panelists consistently participate in research. The average completion rate for the 141,000 cases in the selected surveys is **77 percent**. For these surveys, non-routine measures for increasing response were not employed (such as respondent incentives, pre-notification, telephone prompting, etc.); these are surveys conducted by our standard methodology.

When analyzed by various groupings, the survey completion rate is highest among persons age 45 or higher (81 percent) compared to those under the age of 45 (73 percent), as shown in Exhibit 3. The completion rate is also higher for those panelists who did not have Internet access prior to panel recruitment. This indicates that there is a slightly more significant challenge to gain the cooperation of the pre-recruitment Internet households. Curiously, users of broadband Internet at home have a slightly higher rate than others, perhaps reflecting a propensity to be enthusiastic toward technology (such as the panel-provided Internet appliance). In contrast to telephone surveys, males have the same completion rate as females.

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Exhibit 3: Survey Completion Rates by Selected Demographics and Home Internet Access at Panel Recruitment (n=141,000 sampled cases)

Variable	Category	Completion Rate
Gender	Males	77
	Females	77
Age	18-44	73
	45 and over	81
Race	White	79
	Non-White	69
Educational Attainment	High School Grad. Or Less	76
	Some College or More	77
Employment	Full-Time Employed	80
	Less than Full-Time	78
Home Internet Access	Yes	74
	No	83
Broadband Internet at Home	Yes	81
	No	77

To identify the most prominent factors behind the variation in response timing, a logistic regression model was fitted using the above and other variables. Variables that did not meet the 5 percent significance level were dropped.

Exhibit 4: Logistic Regression of Demographics and Home Internet Access on Survey Completion/Non-Completion

Predictors	Odds Ratio Point Estimate	Interpretation (Propensity to Participate)
Gender – Female	1.02	Females +
Age (in Years)	1.02	More senior +
Race – Non-white	0.6	Non-white --
Hispanic – Yes	0.8	Hispanic -
Education - Some College or Higher	1.2	Some College +
Broadband - Broadband Internet access at home	1.3	Broadband users +
Home Internet Access – Yes	0.5	Home Internet Access --
Length of Tenure on Panel (in Days)	0.994	More tenured panel --

Note: All parameters shown above are significant at $p = 0.002$ or lower.

The logistic regression model amplifies the completion rate differences noted in Exhibit 3 above. A case in point is that even though males and females each have a completion rate of 77 percent, the large sample size and regression model nonetheless indicate that females have only a 2

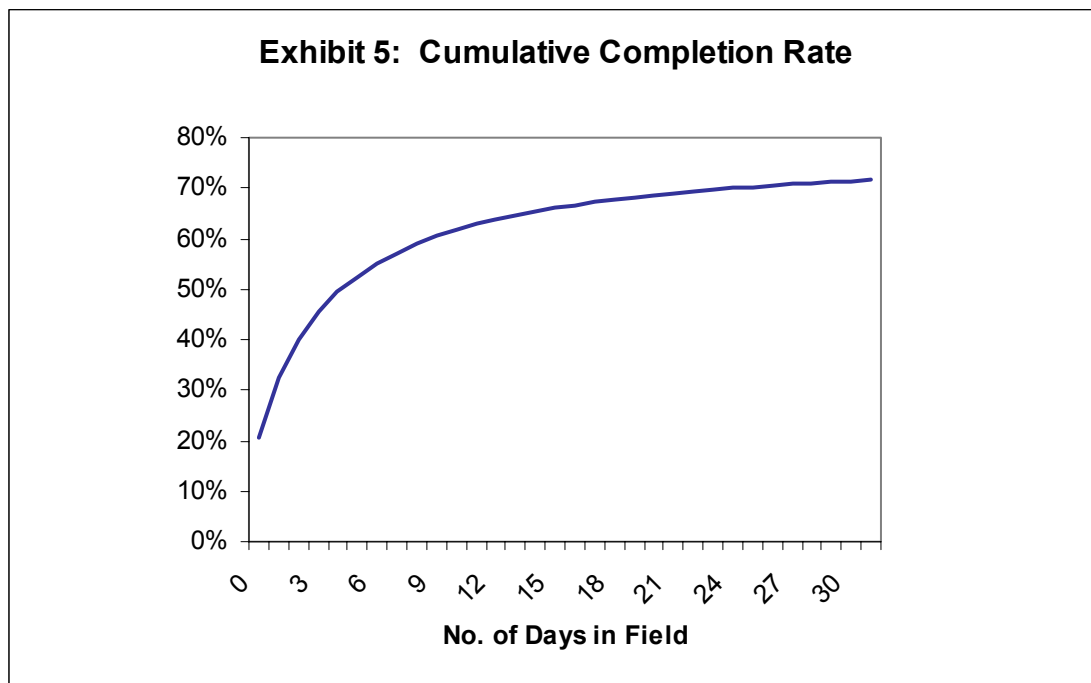
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percent higher odds of participating in research. In general, trends observed in the response rate literature are observed in the above table, as the odds of survey completion are slightly higher for females, more senior panelists, and those with some college education. Non-whites are less likely to participate, as are research subjects with longer tenure on the panel. More influential is access to a computer with Internet access at panel recruitment. In contrast, the panelists with broadband Internet access are actually more likely to participate.

