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ESTIMATION OF NONRESPONSE BIAS

by

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## Nonresponse: Theoretical Perspectives

Within recent years many researchers have noted a significant rise in the nonresponse rate for various studies utilizing the survey research method. In the past such nonresponse has not been a topic of extensive sociological inquiry. There has been a tendency to view nonresponse in survey research as a methodological issue of primary concern to those whose principal interests are sampling and the theory of sampling. However, a declining response rate in many national and local survey research studies has created new interest in this topic from a wider variety of investigators.

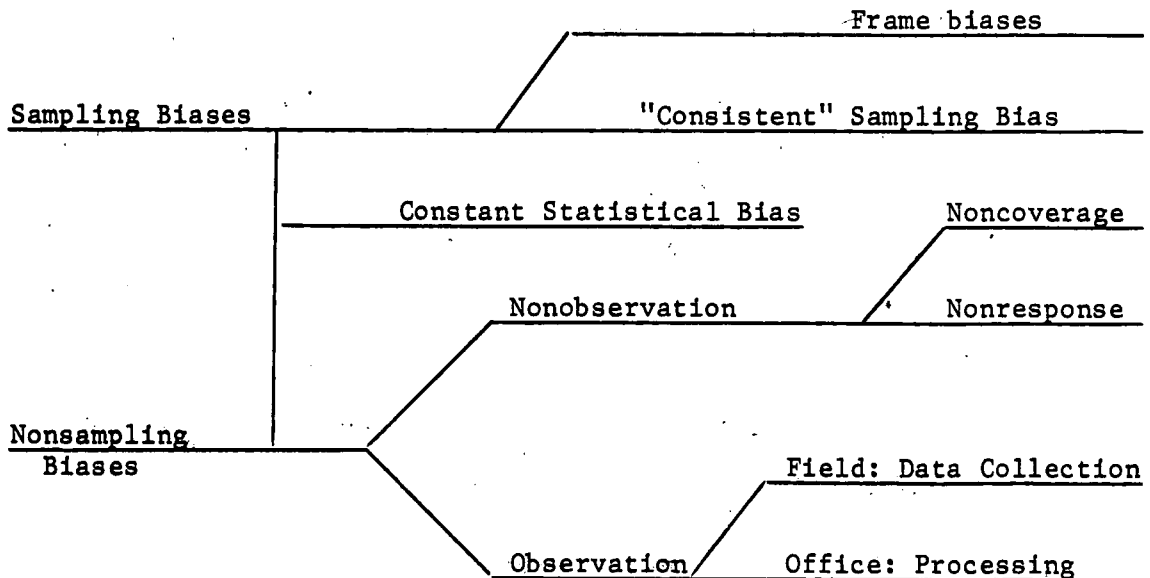
Nonresponse in survey research is defined by Kish (1965: 532) as "the many sources of failure to obtain observations (responses, measurements) on some elements selected and designated for the sample." The two principal types of nonresponses are not-at-homes (NAH's) and refusals. The rate of nonresponse for a given survey is computed only for eligible respondents.

In many survey situations high rates of nonresponse may be anticipated in advance as a result of past research, in which cases compensatory techniques such as oversampling may be employed. However, oversampling only produces a larger and, therefore, more acceptable sample size, while it does nothing about the problem of nonresponse bias which may develop as a result of high rates of nonresponse.

During the actual process of interviewing, or other forms of data collection, various other techniques are available which can affect the nonresponse rate: call backs and subsampling are two common remedial actions. The final (terminal) nonresponse rate which remains after various remedies have been attempted poses quite a different problem--

a problem which goes beyond the mere mechanics of response accumulation. Rather it is a problem of the reliability and validity of the interpretations one makes using the data that has been collected. It is at this point that one must more closely explore the problem of nonresponse as it relates to sampling theory itself. More specifically, one must consider the problem of bias due to high rates of terminal nonresponse, and the effects of such bias on substantive sociological research.

Nonresponse, being a form of nonsampling error or bias, has often received only passing attention from social statisticians. Since it is not strictly a sampling problem, Kish (1965) has suggested that many social statisticians try to use only mathematically unbiased estimators and insist, therefore, that the unavoidable biases of measurement are not of their concern. As a result, the nonresponse rate in various survey research studies has often appeared only as a footnote, and is simply forgotten in the ensuing substantive analysis. The following scheme is used by Kish (1965: 519) to classify the various sources of survey bias.



Using such a scheme, nonresponse can be thought of as a kind of nonsampling bias arising from the failure to observe a selected sample element or respondent. Therefore, the effects of an excessively high rate of nonresponse on a survey are to produce a great amount of nonsampling bias for the survey statistics. Kish (1965: 510) uses the following equation to describe the results of bias:

$$\text{Total Error (Root mean square)} = \sqrt{VE^2 - \text{Bias}^2}$$

Variable errors,  $VE^2$ , equals the sampling variance only when such variable errors are caused exclusively by sampling errors. The deviation of the average survey value from the true population value is the bias for that value; this bias is mostly caused by measurement biases. Nonresponse can produce such measurement bias.

The terms accuracy and precision have been widely used by sampling theorists to speak of the effects of bias and variable errors. Precision has usually been used to refer to small variable errors. This means that the investigator used mathematically unbiased estimators for the most part, thus eliminating or minimizing sampling errors. The concept of precision does not include the effects of biases, such as those in the scheme above. Accuracy is the term used to refer to small total errors and includes the effects of bias also. A precise design is one that has small variable errors, while an accurate design must be precise and have small bias. The investigator must not only use mathematically unbiased estimators, he or she must also take precautions to avoid the effects of bias, both sampling and nonsampling varieties.

Precision and accuracy are roughly synonymous with the terms reliability and validity used in psychology and referred to by Campbell

and Stanley (1963) in their analysis of experimental research designs. Only research designs which possess both reliability and validity can be used to make any kind of generalizations about the research findings which result. Survey research operates on the same principles. Therefore, nonresponse, as a form of bias which affects the accuracy and validity of survey findings should be of great concern for all social scientists who use the survey method. For the problem of nonresponse bias makes one acutely aware of the fact that the methodology of the social scientist cannot be separated from the substance of sociological theory and research. Such bias may have profound effects on the accuracy of probability statements which form the crux of sociological analysis. It is this dual nature of the problem of nonresponse that will be investigated in this paper.

#### Nonresponse: Past Studies

Previous studies of nonresponse as a topic of sociological inquiry have been of several types. One group of studies has focused on attempts to more accurately describe the nature of the bias caused by nonresponse while offering no concrete suggestions for remedy. Since no two surveys will have identical patterns of bias, these studies are case-specific. It is hoped that through a series of such studies future researchers will be able to identify certain consistent "causes" of nonresponse. Some of these analysts have sought to identify possible demographic correlates of nonresponse. Variables such as sex, race, age and social class are used in attempts to explain varying patterns of response in surveys. Other researchers have looked at interviewer effects, the nature of the survey instrument itself, accessibility of the respondents and a wide range of other possible correlates.

