

THE IMPACT OF TELEPHONE INTERVIEWING ON DATA  
FROM THE AMERICAN HOUSING SURVEY

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I. INTRODUCTION

The American Housing Survey was designed to provide a current series of information on the size, composition, and financial characteristics of the housing inventory, the characteristics of its occupants, the changes in the inventory resulting from new construction and from losses, indicators of housing and neighborhood quality, and the characteristics of recent movers. The survey is conducted by the Bureau of the Census for the Department of Housing and Urban Development.

It is generally believed that telephone interviewing can be a more efficient data collection procedure than the current personal visit interviewing for the AHS. Therefore, a large-scale telephone interviewing experiment was implemented in conjunction with the 1981 enumeration of AHS-National in order to provide more definitive information about the effect of telephone interviewing on AHS-National data and cost. The experiment was to serve as the basis for deciding the extent of future implementation of telephone interviewing in successive AHS-National enumerations. The method of telephone interviewing being studied here is decentralized, with the interviews being conducted by field interviewers from their own homes.

The 1981 AHS-National sample was divided into six panels, of which the first, Panel 1, was chosen for the telephone interview experiment. This represented approximately 21 percent of the total 1981 AHS-National sample or roughly 12,500 sample units, that were assigned for telephone interview. The other 79 percent of the sample (approximately 47,500 housing units) was assigned for personal visit. Interviewers were required to attempt to interview by telephone the Panel 1 units that were interviewed in 1980 and that had the telephone number available from the control card. Of these units, those which had the same household present as in 1980, and could be reached by telephone and consented to an interview were interviewed by telephone. As a result, only 54 percent of the interviewed cases in Panel 1 were actual telephone interviews.

A second large-scale telephone interviewing experiment was implemented in the 1983 AHS in order to further investigate the effect of telephone interviewing on AHS data based on a larger sample for the telephone interviewing treatment and on a two-year time span between interviews, which is what AHS is currently using. The 1983 sample was divided into 6 panels, of which three were chosen for

telephone interview (roughly 36,000 units). The other three panels were assigned for personal visit (about 36,000 units). Forty-six percent of the cases designated for telephone interview were actually interviewed by telephone in 1983.

The results of both 1981 and 1983 AHS telephone interviewing experiments were analyzed and the impact on data quality and survey costs was assessed. The results showed that telephone interviewing seemed to have some effect on the data, especially financial characteristics, housing and neighborhood quality characteristics, and income item nonresponse rates. However, this slight effect on the data was offset by the cost savings. Therefore, based on these results, we recommended that maximum telephone interviewing be incorporated into future enumerations of AHS-National.

II. 1981 TELEPHONE INTERVIEWING  
EXPERIMENT DATA ANALYSIS RESULTS

All of the cases from Panel 1 and Panels 2-6 were each weighted up to be nationally representative. The estimates for various housing characteristics from AHS-National were compared using t-tests and Rao and Scott's approximate chi-square test. [1] The t-test was used to compare estimates for specific items from the published data tables. The chi-square test was used to compare the distribution of responses for a specific housing characteristic. [2]

The t-test analysis produced results that were slightly higher than could be attributed to random chance. About 6.4 percent of the differences were significant at the 5 percent level of significance, and about 1.4 percent of the differences were significant at the 1 percent level of significance (See Table I).

These results tend to indicate telephone interviewing had some impact on the data. Detailed inspection of the results failed to identify a pattern in the data, however.

The chi-square tests, likewise, showed levels of significant differences slightly higher than expected, with 8.3 percent of the differences significant at the 5 percent level and 3.3 percent significant at the 1 percent level. (See Table II)

III. 1981 COST STUDY

It was known that telephone interviewing would produce substantial savings in travel costs over personal visits. In 1981, a cost study was undertaken to

estimate the size of the cost savings. It was estimated that maximum telephone interviewing would save 24 percent in payments to interviewers, or about \$3.20 per case, which results in about a 6 percent savings in total costs.

#### IV. 1983 TELEPHONE INTERVIEWING EXPERIMENT - GENERAL HOUSING CHARACTERISTICS ANALYSIS

##### A. T-test Analysis

Most estimates of various housing characteristics from the AHS report for General Housing Characteristics were analyzed using the t-test. The estimates analyzed were for five levels of geography: Total U.S., Inside Metropolitan Areas, Central City of Metropolitan Areas, Outside Central City of Metropolitan Areas, and Outside Metropolitan Areas.

