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As with any survey, the data collection instrument for the census is key to the quality of information that is collected. Since the census is conducted largely through a self-enumerative questionnaire, the form itself largely determines how well people respond to the census—whether or not they participate, and the completeness and accuracy of the data they provide.

Since 1985, the Census Bureau has been engaged in a program of research to improve the data collected in the census, specifically in terms of improving mail response rates, item nonresponse rates, and data quality. This research is focused on the census long form, and has used different techniques to obtain information about respondent problems and to test potential solutions to those problems. Initially, one-on-one interviews were conducted, with observers watching subjects as they completed the form and debriefing them afterwards (see DeMaio, 1986, for a discussion of this research). This was followed by a series of small split-panel experiments in which a revised version of the form was tested against the original form (see DeMaio, Martin, and Sigman, 1987, and Martin, DeMaio, and Campanelli, 1990, for further information). The sample for these experiments was relatively small (about 500), not statistically representative, and used a different mode of data collection than that used in the census. Therefore, the next step in the research was to conduct a large nationally-representative field test using a mailout/mailback methodology (see Bates and DeMaio, 1989, and Bates and DeMaio, 1992, for descriptions of this test).

At each of these steps, the scope of the research broadened slightly. From using a single pre-existing census form, the mailout/mailback test involved three alternative forms and a control, so that changes in layout, question wording, and question order could each be assessed separately. In that test, however, a critical aspect of the "census" experience was missing—the publicity campaign that surrounds an actual census. Therefore, we conducted a split-panel experiment in the census itself. The results of that experiment—called the 1990 Alternative Questionnaire Experiment—are presented in this paper. After describing the questionnaires and the methodology for the test, we present results relevant to the three main objectives of the research project: improving mail response rates, item nonresponse rates, and data quality (specifically for the coverage questions).

QUESTIONNAIRES

Six questionnaires were included in the Alternative Questionnaire Experiment. Along with a control form, five experimental questionnaires were developed, which included varying levels of departure from the design of the 1990 census form.

The control form (Panel 1) was identical to the 1990 long form. It had a fold-out flap on which a listing of all household members was obtained, followed by a matrix of short-form information collected about every person, then three pages of housing information and finally two pages of sample population questions for each person.

The form for Panel 2 followed the same basic construction as the control form, but it introduced some minor changes designed to make the form more "respondent-friendly." These were the addition of new step instructions printed in red ink, minor wording changes to simplify and clarify concepts, and graphic changes to increase the amount of white space on a page.

The form for Panel 3 was the same as Panel 2 except that two question sequence experiments were embedded within the 100-percent person matrix. First, the relationship question was reordered from first to third, following the sex and marital status items. This was done to give respondents a chance to answer simple questions before confronting the more complicated relationship item. Second, the order of the race and Hispanic origin questions was reversed. This was done because Hispanic origin typically has the highest item nonresponse rate in the 100-percent person section, and evidence suggests that respondents feel this question is redundant once they have answered the race question (see Martin, DeMaio, and Campanelli, 1990).

Beginning with Panel 4, more radical changes were introduced into the design of the experimental forms. In Panel 4, the underlying structure of the form was abandoned, as well as the fold-out flap. The basic purpose of this form was to keep all the person items and housing items together, and simplify the respondent's path through the form. This was done by creating a booklet in which all the person questions were arranged in a matrix format. Following the household roster, names of household members were entered once across the top of the booklet. Then, respondents could turn shorter pages that had questions down the side and columns of response spaces for each person. Following the person section, housing questions were placed at the back of the form.

In Panel 5, the concept of a single form was abandoned. In this panel, respondents received a kit consisting of a folder and a number of separate forms. The purpose of this design was to encourage self-response, so it would be easier to obtain responses from households containing unrelated members, or even related household members with privacy concerns. The instructions for completing the forms were printed on the folder, and nine person forms and one housing form were included. The individual person forms contained both the 100-percent and sample questions in a small fold-out form. Information about two more people could be obtained in this way, since the traditional census format only has space for seven persons. The housing form contained four 8 1/2" x 11" pages of questions, including the household roster, 100-percent housing items, and sample housing items. In addition to changes in the basic structure of the form, revisions were made in the household roster and coverage questions. These changes will be discussed in detail later in the paper.