From the resulting, assorted studies only a few significant demographic or other correlates of nonresponse have been found. These few correlates are often significant for explaining nonresponse in some surveys, but not in others. Dohrenwend and Dohrenwend (1968) found some relationship between race and ethnicity and nonresponse in a New York City survey. Irish Americans were found to have an interview nonresponse rate almost four times that of Jews, Blacks or Puerto Ricans. Donald (1960) found no clear demographic trends in the response to a mail survey, and no sharp changes in the nature of those subsampled by phone. However, the potential respondents in this survey were all members of the same organization, and consequently some data concerning the nonrespondents was available to Donald. Using such data, she found that the degree of financial support for the organization, group involvement, the level of information members had about the organization's activities and similar measures of group participation were all related to the response rate. The higher the group involvement, the more likely it was that a member would respond.

Robins (1963) in a study of reluctant respondents in a St. Louis area study of child guidance clinic relations found that refusals were higher among: 1) those living in St. Louis proper as compared to those living in areas outside of the city, 2) those with less than a high school education, 3) routine white collar workers, and 4) those of foreign born parentage. Attempts were made by the original researchers to persuade those who had refused. Efforts by Robins to find variables related to cooperation after persuasion attempts were tried, proved fruitless.

Other studies have concentrated on somewhat different aspects of nonresponse. Mayer (1964) found that the day of the week and the time of the day of the interviewer calls are important factors affecting nonresponse rates. The Mayer study and others have shown that daytime is particularly bad for finding employed (or student) members of households; evenings and weekends are the most favorable; and that there are seasonal variations in nonresponse, especially during vacations.

Some analysts have attributed high rates of nonresponse to faulty public relations caused by misuses of the survey method by salesmen and unscrupulous researchers. Such studies have suggested that the public may be retaliating through higher rates of nonresponse on all surveys.\*

Interviewer effects have also been the subject of analysis. In addition to the findings mentioned earlier, Dohrenwend and Dohrenwend (1968) found that it is possible to identify cases where the interviewer was the cause of nonresponse. Pomeroy (1963) attributes the low nonresponse rate on a survey dealing with a rather sensitive topic, sex, to good interviewer techniques. More recently, Summers and Beck (1973) found that interviewer personality and social status factors are also related to nonresponse.

Alternatively, in a study of the "inaccessible respondent" Ross (1963) found that often neither the respondent nor the interviewer is responsible for high nonresponse rates. Concentrating on the not-at-homes and miscellaneous nonresponse categories, he concludes that door-men in apartment buildings, locked doors and other types of intentional

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\* See: Public Opinion Quarterly, Vol. 28, 1964.

and unintentional barriers between the respondent and interviewer can have a great impact on the nonresponse rates, especially in cities. He attributes the prevalence of such barriers in cities to desires for privacy.

One of the better studies which attempts to critique the problem of nonresponse as well as offer some tentative solutions is Mayer and Pratt's (1966-67) investigation of nonresponse in a mail survey. The source of their data was a study of the economic and psychological consequences of personal-injury automobile accidents in Michigan. As in the Donald (1960) study, a list of potential respondents was available to the researchers and, therefore, the characteristics of nonrespondents could be determined. Based on an analysis of the characteristics of nonrespondents in successive waves of letters, the authors found significant differences between respondents and nonrespondents (.01 level, chi-square test) for sex, age, race and occupation, and at the .05 level for "the extent of injury." Men, nonwhites, middle-aged respondents and blue collar workers were found to have high rates of nonresponse. However the authors (1966-67: 641) point out concerning these findings that:

While the differences exhibited by the characteristic may have statistical significance, they may not have operational significance; the large sample size (2,872) results in relatively small absolute differences showing up as significant. . . From the standpoint of increasing the accuracy of aggregate estimates of known characteristics in this study, the incremental cost of the last two appeals to nonrespondents does not appear to have been justified by a concomitant reduction in nonresponse bias.

After these words of admonition, the authors go on to suggest methods of adjusting for nonresponse bias, including: 1) weighting



the actual responses obtained so as to represent the total sample, the weight assigned to each response being equal to the total sample size divided by the number of respondents, and 2) estimation of population values by extrapolating trends across response waves. The difference between the estimated population values obtained for all respondents represents an estimate of the nonresponse bias, which can then be eliminated by differential weighting.

Few of the studies of nonresponse in interview or mail surveys discussed above are concerned with terminal nonresponse, which is the real cause of bias. In the case of interview surveys, most of the studies of nonresponse involve a series of wave analyses of the characteristics of nonrespondents at various points in the interviewing process. All of the interim nonrespondents, except for those on the last wave, eventually become respondents at the end of the survey. These interim nonrespondents are, for the most part, not-at-homes or mild refusals who are later found at home or persuaded to be interviewed. These studies of nonresponse could more accurately be labelled studies of "reluctant respondents," as indeed some are. For there always remains a group of terminal respondents about which nothing is known for certain.

In other of the studies reported, nonresponse in mail surveys is the subject of analysis. In most instances researchers have prior knowledge of the characteristics of all possible respondents, e.g. Mayer and Pratt (1966-67) mentioned above. Therefore, characterization of nonrespondents is a relatively simple matter.

For these reasons it is questionable whether the findings of Mayer and Pratt and others are applicable to interview situations in

which the researchers know almost nothing about the characteristics of the nonrespondents. Very few studies of nonresponse have been attempted in which there is an effort made to use the adjustive techniques suggested in the Mayer and Pratt (1966-67) study. One such study was done recently by Dunkelberg and Day (1973). They have attempted to provide quantification of the bias due to nonresponse. In their own words they sought "to describe empirically the relationship between bias in the distribution of selected respondent characteristics in a personal interview survey and the number of calls used in the interviewing process." (p. 160). The data for their study was taken from the 1967 Survey of Consumer Finances conducted in January of 1968 by the Survey Research Center at the University of Michigan.

Most of the categories of respondent characteristics were found to converge on their population values after two or three callbacks. A few categories, however, were slow to converge and were characterized by rather large initial distributional errors. One of the major problem categories was the large city classification of the variable "city size of residence." For each variable of importance in the study it was possible to calculate the number of calls required to reach a desired level of accuracy. As in past studies, however, the level of accuracy used as a standard by the researchers is the final response group. Terminal nonresponse bias is not analyzed, only the bias evident between the various waves of calls.

In order to deal with the problem of terminal nonresponse, many attempts have been made to estimate the nonresponse bias and to incorporate that estimate into the statistics. This is a kind of Bayesian

approach to nonresponse. Kaufman and King (1973) give a Bayesian treatment to a two phase sampling problem to determine the optimal first phase sample from a dichotomous population given that an optimal follow-up sample of nonrespondents in the first phase is to be taken. Mayer and Pratt (1966-67) also seem to suggest this kind of approach in their extrapolation remedy. After plotting the accumulated averages of respondent characteristics against the percentage response of successive calls, a curve may be extrapolated to include the nonresponses.\* And as Kish (1965) points out there have also been attempts to use explicit mathematical models to link the means of successive waves or to devise methods of combining the nonresponse bias with the sampling variance into the total error. There are few tests of the value of such compensatory techniques in the literature.