Of 15,155 items tested, 448 items (2.9%) were significant at the 5 percent level of significance, 996 items (6.3 %) were significant at the 10 percent level of significance, and 90 items (0.6 %) were significant at the 1 percent level of significance. Of these 15,155 items, 9,093 were from independent levels of geography. Of these 9,093 items, 242 items (2.7 percent) were significant at the 5 percent level of significance, 543 items (6.0 percent) were significant at the 10 percent level of significance, and 36 items (0.4 percent) were significant at the one percent level of significance.

These results appear to be lower than what we would expect due to random chance. This may be due in part to the fact that our standard errors, as published, are thought to be slight overestimates, due to the fact that our standard error estimates are derived from regression lines fit to a sample of variance items. The results are generalized to all housing characteristics. In carrying out this operation, whenever it becomes necessary to make assumptions, conservative assumptions tend to be made. Also, estimates for many of the items, particularly for mobile home and new construction data, are very small, and our standard error estimates are known to be very inexact in measuring the standard error of very small estimates. Table III presents a detailed breakdown of the t-test results.

##### B. Chi-Square Analysis

Rao and Scott's approximate chi-square statistic was used to test the effect of telephone interviewing on the distribution of housing characteristics. Many of the items, which had t-tests computed, had chi-square tests computed also.

Of 895 chi-square values computed, 47 (5.3%) were significant at the 5 percent level, and 11 (1.2%) were significant at

the 1 percent level. (Refer to Table IV.) These results are somewhat consistent with the view that telephone interviewing has no effect on the data.

Five types of characteristics were identified as having many of the significant chi-square values. These five were: units in structure, year built, heating equipment, broken plaster, and boarded-up buildings on the same street. Particular attention was paid to these characteristics when the 1983 results were compared to results of the 1980 data analysis.

#### V. COMPARISON OF 1980 DATA WITH 1983 DATA

After the preliminary 1983 analysis was completed, the hypothesis was advanced that differences found in the two treatments for certain characteristics were due to inherent differences between the odd and even panels. This hypothesis was tested by tabulating 1980 data by odd and even panel, and reweighting to produce national estimates. These data were analyzed in similar fashion to the 1983 data. If no more than the expected number of significant differences between the odd and even panels were detected, we would conclude that there is no evidence that inherent differences exist between the two treatments, since all the panels in 1980 were interviewed by the same procedure--personal visit.

Tabulations were produced, and data were analyzed using t-tests and Rao and Scott's approximate chi-square test for some selected general housing characteristics and financial characteristics. These results were compared to the 1983 results. (See Tables V and VI for a summary of the 1980 and 1983 results.)

The 1980 data generally showed a somewhat lower level of significant differences between odd and even panels than that of the 1983 data, especially at the 1 percent level of significance, with 30 of 2,225 items (1.35%) showing significant differences from 1983, versus 19 of 2,225 items (0.85%) showing significant differences from 1980. Attempts to explain these differences led us to identify three types of characteristics we felt were responsible for the discrepancy. The items were heating equipment, telephone availability, and boarded-up buildings on the same street. Year built and units in structure were not identified as being a problem here, even though they had been identified after the analysis, because the large numbers of significant differences showing up for 1980 data indicated there may be inherent differences. Broken plaster did not seem to be a problem, upon further inspection, for either year. As for the three types of characteristics we now identified, heating equipment was a flash card item, boarded-up buildings was an interviewer

observation item, and telephone availability is collected under different circumstances for the two treatments. These different methods of collection are thought to have caused the differences.

Financial characteristics showed a large discrepancy in the number of differences between the two years. In 1983, 11 of 1,305 items (0.84%) were significant at the 1 percent level and 66 of 1,305 items (5.06%) were significant at the 5 percent level. In 1980, 1 of 1305 items (0.15%) were significant at the 1 percent level and 34 of 1,305 items (2.61%) were significant at the 5 percent level. Five items appeared to be the cause of this change: home value, real estate taxes, monthly housing costs for units with a mortgage, monthly housing costs for units without a mortgage, and gross rent.

Further study was conducted on these five items. The means and medians were compared for 1983 between the telephone and personal visit treatments. None of the medians tested significantly different. A few of the means were significant, but there was no clear pattern of upward or downward bias. The tails of the distributions were compared by looking at the t-test results for the individual categories of the characteristics to check for differences among subclasses, but, again, no clear pattern emerged.

