

The Effects of Questionnaire Mode on Response in a Federal Employee Survey: Mail versus Electronic Mail

James B. Treat

U.S. Bureau of the Census, DSSD, Room 2021B-SC2, Washington, DC 20233-0001

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Abstract Through the Joint Program in Survey Methodology at the University of Maryland, an Organizational Climate Survey was conducted in nine agencies of the Federal Statistical System. The survey collected data on a range of topics related to organizational climates. The survey data were collected under a split panel design using a combination of a mail survey questionnaire (paper/pencil) and an electronic mail (E-mail) survey questionnaire. This study examines the effects questionnaire mode has on the response rate and the item nonresponse rate. The response rate analysis indicates that the mail survey produced higher response rates than the E-mail survey. The differences in the rates are between 14 and 35 percentage points. The average item nonresponse rate analysis indicates that the E-mail survey produced greater rates than the mail survey. The differences in the rates are between 2.2 and 3.0 percentage points. The difference in the average item nonresponse rates appears to be solely due to the background (demographic) questions.

Introduction

The increased use of personal computers, the Internet and electronic mail within the federal statistical system raises the question whether an electronic mail (E-mail) survey could be used to obtain information on the organizational climate of agencies. From the research literature, E-mail surveys appear to have several advantages over mail (paper/pencil) surveys. First, the response speed in an E-mail survey may be better than a mail survey (Bachmann, Elfrink and Vazzana 1996; Kiesler and Sproull 1986; Mehta 1995; Oppermann 1995). A second advantage is the ability of automating the survey process; such as, return rate reports, data entry, followup operations on nonrespondents and preliminary data analysis. Return rate reports could be generated on a daily basis in order to track the response. The return rates could be used to customize methods to improve response. E-mail surveys require little to no data entry operation, thus reducing the potential of processing errors in the data. Followup operations could be tailored to the nonresponding population thus reducing the burden on the respondents. The automation of preliminary data analysis would allow for timely reporting of the results. Finally, E-mail surveys do not have the costs traditionally associated with mail surveys; such as, printing of the questionnaire and data entry.

Therefore, E-mail surveys can be less expensive than mail surveys (Mehta, 1995).

However, from the research literature there do appear to be disadvantages of an E-mail survey compared to a mail survey. First, the response rates to E-mail surveys typically have been lower than these rates to mail surveys (Bachmann, Elfrink and Vazzana 1996; Kiesler and Sproull 1986; Mehta 1995; Tse, et al. 1995). Second, any variations in the E-mail address results in the survey not being delivered. However, with mail surveys the questionnaire is typically delivered when there are minor variations in an address or as a result of some forwarding system. Finally, the response quality in E-mail surveys is lower than in mail surveys (Mehta, 1995).

In 1986, Kiesler and Sproull reported research into the differences between mail and E-mail surveys. They compared the difference in response rates and item nonresponse rates between the two survey methods. The study was performed at Carnegie-Melon University on a sample of students and faculty/staff employees who worked in a computer-intensive environment. The subjects were given a self-administered questionnaire, either mail or E-mail. The questionnaire consisted of 18 questions and obtained information on health and personal characteristics. The mail and E-mail response rates were 75 percent and 67 percent, respectively. The E-mail survey had a fewer number of items left blank than the mail survey. For the mail questionnaire, 22 percent of the respondents failed to complete one or more of the questions. On the E-mail questionnaire, only 10 percent of the respondents failed to complete one or more of the questions.

Mehta (1995) compared response rates and response completeness of the data between a mail survey and an E-mail survey. Mehta (1995) identified over 6,000 persons who posted articles on the 20 most popular Newsgroup Internet bulletin boards during a one month period. A systematic sample of ten percent was selected from the list of persons. The sample included persons from both the United States and foreign countries. The survey obtained information on the respondent's attitudes toward the commercialization of the Internet. The study contained five treatment panels; two mail panels and three E-mail panels. The E-mail surveys obtained lower response rates than the mail surveys. The differences in response rates between the two mail and three E-mail panels ranged from 5 percentage points to 20 percentage points. These differences were statistically significant. Mehta (1995) also found a statistically significant difference in the response completeness between the mail and E-mail surveys. The

mail surveys had a lower average number of unanswered questions than the E-mail surveys.