The Politz scheme described by Kish (1965) provides an alternative adjustive approach. Using it, a researcher can (ideally) avoid call-backs altogether by collecting only first calls, which are then correlated with information about the probability of finding the respondent (type) on subsequent calls. One problem with this scheme may be that the first respondents are actually, as a group, the most readily available respondents and consequently eager respondents. Few reluctant respondents will be picked up on the first call. Therefore, one cannot estimate the chances of selecting such respondents by looking at the eager respondents. Perhaps

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\* Two assumptions made in this approach, of course, are that nonrespondents are not drastically different from the respondents on the selected characteristics; and that the characteristics of terminal nonrespondents can be determined by the trends in the waves of respondents.

as a result of this tendency, the evidence is not favorable in the two studies that compared the weighted first call results with those of many callbacks. Kish (1965: 559) reports, for example, that "Durbin and Stuart (1954) found that the weighted results resembled those of the first call rather than the combined callback results. Simmons (1954) also found that the weighted first calls fared badly."

A final way of remedying and estimating nonresponse bias is that of substitution. This involves either a limited or full scale imputation of certain survey values. It is often used on a limited basis in many kinds of corrective procedures in social science, and is widely used by Federal and local census bureaus. Compared to other methods of compensating for nonresponse, this procedure has several advantages: 1) it is one of the few methods which allows the researcher to affect the bias caused by terminal nonresponse, 2) it offers the possibility of controlling and adjusting sample size, 3) it is a relatively simple procedure compared to such statistical procedures as the Politz scheme or many mathematical linking models, and 4) it is a post hoc compensatory method. Therefore no potential data is lost.

One of the serious disadvantages of this approach is pointed out by Kish (1965: 559) which is the danger that substitution may "merely replace nonresponses with more elements that resemble responses already in the sample," but it appears that this is true of all compensatory techniques. Perhaps that danger seems more likely with substitution only because of the simplicity of such a mechanical procedure. Because of the obvious advantages of the substitution-imputation technique, it will be used in the present analysis of nonresponse which constitutes the second half of this paper.

### Procedures and Methodology

The data for this analysis of nonresponse comes from the 1973 Detroit Area Study conducted by the University of Michigan. The study involved the use of a survey questionnaire in a personal interview setting. The survey was divided into two major parts. One part was designed to investigate the public's attitudes toward the military. The other part consisted of an assortment of social psychological experiments attempted in a field setting.

A multistage probability sample of housing units was drawn from the Detroit metropolitan area. Within households, respondent selection was based on the number of adults in the household of age eighteen or beyond. One adult was randomly selected to be the respondent. The final sample included 845 households located on 109 blocks in the Detroit metropolitan area, which consists of Wayne county and parts of Oakland and Macomb counties.

The nonresponse analysis consists of two parts: 1) an estimation of the distributional bias of respondent characteristics. This will be done by comparing the distributions of selected respondent characteristics on interim waves of response-nonresponse during the interviewing process from the first to final call; and 2) a substitution-imputation procedure will be used whereby some terminal nonrespondents (refusals) are given imputed values for certain demographic variables and variables of substantive interest in the survey itself. A linear regression is then used in an attempt to estimate differences between the values for respondents and the estimated (imputed) values for the nonrespondents. This difference is then used as an estimate of the bias due to nonresponse.

Part 1: Wave Analysis

A total of 17 calls were needed to obtain the 576 completed interviews in the final sample. For the purposes of this analysis the few cases requiring ten or more calls are combined into a 10+ category. Table 1 shows the response patterns for the various calls in the survey. For each of the waves of responses (calls) in the survey, eleven respondent-demographic variables are used to test for possible correlations with nonresponse.\*

For each category within a respondent characteristic (e.g. male, female) the percentage of that group responding on each call is computed (Table 2). In addition, for each call a distributional breakdown of respondent characteristics is provided (Table 3). Nonrespondents consist of several groups of persons: 1) those who refused to be interviewed (REF); 2) those persons in households in which no one could be found at home during the call (NAH); 3) those designated as respondents previously but are not at home at the time of the call (RA); and 4) other reasons for noninterview such as appointments for a later date, inaccessibility to designated households or respondents, etc. Such incapacities of the respondent as senility and drunkenness may also fall into this category; as may inability to speak English, or a language for which an interpreter can be found readily. Because of the non-permanent nature of the nonresponse categories, nonrespondents at any point in the interviewing process, even refusals, may become respondents at another point.

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\* Eight variables are standard socioeconomic status types (age, sex, race, occupation, family income, education, marital status and religion.) "City of residence" was added to investigate possible Detroit-suburban response differences. "Years in the Detroit area" was added to check for the effects of geographical mobility and migration patterns. The "housing type" variable was added to investigate respondent accessibility affect.

TABLE 1

Results of Successive Calls in 1973 Detroit Area Study

<u>Call Number</u>	<u>Interview</u>	<u>Refusal<sup>a</sup></u>	<u>Result of Call,<sup>b</sup> NAH, RA, other</u>	<u>Non-sample, other<sup>c</sup></u>	<u>N.A.<sup>d</sup></u>	<u>Total</u>
1	112	89	519	113	11	845
2	153	83	373	69	6	684
3	94	46	277	61	5	484
4	67	39	211	35	4	355
5	52	28	161	18	1	259
6	27	22	119	14	1	182
7	18	16	95	9	2	139
8	10	8	65	12	2	97
9	17	6	47	8	1	79
10+	26	7	16	2	1	52
Final Outcome	576	177	50	41	1	845

<sup>a</sup> Attempts were made to lower the number of refusals through a series of persuasion letters and subsequent callbacks. These efforts were successful in lowering the final number of refusals to 177.

<sup>b</sup> Not-at-homes, respondent absent, and other reasons for noninterview such as appointments for a later time.

<sup>c</sup> Vacant houses, ineligible respondents, improper sample listings and other reasons for nonsample such as language problems, senility, etc. of designated respondent.

<sup>d</sup> Result of call not ascertained due to failure of interviewer to record information, etc. The one final "not ascertained" coversheet is not an interview or refusal, however.

Findings

The results of the wave analysis can be taken as a rough quantification of the distributional bias of respondent characteristics at various points in the interviewing process. Several trends can be noted in the response patterns during the course of interviewing. Table 2 provides a summary of these trends by comparing the percentages of the total number of respondents interviewed per call for the selected subgroups within the sample. Consulting the table, one notes for example, that nearly 66 percent of the total number of white respondents were reached after three calls, whereas only 50 percent of nonwhite respondents were interviewed. After two calls nearly 50 percent of all Protestant respondents were interviewed but only 29 percent of Jewish respondents. Similarly, comparatively low rates of response after the first two calls can be observed for white collar workers, the \$6,000-\$9,999 and \$20,000 or more income groups, the higher education groups and multiple unit dwellers. On the other hand, some groups of respondents tend to be comparatively over-represented after two or three calls. The least educated, blue collar workers, and the lowest income groups have higher rates of response than other groups in their categories after two calls. 47 percent of all blue collar workers were interviewed after only two calls, but only 36 percent of white collar workers. Nearly 48 percent of the less than high school education group were reached by the second call. Other groups which are comparatively over-represented after two calls are housewives and students, the unemployed and retired, the over 65 age group, and the under \$6,000 income group. Over half of the lowest income group were interviewed on the first two calls, compared to 40 percent of the highest income group.