How Many Days Do Panelists Take to Participate in Research?

Response timing is a factor in a survey manager's decision about the length of the field period. When faced with customers who may request delivery of the data before the full field period has elapsed, the survey manager must determine whether and by how much the truncation of the field period would have a differential impact across respondent groups. If some groups are known to be "slow" to respond to requests for survey participation, the potential for non-response bias increases if the field period is reduced.

Overall, the median elapsed time for a completed interview is about three days at Knowledge Networks, and by the eighth day, about 75 percent of the expected interview total has been obtained. Surveys of high salience (e.g., about current events) have a completion rate of 85 percent or higher. Exhibit 5 displays the cumulative completion curve for 141,000 sampled cases.



The overall completion rate and response timing justify a field period of one to two weeks for most surveys. Surveys having shorter field periods, however, may experience a substantially higher level of non-response bias since not all groups respond with the same timeliness.

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Exhibit 6 displays the results of a linear regression model intended to isolate the primary determinants of response timing. Response timing, the dependent variable, is defined as the number of days between emailing a request to complete an interview and survey completion (n=85,000 interviews). The predictor variables have all been noted above in the earlier discussion of survey completion. The model answers the question of how much longer the field period should be to collect *N* interviews by panelist characteristics such as age, sex, education, and home-based access to the Internet at the time of panel recruitment.

Overall, the model does an extremely poor job of explaining variation in response timing; only 2 percent of the variation is accounted by the model (adjusted r-square = 0.02). However, some of the variables are robust, reflecting the large sample size.

Exhibit 6: Regression of Demographics and Home Internet Access on Number of Days to Complete Interview

Predictors	Coefficient	P-value
Gender – Female	0.01	0.44
Age (in Years)	-0.06	<0.0001
Race – Non-white	2.4	<0.0001
Education - Some College	0.1	0.43
Hispanic – Yes	0.8	0.004
Work Status - Full time	0.7	<0.0001
Broadband - Broadband Internet access at home	1.9	<0.0001
Home Internet Access – Yes	2.9	<0.0001
Panel Tenure (in Days)	0.01	<0.0001

Most of the predictors are statistically significant at the 0.0001 level or lower; however, the effects are generally small and should be interpreted in a directional sense. Elderly panelists complete surveys about two days before young adults, on average. Home Internet access is the most powerful predictor, with adults in such households taking almost 3 days as long as adults who did not have an Internet connection at the time of panel recruitment. The broadband users also require slightly more time. Gender and education status are not significant predictors ($p > 0.4$).

Given the rapid data collection and data delivery made possible by an online panel, the above differences are overshadowed by the fact that it is now possible to conduct large statistical surveys in several weeks instead of several months. For most of our customers, it is of little consequence that a survey's field period may benefit from an additional two days to assure adequate representation of all groups in the research. Still, it is true that surveys with short field periods might not have adequate representation of younger persons, non-whites, and home Internet users. There are options available to reduce the potential for non-response bias in studies with short field periods such as pre-notification and reminder emails, and respondent incentives.

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More analysis is required to characterize the relationship between estimates for substantive variables and length of field period before firm conclusions can be made.

Political Attitudes and Behavior by Contact Window and Home Internet Access

Unlike access to the Internet from home, *when* respondents completed surveys had little impact on 22 selected measures. Measures calculated on the basis of interviews occurring during the “expensive” and “economical” contact windows are essentially the same as the measures based on all of the interviews. With few exceptions, study conclusions do not change as a result of including only those interviews collected when phone centers are open, even though this meant the removal of as much as 75 percent of the completed interviews. The mean difference between the study measures based on all interviews and those based on the subset of interviews was 0.001 for the “expensive” contact window and 0.005 for the “economical” contact window.¹

For one measure, however, the difference was fairly large between the statistic based on all interviews and the one based on interviews collected from 5:00 pm-9:00 pm. This result may point to a need for additional research about whether evening interviews are susceptible to bias on questions sensitive to respondents’ income and wealth status. The question (n=6,344) asked whether the respondent is currently putting aside money for retirement. For the contact-window subset, the mean is 60 percent, compared to 52 percent for interviews collected outside the 5:00 pm-9:00 pm contact window. The follow-up question was also highly significant (p-value =0.001) on the confidence of the respondent in his or her retirement preparations.

In contrast to the impact of the contact window, including households without Internet access at the time of panel recruitment contributes to significant shifts in the results. In 9 of the 22 measures, the difference between the measure based on non-Internet versus Internet households was in the 5-9 percentage point range; for 3 measures the impact was 10 to 14 percentage points; and in another it was over 15 points. Compared to the panelists already having Internet access, non-Internet cases . . .