Tse, et al. (1995) sampled 400 administrative and teaching staff at the University of Hong Kong. Of the 400 staff, 200 received a mail survey and the remaining 200 received the E-mail survey. The questionnaire contained 29 questions about business ethics and seven demographic questions. Tse, et al. (1995) analyzed response rates and response quality between the two surveys. The mail response rate was 27 percent and the E-mail response rate was only 6 percent. The response rate difference was statistically significant ($p < 0.001$). The analysis of response quality consisted of the mean number of missing items out of the 36 questions. For the mail survey and E-mail survey, the mean number of missing items was 1.15 and 3.00, respectively. The difference between the two surveys was not statistically significant. The reason for these differences not being significant could be the result of the low response rates.

Finally in 1996, Bachmann, Elfrink and Vazzana wanted to determine if E-mail surveys would produce similar results as mail surveys. Among the statistics of interest, they compared response rates and average item nonresponse rates between the two surveys. They developed a survey to obtain data on Total Quality Management (TQM) from business school deans and division chairpersons in higher education. Their combined sampling frame was taken from directories of professional and academic organizations in order to obtain a representative sample. The sample size was 448 which was equally allocated between the two surveys. The mail response rate was 65.6 percent while the E-mail response rate was 52.5 percent. The difference between these two rates was statistically significant (0.05 level). From their analysis very few items were left blank on either survey. The average item nonresponse rate on the mail survey was 0.7 percent and 3.1 percent for the E-mail survey. The difference between the two average item nonresponse rates was not statistically significant.

Tse, et al. (1995) suggests three possible reasons for the differences in the response rates. First, E-mail is a new technology. Second, the mail (paper/pencil) questionnaire may be more convenient to complete. Finally, the issue of confidentiality on the responses, that is it may be possible to trace the E-mail questionnaire. Tracing the mail survey would not be an issue when returning the questionnaire using the United States Postal Service.

The primary goal of this paper is to examine the possible differences in the response rate and the item nonresponse rate due to the mode of administering an organizational climate survey in the Federal Statistical System; mail vs. E-mail. The previous studies were performed on educated populations; Internet users (computer literate), professional organization members, college/university administration, staff, and students. These populations are very similar to

the employees of the Federal Statistical System. In addition, the previous studies dealt with topics similar to organizational climates; health and personal characteristics, attitudinal issues, business ethics, Total Quality Management. The four previous studies found that the E-mail response rates were lower than the mail response rates (Bachmann, Elfrink and Vazzana 1996; Kiesler and Sproull 1986; Mehta 1995; Tse, et al. 1995). In addition, one study (Mehta, 1995) found the item nonresponse rate for the E-mail survey was larger than the mail survey. Though not statistically significant, two other studies observed larger E-mail item nonresponse rates than mail item nonresponse rates (Bachmann, and Vazzana 1996; Tse, et al. 1995). Therefore, based on the similarities in the populations and survey topics between the past research and this study I hypothesize the following:

Hypothesis 1: The E-mail survey will have lower response rates than the mail survey.

Hypothesis 2: The E-mail survey will have a larger item nonresponse rate than the mail survey.

Survey Design

The Joint Program in Survey Methodology was contracted by nine federal statistical agencies to conduct an organizational climate survey of their agencies, Due to confidentiality concerns the nine agencies cannot be identified. A complete census of the nine agencies was performed representing approximately 8,500 employees.

The Joint Program in Survey Methodology took the opportunity to design a test of an E-mail survey versus a mail survey. The survey data were collected using a combination of a mail survey questionnaire (paper/pencil) and an electronic mail (E-mail) survey questionnaire (split panel design) in the five largest agencies. Table 1 contains the number of persons assigned to the mail and E-mail panels by agency.

Table 1 : Number of Persons in Sample by Agency and Panel

Agency	Panel	
	Mail	E-Mail
A	2,000	2,969
B	395	395
C	266	265
D	216	215
E	218	259

Within each agency, the implementation strategy consisted of a prenotice letter or E-mail message from the agency head, a prenotice letter from the Joint Program in Survey Methodology, the survey questionnaire (mail or E-mail), a followup reminder, a replacement questionnaire and finally telephone followup reminder.