The final questionnaire, Panel 6, used the same basic in-style format as Panel 5. The only difference was that Panel 6 did not request names or other identifying information. The reason for the design of this form was to alleviate confidentiality concerns, which have consistently surfaced as a source of threat to respondents in focus group research conducted by the Census Bureau. In addition to the

household roster, the relationship and place of work items were omitted from this form, so it is completely anonymous.

METHODOLOGY

The Alternative Questionnaire Experiment was conducted among a representative sample of all households in densely populated, central city areas of the country. Approximately 7,000 households were randomly selected to receive each questionnaire version, for a total of 42,000 households participating in the experiment. Each household received an experimental form instead of the actual census form. Census forms for sample households were mailed from the Census Bureau's clerical and data processing facility in Jeffersonville, Indiana.

RESULTS

Mail Response Rates

Table 1 shows the rates of mail response for the various alternative questionnaires. As can be seen in this table, the control panel had the lowest mail response rate (48.2 percent), and the level of response increased as the magnitude of the changes to the form increased.

Only slight differences were observed among the first three panels, and these differences were not significant. The forms had the same basic structure, and the revisions to Panels 2 and 3 were relatively small. These changes may have made a difference to respondents who were already disposed to respond, but in the final analysis, the structure itself was what mattered.

The format of Panel 4 was the first real departure from the traditional structure. Here also, the first notable increase in response occurred. The mail response rate was 51.8 percent, significantly higher than the control form. The higher response rate would seem to be a result of the changes we made to the form, eliminating the flap and reorganizing the questions into a booklet format. However, we also had to use a larger envelope for both outgoing and incoming questionnaires. The larger envelope itself could have affected the mail response rate. But to the extent that the larger questionnaire size was necessary to accommodate the booklet design, these features worked together to increase mail response.

The kit approach of Panels 5 and 6 was also successful in increasing mail response. The small increase in response between Panel 4 and Panel 5 was not significant, but the rate of response for Panel 5 (52.5 percent) was significantly higher than for the control. This suggests that the individual forms approach, which encourages self-response and eliminates the need for a road map through a long, complicated household form, has potential as a design for future censuses. In Panel 6, the nameless aspect of the form seems to have stimulated additional response. Response to Panel 6 was significantly higher than to Panel 5; however, the difference of almost two percentage points between these panels is smaller than the increase in mail return due to making structural changes in the form. This effect of providing anonymity is smaller than we might have expected, but it still lends support to the findings from focus group research conducted by the Census Bureau over the years that indicate concerns about confidentiality. And it suggests that further research should focus on issues in this area.

Item Nonresponse: Population and Housing Sections

Mail response is not the only indicator of the level of

completeness of census data. We examined completeness of response in two other ways. First, we broke the form up into sections and calculated the percentage of cases in which all the items in the section were left blank. Second, we looked at individual items to see how completely they were answered.

Table 2 contains the results of our analysis of nonresponse by sections of the questionnaire. Nonresponse for the 100-percent and sample person sections together is presented in the second row, and shows that the pattern of missing sections of data varied dramatically with the basic structure of the form. Panel 1 had very few cases in which all the population items were blank. For Panels 2 and 3, nonresponse to this section was significantly higher, suggesting that the minor changes in wording and sequence were not effective. Nonresponse to all the housing items was relatively low for the first three panels, which used the traditional structure.

The pattern for Panel 4 is quite different. The level of missing population data was more than three times higher than the control, and the level of missing housing data was also significantly higher than the control. Four percent of the booklet forms were missing all housing information. This form contained all the housing questions at the back, and these data suggest that they were overlooked after the population items were completed.

In Panels 5 and 6 which use the kit format, large differences in levels of nonresponse for the population and housing sections were also evident. For both of these forms, the incidence of nonresponse to all the population items was higher than for the control. The level of missing data was particularly high for Panel 5 (5.2 percent). The housing questions were contained on a separate housing form, which could be lost or misplaced, resulting in high levels of missing data for the entire section. As with Panel 4, this structure did result in higher rates of missing housing data.