- have a lower rate of voter registration (74% for non-Internet compared to 81% for Internet cases);
- have fewer Republicans (29% for non-Internet compared to 38% for Internet cases);
- are less confident that the country is headed in the right direction (38% for non-Internet compared to 44% for Internet);
- are less in favor of placing Social Security money into private retirement accounts (50% for non-Internet compared to 59% for Internet cases);
- are less critical of how the Federal Government has managed Social Security (53% compared to 60%);
- are less likely to set aside money for retirement (48% for non-Internet compared to 63% for Internet);
- are far less confident that their current retirement preparations are adequate (33% compared to 43%)

¹ For instance, consider that measure X based on all interviews is .50. When restricting the estimation to cases collected from 9:00 am-9:00 pm, the measure would change, on average, to .499 or .501. When restricting the estimation to cases collected from 5:00 pm-9:00 pm, the measure would change, on average, to .495 or .505.

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- more strongly believe that AIDS can be contracted from someone coughing or sneezing (24% for non-Internet compared to 19% for Internet cases);
- more strongly believe that there is a cure for AIDS (21% compared to 15%);
- have not heard about hybrid electric cars (47% compared to 37%);
- are less prone to believe that hybrid electric cars will perform worse than standard cars (37% compared to 46%).

Exhibit 7 summarizes the findings on substantive differences.

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Exhibit 7: Differences in 22 Measures by Contact Window and by Home Internet Access at Time of Panel Recruitment (See Legend)

Measure	N Interviews	Difference between All vs. 5:00 pm-9:00 pm Interviews	Difference Between Home Internet and Non-Internet Cases
Do you feel things in this country are ... - Generally going in the right direction	42044	NS	* *
Interest in politics – Very Interested	42044	NS	*
Currently registered to vote	42044	NS	* *
Liberal/Conservative – Liberal	42044	NS	*
Religion – Protestant	42044	NS	*
Religion – Catholic	42044	NS	*
Religious Service Attendance - Once or More a Week	42044	NS	*
Party ID - 7 Point Scale - Republican	42044	NS	* *
Investing portions of Social Security taxes into private retirement accounts - Good idea	5643	NS	* *
Appropriate level of government to reform health care - Both Federal and State	5643	NS	* *
Has the Fed. Gov. done a good job in managing Social Security – No	5643	NS	* *
Currently setting aside money for your own retirement – Yes	5643	* *	* * * *
Confident that current retirement preparations will be adequate	5643	*	* * *
People who have AIDS deserve it – Agree	5650	NS	NS
Likely to get AIDS from Sharing a Glass	6302	NS	* *
Likely to get AIDS from someone coughing/sneezing	6307	NS	*
Comfortable with shop owner with AIDS	6287	NS	NS
Is there a cure for AIDS – Yes	6293	NS	* *
Heard anything about new Hybrid cars – Yes	6321	NS	* * *
How does Hybrid car compare to standard car on price – Worse	6129	NS	* *
How does Hybrid car compare to standard car on Maintenance Costs – Worse	6122	NS	NS
How does Hybrid car compare to standard car on Performance – Worse	6124	NS	* * *
Legend Delta in Percentage Points			
* 0 to < .05			
* * 0.05 to < 0.10			
* * * 0.10 to < 0.15			
* * * * 0.15 or higher			
All starred deltas significant at p < 0.01; NS for not significant			

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Conclusion

Our online panelists consistently provide their opinions when asked, participating in 77 percent of the survey requests included in this study. Panelists participate in the research when it is convenient for them (in contrast to what is legally or otherwise permissible for calling windows). About 38 percent of the interviews are self-administered when phone-based researchers do not place calls, a figure that grows to 75 percent when based on the most optimal time to contact respondents by telephone. Such a large share of survey completions, however, does not translate into a consistent impact on the substantive survey results. Of the 22 measures selected for study, only two were sensitive to the contact window during which the interviews are completed. This finding, which concerns the collection of data likely to be correlated with panelists' personal income and wealth, is sufficiently robust to justify additional inquiry along these lines. Additional research will identify subject-matter domains that are sensitive to contact windows.

Whether or not a research panelist had Internet access from home at the initial recruitment plays a role on several levels. First, obvious and beneficial diversity results from including non-Internet households in the panel. Second, the Internet status of households helps to explain response timing and survey completion; non-Internet panelists more quickly respond to requests for survey participation and have higher completion rates than households already having Internet access. The finding suggests that persons with previous Internet access have more information appliances vying for their attention and therefore may be less cooperative with online research.

The most important finding is the divergence of opinion and belief between the Internet and non-Internet panelists. An Internet-only sample, without layering additional statistical adjustments of varying complexity and validity, will yield a picture of a general population that is too "Republican," too confident about the direction of the country, too prepared for retirement, and too well informed about public health research and new innovative products. The effects ranged from 5 to 15 percentage points for most of the selected measures. Effects of this magnitude could lead decision makers to mistakenly conclude that Americans are more prepared for retirement, less accepting of hybrid cars, or less knowledgeable about public health than they actually are. By including non-Internet households in the sample, allowing survey participation at all times, and maintaining adequate field periods, the research house substantially reduces the risk of non-coverage and non-response bias.