#### VI. 1983 TELEPHONE INTERVIEWING EXPERIMENT - ANALYSIS OF HOUSING AND NEIGHBORHOOD QUALITY AND ENERGY CHARACTERISTICS

Selected data from AHS reports for housing and neighborhood quality and energy characteristics for 1983 telephone and personal visit treatments were analyzed using t-tests.

For housing and neighborhood quality, the overall results were about as expected, assuming telephone interviewing has no effect, with 140 of 3,460 items (4.05%) significant at the 5 percent level, and 26 of 3,460 items (0.75%) significant at the 1 percent level. There was, however, a tendency for telephone treatment respondents to under-report problems with housing or neighborhood quality by about 2 to 3 percent. As a consequence, 58 of 430 items (13.49%) pertaining to the category "unsatisfactory conditions" were significant at the 10 percent level. Thirty-five of 430 items (8.14%) were significant at the 5 percent level, but only 4 of 430 items (0.93%) were significant at the one percent level.

This evidence leads us to conclude that the under-reporting of "unsatisfactory conditions" from the telephone treatment is somewhat of a problem, although the tendency appears to be rather slight. The problem will probably

have an effect on future AHS data, although the effect does not appear large enough to cause us to not recommend the future use of telephone interviewing.

Another pattern was discovered for renter-occupied units. The category "not reported" was reported more often for the telephone treatment than the personal visit treatment by an average of about 15 percent. Fifteen of 205 items (7.32%) were significant at the 5 percent level, and 6 of 205 items (2.93%) were significant at the 1 percent level. This "not reported" category is really an item nonresponse and will be discussed further in Section VI.

For energy characteristics, 40 of 495 items (8.08%) are significant at the 10 percent level, 22 of 495 items (4.44%) are significant at the 5 percent level, and 3 of 495 items (0.61%) are significant at the 1 percent level. These levels of significance are consistent with the assumption that telephone interviewing has no effect on the data. There was, however, one small problem with the category "renter occupied, included in the rent" being over-reported for electricity, gas, and oil by the telephone treatment respondents. The difference between the two treatments ranges from 4.6% for oil to 9.3% for electricity. There does not appear to be any upward or downward bias in the distribution of these utility costs, though, since median utility costs are about equal for the two treatments. The trend also appears to be too small to have a significant impact on gross rent, since no downward bias was detected in gross rent, which you might expect if this tendency was very large.

#### VII. ALLOCATION RATES FOR 1983 AHS

For 81 items from the 1983 AHS, item nonresponses had values allocated to them. The rates of allocation were computed separately for telephone and personal treatment data by geography and tenure. On average, the nonresponse rates were about 8 percent higher for the telephone treatment than for the personal treatment. The telephone treatment nonresponse rate was significantly higher for 10 of the 81 items (12.3%) at the 5 percent level of significance, and 4 of the 81 items (4.9%) showed significant differences at the 1 percent level. Breakdowns were looked at for tenure and geography, but no new patterns were discovered. Nearly all of the significant differences were for the income items (all 4 at the 1 percent level, 8 of 10 at the 5 percent level). It should be noted that these items were not all independent, however, and this may have some effect on the number of significant differences found.

## VIII. 1981 TO 1983 AHS: GROSS CHANGE ANALYSIS

Gross changes were analyzed for three treatments: 1) the panel which had been eligible for telephone interview in 1981 and 1983 (Panel 1), 2) the panels which had been personally visited in 1981, but were eligible for telephone interview in 1983 (Panels 3 and 5), and 3) the panels which had been personally visited in both 1981 and 1983 (Panels 2, 4, and 6).

Gross change is a measure of the number of cases reporting a status different in one enumeration from the status in the other. The assumption is that differences in the gross change rate between the three treatments reflect differences in the response variance for the two methods of interview. [3] Tabulations of 1981 versus 1983 responses were produced. The gross change rate was measured using the index of inconsistency [4], the L-fold index, and the level of inconsistency. No significant differences were found in the levels of inconsistency or L-fold indices. For the index of inconsistency, the number of significant differences found was far below that expected due to random chance. Only 8 of 585 (1.4%) were significant at the 5 percent level, and 2 of 585 (0.3%) were significant at the 1 percent level.

## IX. CORRELATIONS BETWEEN KEY VARIABLES

It was felt that any effect telephone interviewing had on the response variances might cause a change in the relationships among the variables. To test for changes, correlation coefficients were computed from the 1983 data file for several distributions of financial characteristics with other characteristics of interest.