TABLE 2

Percentage of Selected Population Groups Interviewed on Each Call

	Percentage Interviewed on Call:					
	1	2	3	4-6	7+	Total
<u>SEX</u>						
Males	15.6	30.4	18.6	22.4	13.0	100.0
Females	22.1	23.9	14.7	27.4	11.9	100.0
* N = 576						
<u>RACE</u>						
White	20.6	27.7	17.7	23.5	10.5	100.0
Black, other	15.4	22.8	11.4	30.9	19.5	100.0
N = 574						
<u>RELIGION</u>						
Protestant	20.1	27.0	15.6	23.6	13.7	100.0
Catholic	21.8	25.4	16.8	26.9	9.1	100.0
Jewish	11.8	17.6	29.4	23.5	17.7	100.0
N = 520						
<u>EDUCATION</u>						
1-11 years	19.2	28.7	16.2	24.0	11.9	100.0
High School Grad.	20.8	28.4	11.5	25.2	14.1	100.0
Voc. Tech & 1-3 yrs. college	22.9	19.4	18.7	27.7	11.3	100.0
College Grad. or more	11.7	31.2	23.4	22.1	11.6	100.0
N = 571						
<u>OCCUPATION</u>						
White Collar	10.1	26.3	21.2	28.5	13.9	100.0
Blue Collar	21.6	24.2	13.7	23.5	17.0	100.0
Housewife & student	27.8	26.7	13.9	22.8	8.8	100.0
Unemployed & retired	20.8	34.0	15.1	22.6	7.5	100.0
N = 565						
<u>AGE</u>						
18-24 years	18.5	28.3	14.1	26.1	13.0	100.0
25-44 years	17.6	27.3	17.2	26.9	11.0	100.0
45-64 years	21.6	24.3	15.1	23.3	15.7	100.0
Over 65 years	25.5	25.5	19.6	23.4	6.0	100.0
N = 566						
<u>MARITAL STATUS</u>						
Married	19.3	26.4	18.3	22.6	13.4	100.0
Single	18.2	31.2	14.3	23.4	12.9	100.0
Divorced, widowed or separated	19.8	24.6	12.7	34.1	8.8	100.0
N = 570						

	1	2	3	4-6	7+	Total
<u>FAMILY INCOME</u>						
\$000-\$5,999	24.0	30.2	11.5	23.9	10.4	100.0
\$6,000-\$9,999	18.3	22.0	19.5	25.6	14.6	100.0
\$10,000-\$19,999	18.4	30.5	18.4	22.4	10.3	100.0
\$20,000 or more	15.7	24.3	15.7	30.4	13.9	100.0
	N = 516					
<u>CITY OF RESIDENCE</u>						
Detroit	20.7	26.1	14.1	23.2	15.7	100.0
Suburbs	18.5	26.9	17.9	26.9	9.8	100.0
	N = 576					
<u>YEARS IN DETROIT AREA</u>						
1-9 years	16.4	32.8	16.4	24.5	9.9	100.0
10-40 years	20.5	27.8	13.7	24.3	13.7	100.0
Over 40 years or entire life	19.1	24.7	18.4	26.0	11.8	100.0
	N = 570					
<u>TYPE OF HOUSING UNIT</u>						
Detached Single Family	20.8	27.6	17.4	23.5	10.7	100.0
2-4 Family or Row House	14.1	21.1	15.5	31.0	18.3	100.0
Apartment, trailer, other	18.1	21.9	10.9	30.9	18.2	100.0
	N = 569					

\*"N"s refer to the number of valid cases after all calls were completed.

The nature of these differences becomes more evident when one looks at Table 3. Using the cumulative distribution of respondent characteristics after 10+ calls as the standard, one can compare it to the cumulative distribution of respondents at various interim points in the interviewing process. The difference between the two represents another, perhaps more accurate way of looking at the bias in the distribution of respondent characteristics. Such distributional bias can be observed for the sex variable. The final sample contains 41 percent males and 59 percent females. The sample after one call contains over 66 percent females. After two calls females are still slightly over-represented. The same can be observed for various other respondent characteristics over the successive waves. For example, white collar workers make up 16 percent of all respondents after one call: but by the final call they comprise nearly 32 percent of the completed sample.

One test of the difference in the distribution of the selected respondent characteristics across the waves is reported in Table 3. This involves the calculation of the percentage error (% error) in the cumulative distributions between the first and last calls and between the sixth and last calls. These calculations show that some groups are initially greatly under-represented, while others are over-represented. Between the first and final calls the white collar group, the college educated group, Jewish respondents, multiple unit dwellers, the lowest income group, the aged and housewives show the greatest percentage error. Low percentage error can be noted for low education groups, married persons, Protestants, and the middle income groups. By the sixth call many of these differences have diminished greatly and one observes an almost complete convergence on the population values as evidenced after

Table 3

## Cumulative Distributions of Respondent Characteristics by Number of Calls

Characteristic	Number of Calls					Percentage Error <sup>a</sup>		N <sup>b</sup>
	1	2	3	6	10+	Calls 1 & 10+	Calls 6 & 10+	
<u>SEX</u>								
Males.	33.6	40.9	42.4	40.9	41.1	-18	-1*	237
Females	66.4	59.1	57.6	59.1	58.8	+13	+1	339
<u>RACE</u>								
White	82.3	82.6	82.8	80.5	78.6	+ 5	+2	451
Black, other	17.7	17.4	17.2	19.5	21.4	-14	-7	123
<u>RELIGION</u>								
Protestant	55.2	56.9	55.3	54.5	55.6	- 1	-2	289
Catholic	41.0	38.9	38.3	39.3	37.9	+ 8	+4	197
Jewish	3.8	4.2	6.4	6.2	6.5	-42	-5	34
<u>EDUCATION</u>								
1-11 years	29.2	30.0	30.1	29.3	29.2	0	+1	167
High School Graduate	33.6	34.2	30.9	31.5	32.0	+ 5	-2	183
Voc. Tech & 1-3 years college	29.2	23.2	24.5	25.6	25.2	+16	+2	144
College graduate, or more	8.0	12.5	14.5	13.6	13.5	-41	+1	77
<u>OCCUPATION</u>								
White Collar	15.9	24.9	28.9	31.2	31.7	-50	-2	179
Blue Collar	29.2	26.8	25.6	25.8	27.1	+ 8	-5	153
Housewife & student	44.3	37.5	35.1	33.1	31.9	+39	+4	180
Unemployed & retired	10.6	10.7	10.4	9.9	9.3	+14	+6	53
<u>AGE</u>								
18-24 years	15.0	16.5	15.8	16.2	16.3	- 8	-1	92
25-44 years	37.2	41.2	41.7	42.8	42.0	-11	+2	238
45-64 years	35.4	32.7	32.1	31.3	32.7	+ 8	-4	185
Over 65 years	12.4	9.6	10.4	9.7	9.0	+38	+8	51