It is interesting to note that Panels 5 and 6 had generally opposite patterns of entire section nonresponse for the population and housing sections. For Panel 5, more housing forms were returned than population forms; for Panel 6, more population forms were returned than housing forms. It is understandable that the elimination of identifiers would increase the likelihood that population forms would be returned, but it is not clear why it would have an effect of decreasing the return of housing information.

It is clear by looking at the mail response levels and the levels of nonresponse to entire sections of the form that there are tradeoffs among the forms in these two aspects of nonresponse. The next question is, what is the bottom line in terms of total nonresponse, taking both of these aspects into account? The last three rows of Table 2 show that for the population items, the gains in form mail response for Panels 4 and 6 more than compensated for the losses in entire section response. Total nonresponse rates for these two panels were significantly lower than the control.

As far as the housing items are concerned, differences between the forms in total nonresponse were less pronounced, although still statistically significant. Panel 5 fared the best and Panel 6 and Panel 3 also had significantly less nonresponse than the control.

Item Nonresponse: Individual Items

The lowest level of item nonresponse involves omitting a response to an individual item. To conduct this analysis, we calculated item nonresponse rates for individual items,

excluding cases where the entire section that contained the item was left blank. Then we calculated summary statistics to measure average item nonresponse.¹ Summary statistics for the 100-percent person section, sample person section, and housing section are presented in Table 3. The summary statistics are sensitive to the fact that people are required to answer a different number of items depending on their situation (e.g., age characteristics in the sample person section).

The first row of Table 3 shows that there were differences overall in the level of nonresponse to the 100-percent person section. Nonresponse on the control panel was the highest. Nonresponse generally declined with each succeeding questionnaire panel—for Panels 5 and 6, nonresponse was reduced by almost two thirds.

A number of question wording, layout, and sequence changes in Panels 2 and 3 were responsible for the decrease in average nonresponse. The extremely high rate of missing data for Panel 1 is largely due to the fact that 19 percent of the responses for Hispanic origin were missing. In Panel 2, the average nonresponse rate declined by more than half with the addition of an instruction to "Fill in the NO circle if not Spanish/Hispanic." Additionally, in Panel 3 it declined further with the reverse placement of the race and Spanish origin items.

Other changes such as the sequence experiment that moved the relationship item down to third position in Panel 3 also had a positive effect. Conversely, the alternative format of the age and year of birth items did not have positive results.

The wording and sequencing of 100-percent items in Panels 4, 5, and 6 were all similar to Panel 2. However, significant decreases in average item nonresponse were observed. This suggests that the general layout affected the level of missing data over and above the effects of changes to particular questions or their order. The booklet format of Panel 4 and particularly the kit approach of Panels 5 and 6 were successful in simplifying the response task and increasing the amount of information reported.

The middle row of Table 3 suggests that the positive effects of the kit carry over to the sample person section, since the average levels of item nonresponse for Panels 5 and 6 are significantly lower than for all other panels. This is not surprising, since this format eliminates all the complexities of having to find one's way through the form, and at the same time it clearly indicates how many questions have to be completed for each person.

The design of Panel 4, however, did not show any improvement over the control in terms of the average percent item nonresponse to the sample person section. Although all the person items were together, simplifying the path through the questionnaire, the advantage of this format did not seem to hold the interest of respondents. Perhaps the length of the form overwhelmed respondents by the time they got past the 100-percent person section.

The final section of Table 3 presents average item nonresponse rates for the housing section. During the analysis we found a typographical error in the utility items in Panel 4, so we excluded these items from the analysis. The results indicate a slight decrease in nonresponse to the housing items. Although the overall Chi-square was significant, the differences were relatively small. In general, individual item nonresponse to items in the housing section seems unaffected by the design of the form.

Data Quality

The third area in which we looked for improvement was data quality. We examined data quality specifically as it relates to the coverage items. The content of the census form is not generally perceived to be responsible for the historically observed undercount of certain population subgroups; nevertheless, in designing the alternative census forms we made some changes that were related to coverage issues.

Traditionally, the household roster is the first item on the census form. The changes we made to this item varied across the different panels. They included graphic and format changes in Panels 2 and 3, and additional changes in placement in Panel 4 (where the original placement on the foldout flap could not be maintained). For Panels 5 and 6, the household roster was included on the housing form rather than the person form, since it is asked only once per household. In Panel 5, the residency rules were omitted. In Panel 6, no roster was included at all. Instead, a question was added that asked about the number of people living or staying at the household.