Since correlation coefficients don't adhere to a normal distribution, a transformation was performed on the r-values to determine a corresponding normally distributed Z value. Approximate standard errors were produced under the assumption that each variable being correlated has a continuous distribution. Correlations were run separately on personal and telephone treatment data and the results were compared using a t-test.

Twelve of 170 items' correlations (7.1%) were found to be significantly different between telephone and personal interviews at the 5 percent level of significance. Seven of 170 items (4.1%) were significant at the 1 percent level, and 26 of 170 items (15.3%) were significant at the 10 percent level. These results seem to indicate that telephone interviewing does have some effect on the response variances, as the higher than expected number of significant differences in the correlation coefficients would indicate. However, it is difficult to determine what the effect is. Half of

the significant differences at the 5 percent level showed the absolute value of the correlation coefficient larger for telephone interviewing and the other half smaller. This means we cannot determine whether telephone interviewing causes response variances to increase or decrease. In general, then, we can say we believe telephone interviewing does have an effect on the relationship between certain variables, although we cannot determine the magnitude or direction of that effect. Note that the items we tested were not all independent. This may cause the number of significant differences found to be inflated or deflated.

## X. 1983 COST ESTIMATES

Cost data from 1981 AHS was revised to reflect changes from 1981 to 1983 in mileage and salary rates. The original figures for time and mileage per case were assumed not to change. It appears telephone interviewing will result in slightly lower savings if mileage rates decline, but overall savings should still remain in the 5 percent range. If mileage rates increase, costs savings will exceed 5 percent.

## XI. SUMMARY

On the basis of our extensive research on the 1983 Telephone Test Data, we conclude that telephone interviewing does have some effect on the data. As we have seen, telephone interviewing had some effect on certain general housing characteristics. Most of these characteristics, though, were either flash card or interviewer observation items (heating equipment, telephone availability, boarded-up buildings on the same street). In future enumerations of AHS, these items will be collected with a single methodology, instead of one method for personal visits and a different one for telephone interviews. Telephone interviewing also seems to have had some effect on financial characteristics (value, real estate bases, monthly housing costs). There was some tendency to under-report problems with neighborhood quality as well, although this tendency was generally rather slight.

We believe it is quite possible that telephone interviewing has had some effect on response variances, although the evidence is inconclusive.

The most obvious effect of telephone interviewing is the increased item nonresponse rate for income items. Perhaps respondents are less trusting of telephone interviewers, since no identification can be produced by interviewers over the telephone. As we would expect might be true, the more sensitive items, such as income, showed the greatest differences in item nonresponse rates between

the two treatments. While this fact is somewhat disturbing, it does not appear to be causing any changes in the published estimates. We estimate a one percent increase in sample size would make up for the loss in precision due to higher item nonresponse rates. Note that AHS will not increase its sample size in the future, but a one percent sample size increase would still result in cost savings.

Any impact on the data is a negative impact for a survey such as AHS, for which changes over time are of major importance. Changes in the data which may appear in 1985 versus 1987 comparisons, though, should tend to disappear in subsequent years' comparisons, since 1985 data was collected exclusively by personal visit, and the use of telephone interviewing will be maximized in 1987 and subsequent enumerations. The small changes in data we have seen were weighed against the projected 5 percent savings in total cost of the survey. On this basis, it is our judgment that the slight disruption in the data series is made up for by the potential cost savings, and so we do recommend that interviewers conduct telephone interviews whenever possible in future enumerations of AHS-National.

## XII. FUTURE TELEPHONE INTERVIEWING EXPERIMENT

To make use of the new technologies and new facilities, a large-scale Computer Assisted Telephone Interviewing (CATI) experiment will be implemented for 1987 AHS. Half of the 1987 AHS sample will be assigned for CATI and the remaining half will be assigned for telephone interview out of the interviewers' homes. This experiment will serve as the basis for deciding whether CATI should be used for future AHS enumerations rather than local telephone interviewing.