(81)

Table 3 (continued)

## Cumulative Distributions of Respondent Characteristics by Number of Calls

Characteristic						Percentage Error		N
	1	2	3	6	10+	Calls 1 & 10+	Calls 6 & 10+	
<u>MARITAL STATUS</u>								
Married	64.5	64.1	66.1	63.6	64.4	0	-1	367
Single	12.7	14.5	13.7	13.4	13.5	- 6	-1	77
Divorced, widowed or separated	22.8	21.4	20.2	23.0	22.1	+ 3	+4	126
<u>FAMILY INCOME</u>								
\$000-\$5,999	23.7	21.7	19.3	18.9	18.6	+27	+2	96
\$6,000-\$9,999	15.5	13.7	15.0	15.4	15.9	- 2	-3	82
\$10,000-\$19,999	42.3	45.4	45.9	44.0	43.2	- 2	+2	223
\$20,000 or more	18.6	19.2	19.9	21.8	22.3	-17	-2	115
<u>CITY OF RESIDENCE</u>								
Detroit	44.2	42.8	41.0	40.1	41.8	+ 6	-4	241
Suburbs	55.8	57.2	59.0	59.9	58.2	- 4	+3	335
<u>YEARS IN DETROIT AREA</u>								
1-9 years	9.1	11.5	11.2	11.0	10.7	-15	+3	61
10-40 years	38.2	37.8	35.6	35.4	36.0	+ 6	-2	205
Over 40 years, or entire life	52.7	50.7	53.2	53.6	53.3	- 1	+1	304
<u>TYPE OF HOUSING UNIT</u>								
Detached Single Family	81.4	82.3	81.5	79.5	77.7	+ 5	+2	442
Two-four Family or Row House	9.7	9.2	10.4	11.5	12.5	-22	-8	71
Apartment, trailer, other	8.9	8.5	8.1	9.0	9.8	- 9	-8	56

a

The percentage error is a measure of the extent to which the sample after 1 and 6 calls differs from the final sample, i.e.,  $\frac{\% \text{Call 1 or 6} - \% \text{Call 10+}}{\% \text{Call 10+}}$ .

b

The number of cases in this column refers to the total number of respondents after 10+ calls.

\* A "1" is also used to denote percentages which are greater than zero but less than 1.

the final call. However, even between the sixth and final call, Blacks, the unemployed and retired, the over 65 age group, blue collar respondents, and Jewish respondents still show an appreciable percentage of error. This suggests that more of these respondents were picked up on later calls.

As to be expected, a sample consisting only of persons who had responded after one call would be markedly different from the sample of respondents after 10+ calls on almost all of the characteristics selected. In most cases at least three to six calls were required before a sample distribution approximating the final sample is achieved. Even after six calls there are slight discrepancies in distributions which might cause problems of bias in the interpretation of substantive issues which are very sensitive to distributional changes in respondent and demographic characteristics. The final part of this analysis will investigate the effects of terminal, distributional nonresponse bias on three substantive issues taken from the survey questionnaire.

#### Interpretations and Conclusions

The principal objective of this part of the analysis of nonresponse was to provide some quantitative estimate of nonresponse bias in the distribution of respondent-demographic characteristics as evidenced in various waves of interview completions. For these purposes, a more careful scrutiny of the nature of nonresponse itself was not needed. Nonresponse was thought of only in terms of its effects on rates of response. However, many past studies of nonresponse have been done in order that researchers can afterwards suggest remedies for high rates of nonresponse in future surveys. For these analysts, the exact nature of nonresponse itself is of vital interest. For example, some evidence indicates that

different population groups have different patterns of refusals, not-at-homes and other kinds of nonresponse. At certain points in the callback procedure the nonresponse rate for low income groups could be due to a higher rate of refusals, however, for higher income groups it could be due to higher rates of not-at-homes. Persuasion attempts would thus be more useful for the former than the latter group, while only more callbacks and callbacks at prime times would lower the high income group's nonresponse rate. Such patterns of nonresponse deserve much more study and investigation.

Dunkelberg and Day (1973) also observed that many of the respondent characteristics commonly used in studies of nonresponse are interrelated. For example, it is obvious that a part of the reason for a high rate of female response in this survey and many others is due to the fact that many of them are housewives and hence are more likely to be found at home than working males, especially on the first few calls. Retirement and old age are interrelated. In addition, both the retired and aged, like housewives, are more likely to be at home than many other age and employment groups. By using a search algorithm designed to test for interaction among variables, Dunkelberg and Day (1973) found that city size of residence was the variable that explained most of the variation in the nonresponse patterns in their study. Central city residents in large urban areas required more callbacks than rural residents or residents of small towns. No rural areas or non-urban small cities were included in the Detroit Area Study; however, Table 2 shows that Detroit residents had a response rate that was not very different from that of the suburban, county areas. In fact, two suburban counties in the survey had a lower rate of response after the first two calls than did

Detroit. This may have been due to a higher rate of not-at-homes in these areas.

Several findings listed in Tables 2 and 3 support the findings of some previous studies, while they fail to support others. Unlike the Dohrenwend and Dohrenwend (1968) study, Jewish and Black respondents were found to have high rates of nonresponse on the first few calls. It took more calls, on the average, to interview Jewish and Black respondents than it did for white respondents. However, the Dohrenwends' study was of refusals (terminal nonrespondents). It could be that the terminal nonresponse rate for these groups is indeed lower in the Detroit Area Study than the rates of white ethnics, such as the Irish in the Dohrenwend study. The analysis of terminal nonresponse in the second part of this paper suggests that this may be true for Blacks.

Unlike the Robins (1963) study, less educated respondents were not found to have higher rates of nonresponse than more educated respondents. In fact, the opposite appears to be the case. But the findings do support his findings concerning white collar workers. The findings also support somewhat Mayer and Pratt's (1966-67) study which found comparatively higher rates of nonresponse for males, middle-aged respondents and nonwhites. However, in both these studies the researchers were concerned principally with terminal nonrespondents. Therefore, the results are not completely comparable to the present findings.

The findings reported in Table 2 and Table 3 indicate a great amount of distributional bias for various respondent characteristics throughout the series of callbacks. Many of the characteristics show substantial bias even after three or more calls. This bias is slowly eliminated with the number of calls made, but the final cumulative



results of the 10+ calls can in no way be thought of as completely unbiased. The larger sample size after many calls decreases the probability of bias, while at the same time making small differences appear significant as Mayer and Pratt (1966-67) are quoted as observing earlier. However, almost every survey is faced with the problem of terminal non-response (principally refusals). The bias which results from this hard core of nonresponse cannot be calculated in a wave analysis, as can be done for interim nonresponse. Almost nothing is usually known about terminal nonrespondents in area probability samples, not even their exact demographic characteristics. Trends in the patterns of nonresponse may give some indications of the characteristics of missing respondents. However, there is no evidence of consistent, overall trends in the distributions of demographic or respondent traits in Table 2 or Table 3 which could be useful in drawing conclusions about the characteristics of the 177 refusals found in the 1973 Detroit Area Study.