Changes were also made to the coverage questions. The coverage question on Panel 1 consisted of two parts: one asked about persons left off the form who should have been counted ("Did you leave anyone out of your list of persons ... because you were not sure if the person should be listed - for example, someone temporarily away on a business trip or vacation, a newborn baby still in the hospital, or a person who stays here once in a while and has no other home?"); the other asked about people who were included on the form but perhaps should not have been ("Did you include anyone in your list of persons ... even though you were not sure that the person should be listed - for example, a visitor who is staying here temporarily or a person who usually lives somewhere else?").

In Panels 2 and 3, these two parts were separated, and the overcoverage and undercoverage aspects of the concept were dealt with in different ways. At the beginning of the housing section, an undercoverage question was included ("List the names of anyone you left off your list ... because you weren't sure they should be included."). Then, in the sample person section, a question was added that was meant to probe for potential overcoverage ("Is there another place this person lives all or most of the time?"). The response categories reflected the content of the residence rules. That is, they were designed to identify persons who may have been included on the household roster when they should not have been, because they were at another house or apartment, away at college or boarding school, at a military base, or in some type of institution.

In Panel 4, the same strategy was employed, dealing separately with undercoverage and overcoverage. However, two questions were added in the sample person section: one asked for the person's living situation as of April 1 (i.e., lives here all or most of the time, lives somewhere else most of the week while working, lives here some of the time, visiting or staying here temporarily), and the second was the same question included in Panels 2 and 3.

In Panel 5, the strategy was expanded somewhat. No residence rules were included in the household roster question. And the question getting at undercoverage was revised to focus explicitly on persons with marginal attachments to the household ("One purpose of taking the census is to count everyone. However, we know that people sometimes get missed. For example: people who stay at

various places on and off during the year, people who are staying someplace only temporarily until they find another place to live, college students who rent a room while they attend school. In addition to the names you just listed, is there anyone else who stays at your household who might not get counted someplace else? If so, please list the names below.”). On the overcoverage side, a third question was added to the questions in the sample person section after the other two. This question asked for the address of the other place where the person lived most of the time.

In Panel 6, our attempt to manipulate the coverage questions was extremely limited, since no names or other identifiers were obtained. The undercoverage question was eliminated, but there was a reminder to complete forms for both regular and marginal household members. The two overcoverage questions included in Panel 4 were also included.

Table 4 presents the item nonresponse rates for the household roster item. Both the format changes in Panels 2, 3, and 4 and the switch to the individual forms in Panels 5 and 6 resulted in respondents being more likely to complete the item. The item nonresponse rates for Panels 2, 3, and 4 were similar, and each was less than half the rate for the control panel. This suggests that the graphic changes were successful and that the removal of the flap was less important in terms of completing the roster item. The level of missing data for the individual forms was extremely low. (The figure for Panel 6 is the level of response to the request for number of household members, since there was no roster of names.)

Information about the number of persons counted at the address is also important. Table 4 shows that overall, there was a significant difference in the mean number of household members reported.² However, this difference was very small. The only significant improvement over the control was in Panel 5. The format of this panel omitted the residency rules from the question, but included a second roster designed to elicit names of marginal residents. These results suggest that this format is successful in stimulating increased reporting of household members.

The other manipulation that we attempted in this experiment was also marginally successful. We included nine person forms rather than seven in the kits for Panels 5 and 6, to encourage more reporting. As noted above, the average household size was significantly larger than the control for Panel 5 but not for Panel 6. However, we also looked at the percentage of cases in which eight or more persons were reported at the address. This comparison is of interest, since person information is obtained for only seven persons using the traditional structure of the census form. (Information about additional persons in households with more than seven persons is obtained separately.) The overall comparison of the number of cases with more than seven persons was significant, although the differences across experimental panels were relatively small. Both Panels 5 and 6 had higher rates of reporting more than seven persons than the other panels. Thus, these results present some evidence that lengthening the form to accommodate more people may be associated with higher reporting on the household roster.