### REFERENCES

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TABLE I

Summary of t-tests: Proportions of Items with Significant Differences at 1% and 5% Significance Levels for 1981 Data

		a = 1%		a = 5%	
		Proportion	%	Proportion	%
Characteristics of the Housing Inventory	Total U.S.	3/147	2.04	8/147	5.44
	SMSAs	2/147	1.36	6/147	4.08
	Outside SMSAs	3/147	2.04	12/147	8.16
Financial Characteristics of the Housing Inventory	Total U.S.	0/55	0	4/55	7.27
	SMSAs	0/55	0	2/55	3.64
	Outside SMSAs	0/55	0	2/55	3.64
Selected Characteristics for New Construction Units	Total U.S.	3/105	2.86	8/105	7.62
	SMSAs	2/105	1.90	14/105	13.33
	Outside SMSAs	0/91	0	2/91	2.20
Overall Total		13/907	1.43	58/907	6.39

TABLE II

Summary of Chi-Square Tests: Proportions of Chi-Square Tests with Significant Differences at 1% and 5% Significance Levels

		a = 1%		a = 5%	
		Proportion	%	Proportion	%
Characteristics of the Housing Inventory	Total U.S.	0/37	0	4/37	10.81
	SMSAs	2/37	5.41	5/37	13.51
	Outside SMSAs	0/37	0	2/37	5.41

TABLE II (Continued)

		a = 1%		a = 5%	
		Proportion	%	Proportion	%
Financial Characteristics of the Housing Inventory	Total U.S.	0/10	0	2/10	20.00
	SMSAs	1/10	10.00	2/10	20.00
	Outside SMSAs	0/10	0	0/10	0
Selected Characteristics for New Construction Units	Total U.S.	0/21	0	0/21	0
	SMSAs	1/21	4.76	1/21	4.76
	Outside SMSAs	0/21	0	1/21	4.76
Overall Total		4/204	1.96	17/204	8.33

TABLE III

Summary of Proportion of Significant T-Tests by Geographic Area for 1983 Data

		Proportion	%
Total U.S.	a = .10	188/3031	6.2%
	a = .05	92/3031	3.04%
	a = .01	25/3031	.82%
In SMSA	a = .10	198/3031	6.53%
	a = .05	88/3031	2.90%
	a = .01	24/3031	.79%
Central City	a = .10	200/3031	6.6%
	a = .05	97/3031	3.2%
	a = .01	11/3031	.36%
Non-Central City	a = .10	173/3031	5.71%
	a = .05	68/3031	2.24%
	a = .01	15/3031	.49%
Outside SMSA	a = .10	170/3031	5.61%
	a = .05	77/3031	2.54%
	a = .01	10/3031	.33%

TABLE IV

Summary of Proportion of Significant Chi-Square Tests by Geographic Area for 1983 Data

		Proportion	%
Total U.S.	a = .05	10/179	5.6%
	a = .01	3/179	1.7%
In SMSA	a = .05	9/179	5.0%
	a = .01	2/179	1.1%
Central City	a = .05	12/179	6.7%
	a = .01	1/179	.6%
Non-Central City	a = .05	11/179	6.1%
	a = .01	2/179	1.1%
Outside SMSA	a = .05	5/179	2.8%
	a = .01	1/179	.6%

TABLE V

Summary of T-tests: Proportions of Characteristics with Significant Differences from 1980 and 1983 (# and % Out of 706 Comparisons)

		1980		1983	
		#	%	#	%
Total U.S.	a = .10	56	7.93	63	8.92
	a = .05	23	3.26	36	5.10
	a = .01	2	.28	12	1.70
Inside SMSA	a = .10	67	9.49	80	11.33
	a = .05	33	4.67	39	5.52
	a = .01	10	1.42	13	1.84
Outside SMSA	a = .10	67	9.49	63	8.92
	a = .05	29	4.11	30	4.25
	a = .01	2	.28	4	.57
Central City	a = .10	58	8.22	66	9.35
	a = .05	28	3.97	30	4.25
	a = .01	2	.28	3	.42
Balance SMSA	a = .10	45	6.37	62	8.78
	a = .05	24	3.40	29	4.11
	a = .01	5	.71	9	1.27

TABLE VI

Summary of Chi-Square Tests: Proportions of Characteristics with Significant Differences from 1980 and 1983 (# and % Out of 85 Comparisons)

		1980		1983	
		#	%	#	%
Total U.S.	a = .05	6	7.06	9	10.59
	a = .01	2	2.35	4	4.71
Inside SMSA	a = .05	10	11.76	7	8.24
	a = .01	2	2.35	2	2.35
Outside SMSA	a = .05	4	4.71	2	2.35
	a = .01	1	1.18	1	1.18
Central City	a = .05	5	5.88	4	4.71
	a = .01	1	1.18	1	1.18
Balance SMSA	a = .05	8	9.41	9	10.59
	a = .01	1	1.18	3	3.53

This paper reports the general results of research undertaken by Census Bureau staff. The views expressed are attributable to the authors and do not necessarily reflect those of the Census Bureau.