Finally, it is obvious that wave analysis does nothing in terms of estimating the impact of distributional bias of respondent characteristics on the substantive issues which almost every survey contains. For example, what is the effect of such bias in the income variable on substantive issues in which income is used as an explanatory variable? How would the results of such issues be changes? These questions are especially crucial since most surveys in sociological research are used as instruments to test hypotheses and theories which often require elaborate statistical manipulations. How does distributional bias of respondent traits affect the results of such statistical procedures as correlation, regression, chi-square or other tests of significance used in sociological research? It is this question that is investigated in the next part of this analysis of nonresponse.

Part 2: Estimation of Terminal Nonresponse Bias

The 1973 Detroit Area Study interview cover sheets included space for information about persons who refused to be interviewed. Along with descriptions of the dwelling unit within which the refusal occurred, the age and sex of the refusing person were also obtained. The respondent selection procedure used for this survey necessitated a listing of household adult members prior to designating a respondent. This information was often obtained before the designated respondent had an opportunity to refuse. Most of the age data was obtained from these listings. Some of the age data was estimated by the interviewer when it was possible to see and talk to the respondent but when he/she did not wish to divulge his/her age. The sex data was obtained from direct interviewer observations or from information given by another person in the household.

Of 177 terminal refusals, both age and sex data are available for 140 of them. Using this data, the racial composition of the blocks on which the refusal occurred (from 1970 census data), and income data from the survey itself a profile of non-respondents having four respondent-demographic characteristics was developed. These four characteristics are sex, age, race and family income. The process used to develop this completed profile involved a series of imputations which are described below.

Race Imputation Procedure

For each of the 140 refusals, the racial composition of the block where they resided was obtained from 1970 block census data for the Detroit metropolitan area. The refusals were located on 80 different blocks. Of these 80 blocks, 58 blocks were listed as having no nonwhite residents. An additional seven blocks had nonwhite populations which ranged from one

percent (1%) to thirty (30%). Eleven blocks had nonwhite populations which ranged from sixty nine percent (69%) to one hundred percent (100%). The refusals located on the 58 blocks containing no nonwhites and those located on the seven blocks with minimal nonwhite populations were given the imputed racial characteristic "white". The refusals living on the eleven blocks with high percentages of nonwhites (69% to 100%) were labelled "non-white". Thus, using this procedure 65 of the blocks are considered to contain white refusals and 11 are considered to contain non-whites.

Four of the ~~3~~<sup>4</sup> blocks had almost equal percentages of white and non-white populations (49%, 55%, 60% non-white). The probability of selecting a respondent of either racial category was, therefore, about equal. For these ~~three~~<sup>four</sup> blocks, additional sets of data from the census were used--the percentage of owner and renter occupied households with blacks as heads, and the number of each such units on each block. The use of these measures resulted in refusals living on three of the four remaining blocks being given the "non-white" label and one the "white" label.\* The final results of this procedure was a refusal sample of 15 Blacks and 125 whites.

#### Income Imputation Procedures

The income data for each refusal was imputed from the incomes of respondents on their respective blocks. When two or more respondents could be found on the block on which a refusal was given an imputed income equal to the mean block income of the respondents. This procedure was followed for 122 of the 140 refusals.

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\*The two additional census descriptions were also used to check on the accuracy of the racial designations for the 76 other blocks.

The remaining 18 refusals were white females aged 65 or more. After a routine check of the mean income of all racial and age groupings, it was found that the imputed incomes for the refusals and those for the actual respondents were reasonably comparable for all racial and age groups except for older, white females. Theirs was greatly over-estimated. Since there is evidence from both the responding sample and from past sociological studies that older people, especially older women, tend to have relatively low incomes, an adjustment was made for these ~~14~~<sup>18</sup> aged, women refusals. They were given the mean income of all white females, 65 years old or more in the responding sample instead of their mean block incomes.\*

Table 4 shows the differences between the 140 refusals and the 576 respondents on the four characteristics selected--age, sex, race and family income, plus an additional variable "Type of Housing Unit", is not a substantial difference between the sex distributions in either group, although slightly more men tend to refuse than women. However, there are more middle-aged and older persons and less non-whites among the refusals than among the respondents. The mean income imputed for the refusals is also somewhat lower for the refusals than for the respondents. Considering the trend toward a decreasing percentage of "Single Family Unit" respondents noted in Tables 2 and 3, a surprisingly large number of refusals are from this category of housing. In an effort to investigate how this distributional bias in respondent characteristics may affect areas of substantive interest in the survey itself, the following test for substantive bias was used.

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\* The imputed mean income for these refusals using the mean block income was approximately \$11,000. Using mean income for their age group it was lowered to \$6,000.

**Comparison of the Distribution of the Characteristics  
of Respondents and Refusals**

Characteristic	Respondents	Refusals	Percentage Difference*
<b>Percent</b>			
<b>SEX</b>			
Male	41.1	43.6	- 6
Female	58.9	56.4	+ 4
	N=565	N=140	
<b>RACE</b>			
White	78.6	89.3	-14
Black	21.4	10.7	+50
	N=574	N=140	
<b>AGE</b>			
18-24 years	15.0	4.3	+71
25-44 years	37.2	29.0	+22
45-64 years	35.4	46.4	-31
65 years or more	12.4	20.3	-63
Mean Age ( $\bar{X}$ )	41.8 years	50.4 years	
	N=566	N=140	
<b>FAMILY INCOME</b>			
\$000-\$5,999	23.7		
\$6,000-\$9,999	15.5	(See Appendix 3)	
\$10,000-\$19,999	42.3		
\$20,000 or more	18.5		
Mean income ( $\bar{X}$ )	10.65 ± \$9,500 (See Appendix 1)	10.0 ± \$9,000 (See Appendix 1)	
	N=516	N=140	
<b>TYPE OF HOUSING UNIT</b>			
Detached Single Family	77.7	81.1	- 4
Two-four Family or Row House	12.5	10.8	+14
Apartment, trailer, other	9.8	8.1	+17
	N=569	N=191 <sup>a</sup>	

\* Percentage difference is calculated as  $\frac{\% \text{ Respondents} - \% \text{ Refusals}}{\% \text{ Respondents}}$ .

<sup>a</sup> Includes all 177 refusals, plus 11 terminal NAH's and 3 terminal RA's.

Three opinion-attitude questions from the survey were selected. They were selected because they are often found in the sociological literature. (See Appendix 1 for these items as they appear in the survey.) One question asked the respondents about the strength of their political party affiliation (Political Party); one sought to have the respondents designate their social class status (Subjective Class); and the other was designed to tap the respondent's attitudes regarding the pace of government efforts to eliminate racial discrimination in employment (Race Discrimination).