In terms of the coverage questions, we first examine the undercoverage results. Table 5 presents the percentage of forms in which respondents reported that they left names off the roster due to uncertainty about whether they should be listed. Overall, there were sizable differences in the

extent of potential undercoverage across forms. The control panel has the lowest level, with all the question wording and placement variations increasing the percent of forms with names reported. This suggests that, using census procedures to follow up on any form with additional persons reported, the alternative forms could potentially result in fewer missed persons.

The revised wording of the undercoverage question in Panels 2, 3, and 4 showed a slight but significant improvement over the control in increasing possible undercoverage cases. The major gains in reporting, however, resulted from the expanded coverage question in Panel 5, focusing on persons who might get missed. In this panel, the placement was also different—it was at the bottom of the separate housing form, in a more prominent location. Either one of these factors could explain the higher rate of response.

The next set of analyses concerns the questions designed to measure overcoverage in the census. The bottom half of Table 5³ shows that Panel 1 had the least potentially “incorrect” reporting in terms of counting people who should have been omitted from the roster. Percentages for all the experimental panels, for which the overcoverage questions were in the sample person section, were dramatically higher than for the control panel, which contained a single question in the housing section.⁴ Panels 2 and 3 had the highest rates of potential overcoverage, with Panels 4, 5, and 6 falling in between. The content of the series of items in the sample person section is likely responsible for some of the differences. Panels 2 and 3 contained a single question that asked “Is there another place this person lives all or most of the time?”, while Panels 4, 5, and 6 also contained a screener. Persons who were reported in the screener as living “here all or most of the time” were skipped out of the second question, which is the basis for the figures in Table 5.

When the screener was not used to identify the proper base for the “other place” question in Panels 4, 5, and 6, the percentage of persons who were potentially ineligible increased from 1.5, 2.9, and 3.1 percent to 2.6, 4.0, and 4.4 percent, respectively. These latter percentages are more in line with those found in Panels 2 and 3. This suggests that both the screener and the new “other place” item are necessary to determine whether persons fit the Census Bureau definition of “eligible.”

The results of these coverage experiments suggest that something very different happens in the alternative method of evaluating overcoverage as compared with the control. The differences between these two methods should not be taken too literally, however, because there are some limitations to this experiment. First, no attempt was made to recontact households and confirm the living situations of those reported in “ineligible” categories. Second, we do not know for sure whether the sample for the control panel actually contained fewer ineligible persons, or whether the question used in the control panel was simply less sensitive than the alternative question. Thus, the results suggest that additional work is needed to develop and refine questions to measure and classify residency.

CONCLUSION

In this experiment we devised several alternative strategies to improve response in the census. First, we made small changes in traditionally structured census long forms to make them more respondent-friendly (Panels 2 and 3).

Second, we tried two different ways of making dramatic changes in the structure of the form (Panels 4 and 5). And third, we provided anonymity to respondents and their household members (Panel 6).

The results showed that we were successful in some but not all of our revisions. Our attempts to motivate respondents to complete the traditionally-structured form were generally not successful. Mail response rates to Panels 2 and 3 were not significantly higher than for the control (Panel 1). Average item nonresponse to the 100-percent population items was improved by the changes we made, but there was no difference in nonresponse to either the sample population items or the housing items. These results suggest that the structure of the form is a major impediment to respondent cooperation.

The larger changes we made to the structure of the form were much more successful. Both the booklet form (eliminating the flap and placing all the person items together) and the kit approach (individual forms for each person in the household) produced significant improvements in mail response as well as improvements in response to individual items. There were tradeoffs between whether or not forms were returned and how completely whole sections were filled out. However, in terms of total nonresponse—taking both these kinds of missing data into account—the booklet format of Panel 4 and the kit approach of Panel 5 demonstrated that dramatically different ways of approaching the design of the census form have potential for increasing respondent cooperation.

Our effort to provide anonymity to respondents also produced significant improvements in mail response. These results demonstrate that confidentiality concerns do affect the amount of data collected in the census. Although a nameless census form is not a feasible approach, the results suggest that future research should concentrate on the issues of privacy and confidentiality.

Our experimentation with the coverage items was inconclusive, but it pointed out that a range of issues must be dealt with, especially as far as overcoverage is concerned. This effort was really the first step in dealing with the topic of residency, and the results point out the importance of additional research to develop and refine questions to measure and classify residency.