There were differences in the survey implementation among the agencies. Agencies A and E had technical problems with the E-mail survey questionnaire. In some cases, the E-mail questionnaire was converted to an attachment. In order for the respondent to complete the questionnaire they were required to complete a series of file processing steps. In addition, the organizational climate among the five agencies may be different. These differences among the agencies may influence the propensity of the employees within an agency to respond. Therefore, the analysis examines response rates and item nonresponse rates by panel (mail versus E-mail) and agency.

Response rate is defined as the total number of usable responses divided by the difference between the total in the survey and the undeliverables (Dillman, 1978). For this analysis I anticipated that there would be a small number of undeliverable questionnaires. Therefore, the response rate is defined as the total number of usable questionnaires divided by the total number of questionnaires. A usable questionnaire is any questionnaire returned by a respondent regardless of the number of questions answered. Item nonresponse rate is defined as the number of questions left blank (item nonresponse) on the questionnaire divided by the total number of questions (94).

Finally, there are two anomalies with the data file. First, eight returned questionnaires have return dates prior to the date sent. Second, there are 79 returned questionnaires which we could not determine the date they were sent. In both cases, the questionnaires are assumed to have been returned within the first fourteen days of it being sent.

Results

Table 2 contains the response rate analysis for the five agencies by the questionnaire mode. For all five agencies, the results show that the response rates for the E-mail panel are smaller than the response rates for the mail panel. The differences range from 14.4 percentage points to 34.5 percentage points. These differences are larger than what was observed in the previous studies. The technical E-mail problem mentioned earlier in Agencies A and E is reflected in their E-mail response rates. Their E-mail response rates for these agencies are the lowest of all five agencies.

Response rate analysis was performed for early respondents and late respondents to determine if the differences were consistent by respondent type. Early respondents are defined as returning their questionnaire within fourteen days of being sent the questionnaire. Late respondents are defined as returning their questionnaire

after fourteen days of being sent the questionnaire. The results of the response rate varied by agency and respondent. For Agencies A and D, there were statistically significant differences ($p < 0.001$) in the response rates for the early respondents. The mail response rates were between 13.6 and 15.6 percentage points larger than the E-mail response rates. For all but Agency D, there were statistically significant differences ($p < 0.001$) in the response rates for the late respondents. The mail response rates were between 15.4 and 20.8 percentage points larger than the E-mail response rates.

Table 2: Agency Response Rates by Mode

Agency	Mode		Comparison Difference
	Mail	E-Mail	
A	71.2%	36.7%	34.5% *
B	80.5%	60.5%	20.0% *
C	74.4%	60.0%	14.4% *
D	76.4%	54.9%	21.5% *
E	74.8%	45.2%	29.6% *

* indicates that the difference is statistically significant at $p < 0.001$

Table 3 contains the average item nonresponse rates by questionnaire mode and agency based on all 94 questions. For all five agencies, the results show that the average item nonresponse rates for the E-mail panel are greater than the average item nonresponse rates for the mail panel. The differences range from 2.2 percentage points to 3.0 percentage points. The differences indicate that the E-mail questionnaire had between two and three more questions left blank than the mail questionnaire.

Table 3: Average Item Nonresponse Rates by Agency and Mode

Agency	Mode		Comparison Difference
	E-Mail	Mail	
A	4.1%	1.6%	2.5%*
B	3.8%	1.6%	2.2%*
C	4.8%	2.1%	2.7%*
D	5.0%	2.0%	3.0%*
E	5.4%	2.5%	2.9%*

* indicates that the difference is statistically significant at $p < 0.001$

The questionnaire contains 15 sections. The first 14 sections contain 81 attitudinal questions related to organizational climates. The remaining section (R) contains 13 background questions. Concerned that the difference in item nonresponse might influence the attitudinal question analysis, analysis was performed by type of question; attitudinal versus background. Table 4 contains the average item nonresponse rates by type of question, questionnaire mode and agency. The rates are based on the number of questions for each type of question. For the 81 attitudinal questions, the results show for all five agencies that the average item nonresponse rates for the E-mail panels are not significantly different from the average item nonresponse rates for the mail panel. On average, at most one question of the 81 attitudinal questions was left blank for either panel. For the 13 background questions, the results show for all five agencies that the average item nonresponse rates for the E-mail panel are greater than the average item nonresponse rate for the mail panel. For the E-mail panel, on average three to four questions were left blank. For the mail panel, at most 1.5 questions were left blank. These results indicate that the difference in the overall item nonresponse is attributed to the item nonresponse to the background questions and not the attitudinal questions.