Using the responses from these three survey items as dependent variables, ( $Y_i$ ) and sex ( $X_1$ ), race ( $X_2$ ), age ( $X_3$ ) and family income ( $X_4$ ) as independent variables, a regression analysis was performed for the 544 respondents in the sample.

$$\hat{Y} = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + E$$

or

$$\hat{Y}_i = b_{i0} + \sum_{j=1}^4 b_{ij}X_{ij} \quad (1)$$

From the results of the regression for each of the three dependent variables, the estimated slopes were obtained (See Table 5). These co-efficients are then used to estimate a value for the refusals on the three dependent variables in the following manner:

$$\hat{Y} = b_0 + b_1X_5 + b_2X_6 + b_3X_7 + b_4X_8 + E \quad (2)$$

$b_0, b_1, b_2, b_3, b_4$  equal intercept and coefficients from (1) and where  $X_5$  is the sex of refusal,  $X_6$  is the race,  $X_7$  is age, and  $X_8$  is the refusal's family income. The estimated means of both the respondent and

Table 5

Result of Least Squares Linear Regression for Respondents

	Political Party	Subject. Class	Race Discrim.
N	499	500	499
R <sup>2</sup>	.092	.129	.128
b <sub>0</sub>	5.6850	2.2101	3.4690
b <sub>1</sub> (sex)	.16176	-.027071	.063235
b <sub>2</sub> (race)	1.0745	-.344210	.77371
b <sub>3</sub> (age)	-.007438	.001303	-.011078
b <sub>4</sub> (family income)	-.072383	.033435	-.002131
Significant variables	Race .0000 Income .0037	Race .0000 Income .0000	Race .0000 Age .0001
Standard Error of Estimate	1.8870	.55721	.95177

refusal samples are then computed, and a difference of means test is used to test for significant differences in the estimated means of the two samples for the three dependent attitude variables.

Findings

Test statistics indicate significant differences in the variances of the dependent variable values for respondents and refusals. (See Table 6) This is true for all three dependent variables. In addition, the means of the two samples on the race discrimination item are significantly different at the .00 level. These differences reflect the bias due to a relatively high rate of refusals in the Detroit Area Study. This bias becomes more evident if one looks at the difference in the means for the respondents alone and for the respondents plus the refusals:

	<u>Respondents</u>	<u>Respondents + Refusals</u>	<u>Difference</u>
	N = 509	N = 649	
-			
Y Political Party	6.0751	6.0734	-.0017
-			
Y Subjective Class	2.1985	2.1924	-.0061
-			
Y Race Discrimination	4.0124	3.9776	-.0348

These findings suggest that distributional bias of respondent characteristics caused by terminal nonresponse may have differential effects on the substantive issues within the survey itself, though the differences (bias) seems slight. Some areas or topics of interest may be affected more than others: the effect of refusals on the race discrimination item is an order of magnitude greater than its influence on the other items. Distributional and concomitant substantive bias can thus be seen as having varying effects on the accuracy of probability statements depending on the variables used in calculating these statements. While there are differences between the sample means of refusals for all three



Table 6

Results of Imputation Procedure

Variable	Respondents N=509*	Refusals N=140	T Test	Significance Level
Political Party	$\bar{Y} = 6.0751$ Var. = .35634	$\bar{Y} = 6.0670$ Var. = .19306	T = .15051 F = 1.8458	.8804 .0000
Subjective Class	$\bar{Y} = 2.1985$ Var. = .04605	$\bar{Y} = 2.1702$ Var. = .02522	T = 1.4555 F = 1.8259	.1460 .0000
Race Discrimination	$\bar{Y} = 4.0124$ Var. = .13318	$\bar{Y} = 3.8511$ Var. = .07892	T = 4.8486 F = 1.6876	.0000 .0001

\* The discrepancy of 9 or 10 additional respondents in the imputation procedure is due to the fact that fewer variables are used in this process with a resulting increase in the number of valid cases.

variables considered, only one of these has means that are significantly different--race discrimination. One must now look at the differences in the distributions of respondent characteristics from Table 4 to see if they are sufficient to explain the substantive bias one observes in Table 5.

The linear regression of the race discrimination variable for the <sup>576</sup> ~~544~~ <sup>499</sup> ~~(487)~~ valid cases) respondents reveals that of the four explanatory variables used in the analysis, race and age are the most significant:

	<u>Partial</u>	<u>Significance</u>
Race	.29380	.0000
Age	-.17368	.0001

Non-white and younger respondents would tend to raise the mean value of the variable. The sample of refusals is "older" than the sample of respondents. It is also "whiter". Therefore, the decline in the mean score is predictable given the characteristics of the persons in the refusing sample. The "older" and "whiter" sample has a mean score on the variable which indicates that more people are satisfied with the present rate of speed of government attempts to eliminate racial discrimination in employment.\* (Note: See Appendix 1 for a description of the race variable and other variables used in the analysis.)

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\* Because of the fact that there were 37 refusals with missing data that were not used in the nonresponse analysis, a final check of the racial characteristics of these refusals was made. Using the race imputation procedure outlined above, 30 of these would have been labelled "white" and 7 "black". If these 37 are then added to the 140 refusals with no missing data, the percentage of blacks in the sample of refusals would increase from 10.7 to 14.1. This small increase would not have seriously affected the results obtained in this analysis.

The slight decline in the mean for the subjective class variable can probably be explained by the lower mean income of the sample of refusals. A similar decline in the political party variable is due to the lower income and perhaps also to the older age of the sample of refusals. (See Appendix 2 for data on which these explanations are based.)

The differences between the two sample variances for the three variables is understandable considering the fact that aggregate data was used for the imputation of the refusal characteristics. These differences may also indicate that there are substantial differences between the two samples that are not reflected in significantly different means, except for race discrimination. The differences between the two sample variances for Race Discrimination is expected given the fact that the means are different. Since analysis of variance tests are easily influenced by one or two extremely deviant values, the differences for the other two dependent variables are also understandable. For example, the sample of refusals contains six persons aged 18 to 24 whose predicted values on most of the variables could disturb the variances of a sample of much older refusals. Therefore, the difference of means test is probably a much better indicator of the differences between the two samples.

#### Summary and Conclusions

For sociologists whose main interest is not sampling theory but substantive sociological theory, the method of estimating nonresponse bias outlined in this paper may be of more value than many of the methods found in the literature on nonresponse. The accumulation of facts and figures about the characteristics of nonrespondents such as their age, sex, race and education, while of much value gives sociologists little

information concerning the impact of such characteristics on the kind of substantive work done by these researchers.

I have attempted in this paper to re-interpret nonresponse bias in the kinds of terms understood best by sociologists who are forever indebted to survey research as a valuable research tool, but who have neither the desire nor inclination to explore the intricacies of sampling theory. Yet, as stated earlier in this paper, sampling theory and its implications for the accuracy and reliability of sociological research cannot be ignored by any social scientist. And the problem of nonresponse deserves more than a casual reference via a footnote. Much more research should be done on nonresponse, especially studies which make the concept of nonresponse bias more understandable to the social scientists who frequently use survey research. The procedure outlined in this paper must be duplicated to see if the findings are merely a fluke due to a faulty imputation procedure or whether this is a reliable way of estimating nonresponse bias.