These results provide a solid foundation with which to begin research to tackle the complicated prospect of taking a census in the Year 2000.

NOTES

¹ The denominator of the statistic is defined as the number of items a respondent should have answered in a section; the numerator is a count of the items left unanswered. By multiplying by 100, we arrived at an average percent nonresponse for the section.

² In Panels 1-4, the mean number of persons reported on the roster was calculated; in Panel 5, the mean was calculated from the sum of the names in questions 1 and 2, to take into account household members added from the expanded coverage question; in Panel 6, the response to the question asking about the number of people in the household was used.

³ Data for Panel 1 come from the overcoverage question in the housing section; figures for the other panels were generated from the new question added to the sample population section.

⁴ In Panels 2-6, cases in which the person has another address at college, in an institution, at a military base, or at another house or apartment are considered to be potential overcoverage.

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Table 1. Mail Response Rate by Panel

	P A N E L						
	TOTAL	1	2	3	4	5	6
Mail Response Rate	50.9	48.2	48.6	49.9	51.8	52.5	54.3
Number of Returned Questionnaires	21160	3340	3369	3460	3589	3645	3757

$$\chi^2 = 79.6, D.F. = 5, P < .001$$

Table 2. Components of Nonresponse by Panel

NONRESPONSE COMPONENT	TOTAL	PANEL						X ²	d.f.	p value
		1	2	3	4	5	6			
Percent of Forms Not Mailed Back	49.1	51.8	51.4	50.1	48.2	47.5	45.7	79.6	5	.001
Percent of Returned Forms Missing 100% & Sample Data	2.1	0.5	1.4	1.0	1.8	5.2	2.2	251.9	5	.001
Percent of Returned Forms Missing All Housing Data	2.8	1.4	1.3	1.4	4.0	3.1	5.3	184.7	5	.001
Total Nonresponse to All Person Data	51.2	52.3	52.8	51.1	50.0	52.7	47.9	67.8	5	.001
Total Nonresponse to Sample Person Data	53.6	56.6	56.7	54.8	51.8	53.3	48.4	139.8	5	.001
Total Nonresponse to Housing Data	51.9	53.2	52.7	51.5	52.2	50.6	51.0	14.1	5	.05
N	21160	3340	3369	3460	3589	3645	3757			

Table 3. Average Percent Item Nonresponse for Various Questionnaire Sections by Panel

	TOTAL	PANEL						F-value	p value
		1	2	3	4	5	6		
100-Percent Person Section	3.5	5.8	4.3	3.6	3.3	2.0	2.1	189.8	.001
N	52837	8313	8356	8664	9128	8851	9525		
Sample Person Section	11.7	12.4	12.5	12.6	12.6	10.1	10.4	35.1	.001
N	51910	7980	8171	8439	9031	8807	9482		
Housing Section Items	4.9	5.4	4.6	5.0	5.4	4.5	4.3	3.9	.01
N	20568	3295	3325	3412	3446	3531	3559		

Table 4. Summary of Information Related to the Household Roster by Panel

	TOTAL	PANEL						X ²	d.f.	p value
		1	2	3	4	5	6			
No Response to the Household Roster	2.1	5.3	2.2	2.3	2.0	0.3	0.4	280.2	5	.001
N	20568	3295	3325	3412	3446	3531	3559			
Mean Number of Names on Household Roster	2.6	2.5	2.5	2.6	2.6	2.7	2.6	3.4 (F-value)		.01
Percent of Cases With Eight or More Names on Household Roster	1.0	0.6	1.1	1.1	1.0	1.3	1.3	13.0	5	.05
N	20146	3119	3252	3333	3376	3521	3545			

Table 5. Summary of Results for the Coverage Items by Panel

	TOTAL	PANEL						X ²	d.f.	p value
		1	2	3	4	5	6			
Undercoverage: Percent of Forms with Names Added to Undercoverage Questions	2.3	0.8	1.9	1.7	2.2	4.9	N.A.	151.9	4	.001
N	17403	3340	3369	3460	3589	3645				
Overcoverage: Percent of Persons Potentially Ineligible	2.8	0.4	4.5	4.6	1.5	2.9	3.1	330.0	5	.001
N	52837	8313	8356	8664	9128	8851	9525			