Table 4: Average Item Nonresponse Rates by Agency, Mode and Type of Question - Attitudinal versus Background

Average Item Nonresponse Rate				
Mode				
Agency	Type Question	E-Mail	Mail	Comparison Difference
A	attitudinal	1.0%	1.2%	-0.2%
	background	24.1%	4.0%	20.1%*
B	attitudinal	0.3%	0.7%	-0.4%
	background	25.6%	7.2%	18.4%*
C	attitudinal	0.6%	0.7%	-0.1%
	background	31.3%	10.9%	20.4%*
D	attitudinal	0.6%	0.7%	-0.1%
	background	31.9%	9.9%	22.0%*
E	attitudinal	1.2%	1.2%	0.0%
	background	32.0%	10.5%	21.5%*

*indicates that the difference is statistically significant at $p < 0.001$

The background section obtained information on location of employment, years of service at the agency, years of

service in the federal government, grade, job series, job title, whether they are a manager, if they supervise employees, gender, Hispanic origin, race and an additional comment question. Five of the 13 questions were open-ended. Further investigation indicates that the majority of the item nonresponse on the E-mail survey was due to the question(s) which asked job series and job title. This question was open-ended with separate areas for job series and job title. The higher level of item nonresponse for the E-mail panel could be a processing error. The system which converted the E-mail questionnaire data to a usable format may be combining the job series and job title entries into one response. Thus, the other response would be coded as missing. For the mail questionnaires, the data entry staff was able to identify the separate components to the question. In addition, there was no difference in the item nonresponse rates for the three other open-ended questions by panel.

Conclusions

The lower the response rate in a survey the greater the potential effect nonresponse bias has on the results. Therefore, the magnitude of the nonresponse bias can be directly related to the response rate. A high response rate reduces the potential effect of nonresponse bias on the results. The response rate analysis indicates that the mail survey produced higher response rates than the E-mail survey. The difference in the rates are between 14 and 35 percentage points. The differences in the response rate could be the result of problems associated with E-mail. The respondents may be uncomfortable with answering the questionnaire in an E-mail/computer environment. With the mail questionnaire, respondents can start and stop the questionnaire and return to it at a later point in time. That process is not as easy with the E-mail questionnaire. Also, the respondent can take the mail questionnaire with them, e.g. home, to lunch, to complete before or between meetings. The E-mail questionnaire must be completed at the respondent's computer. Another possible reason for the lower E-mail response rate could be the issue of confidentiality. Respondents may be concerned about sending their answers across the Internet. Finally, errors in the E-mail addresses would result in questionnaires not being delivered. Obviously there are problems associated with an E-mail survey, such as technical and/or respondent problems. Until these problems can be identified and controlled, the use of an E-mail survey will reduce the level of response potentially increasing nonresponse bias. Therefore, I recommend continued testing of E-mail surveys in order to identify and correct the problems.

As a result of item nonresponse, either the missing data is imputed or the analysis is weighted to account for the missing data. The greater the number of questions left blank in a survey the greater the effect imputation or

weighting has on the results. Therefore, the magnitude of item nonresponse is directly related to the results. The lower the item nonresponse rate the greater the reliability of the results. The average item nonresponse rate analysis indicates that the E-mail survey produced greater rates than the mail survey. The differences in the rates range from 2.2 percentage points to 3.0 percentage points. However, the differences in the item nonresponse rates are not attributed to the attitudinal questions. In addition, the differences may be the result of data entry and/or processing errors. The actual job series and job title data were not available at the time of the analysis. Therefore, further investigation is recommended in order to determine if the differences in item nonresponse is due to data entry and/or processing errors. For the E-mail questionnaire, the difference in the average item nonresponse rates equates to two or three more questions left blank (on average) out of 94 questions. This difference is not a large number. Therefore, if the response rate for the E-mail survey can be increased without reducing the item nonresponse rate I would recommend using E-mail surveys due to the advantage such as cost and speed.

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