No doubt any researcher who works with the problem of race discrimination would control for race in any interpretations that were made about the public's opinion on this issue. However, the fact that the difference in the sample means was also caused by the age of the nonrespondents suggests that on such an issue age must also be considered. For political scientists and pollsters who frequently are concerned with the percentages of persons having a given opinion on an issue such as race discrimination, nonresponse bias may greatly affect the reliability of their interpretations. It may be that surveys are systematically missing a more middle aged and older segment of the population whose opinions on such issues as race and others are different from those of

younger persons who are inclined to accept interviews. These nonrespondents could also be vastly different from the sample of older persons who become respondents. These questions deserve a great deal of investigation. One practical step for future researchers would be to increase persuasion efforts for middle aged respondents, as well as to consider the use of such techniques as subsampling and oversampling this group when possible. All such efforts will help one to understand and control the kind of substantive bias which, though slight, is evident in this analysis of nonresponse.

Appendix 1

Variables used in the Regression Analysis

Political Party (strength of affiliation)

This item follows a question which obtains the respondent's party affiliation.

Do you consider yourself a strong Republican or a not very strong Republican?

Do you consider yourself a strong Democrat or a not very strong Democrat?

Do you generally lean more toward the Republican or Democratic Party? (asked of Independents)

1. Strong Republican
2. Not strong (Republican)
3. Lean Republican
4. Neither party
5. Lean Democrat
6. Not strong (Democrat)
7. Strong Democrat

Subjective Class

If you were asked to use one of these four names for your social class, which would you say you belong in:

1. Working Class
2. Middle Class
3. Lower Class
4. Upper Class

Recoded as:

1. Lower Class
2. Working Class
3. Middle Class
4. Upper Class

Race Discrimination

Do you feel that the government is moving much too fast, too fast, much too slow, too slow, or just about right in its efforts to eliminate racial discrimination in employment?

1. Much too fast
2. Too fast
3. Just about right
4. Too slow
5. Much too slow

Respondent's Age

Respondent's exact age in years was used. These ranged from 18 (lower limit set in study) to 84 among the final respondents.

(Appendix 1 continued)

Respondent's Sex (Dummy Variable)

- 1. Males
- 2. Females

Respondent's Race (Dummy Variable)

- 1. Whites
- 2. Nonwhites (included only four persons who are not black)

Respondent's Family Income

A categorical variable coded as follows:

- 1. \$000-999
- 2. \$1000-1,999
- 3. \$2,000-2,999
- 4. \$3,000-3,999
- 5. \$4,000-4,999
- 6. \$5,000-5,999
- 7. \$6,000-6,999
- 8. \$7,000-7,999
- 9. \$8,000-8,999
- 10. \$9,000-9,999
- 11. \$10,000-11,999
- 12. \$12,000-14,999
- 13. \$15,000-19,999
- 14. \$20,000-24,999
- 15. \$25,000 or more

Appendix 2

Partials from the Regression of Respondents

Political Party

	<u>Partial</u>	<u>Standard Error</u>	<u>T-Statistic</u>	<u>Significance</u>
Sex	.04182	.17390	.93021	.3527
Race	.21023	.22483	4.7793	.0000
Age	-.06031	.00539	-1.3428	.1800
Family Income	-.13022	.02479	-2.9192	.0037

N = 499

Subjective Class

Sex	-.02371	.05130	-.52765	.5980
Race	-.22759	.06619	-5.2000	.0000
Age	.03592	.00162	.79974	.4242
Family Income	.20136	.00731	.5736	.0000

N = 500

Race Discrimination

Sex	.03243	.08767	.72124	.4711
Race	.29380	.11325	6.8316	.0000
Age	-.17368	.00282	-3.9199	.0001
Family Income	-.00756	.01268	-.16806	.8666

N = 499



Appendix 3

Because of the fact that the incomes for the refusals are the mean block incomes of the respondents, many are not in the same units as those of the respondents. (See Appendix 1). The following is a listing of the exact units in which the incomes of the refusals appeared.

<u>Value</u>	<u>Number of Persons</u>	<u>Value</u>	<u>Number of Persons</u>
3.00	1	10.50	5
3.50	1	10.57	3
4.33	1	10.60	3
5.00	1	10.67	1
6.00	2	10.80	1
6.60	3	11.00	1
6.67	2	11.20	2
6.94	18*	11.25	2
7.00	1	11.33	1
7.33	2	11.40	4
7.40	1	11.50	1
7.50	3	11.60	1
8.33	5	11.67	2
8.40	1	11.75	3
8.67	4	11.80	1
8.71	1	12.00	4
8.83	1	12.20	5
9.00	4	12.50	6
9.25	1	13.00	3
9.33	1	13.25	2
9.50	3	13.33	1
9.71	1	13.50	3
9.80	1	13.80	2
10.00	4	14.00	6
10.20	3	14.50	2
10.25	3	14.85	1
10.40	4	15.00	1

\* White females 65 years or more

REFERENCES

- Donald T. Campbell and Julian C. Stanley  
1963 Experimental and Quasi-Experimental Designs for Research.  
Chicago: Rand McNally and Company.
- Barbara Snell Dohrenwend and Bruce P. Dohrenwend  
1968 "Sources of refusals in mail surveys." Public Opinion  
Quarterly 32 (Spring): 74-83.
- Marjorie N. Donald  
1960 "Implications of nonresponse for the interpretation of  
mail questionnaire data." Public Opinion Quarterly 24  
(Spring): 99-114.
- William C. Dunkelberg and George S. Day  
1973 "Nonresponse bias and callbacks in sample surveys."  
Journal of Marketing Research 10 (May): 160-168.
- Elizabeth Hartman, Lawrence Isaacson and Cynthia M. Jurgell  
1968 "Public reaction to public opinion surveying." Public  
Opinion Quarterly 32 (Fall): 295-298.
- G. M. Kaufman and Benjamin King  
1973 "A Bayesian analysis of nonresponse in dichotomous  
processes." Journal of the American Statistical  
Association 68 (September): 670-678.
- Leslie Kish  
1965 Survey Sampling. New York: J. Wiley.
- Charles S. Mayer and Robert W. Pratt, Jr.  
1966-67 "A note on nonresponse in a mail survey." Public Opin-  
ion Quarterly 30 (Winter): 637-646.
- Lawrence H. Ross  
1963 "The inaccessible respondent: a note on privacy in city  
and country." Public Opinion Quarterly 27 (Summer):  
269-275.
- Lee N. Robins  
1963 "The reluctant respondent." Public Opinion Quarterly  
27 (Summer): 276-286.
- Gene F. Summers and E. M. Beck  
1973 "Social status and personality factors in predicting  
interviewer performance." Sociological Methods and Re-  
search 2 (August): 111-122.
- United States Department of Commerce. Bureau of the Census  
1970 Block Statistics Detroit, Michigan Urbanized Area. 1970  
Census of Housing HC (3)-120.

