

The Internet Response Method: Impact on the Canadian Census of Population data

Laurent Roy and Danielle Laroche
 Statistics Canada, Ottawa, Ontario, K1A 0T6, Canada

Abstract

The option to complete the census questionnaire via the Internet is one of the major changes for the 2006 Canadian Census of Population. The 2004 Census Test tested most systems and operations in preparation for the 2006 Census, including the Internet collection method. After the 2004 Census Test, analyses were carried out to measure the impact of the Internet collection method on the data as compared with the traditional paper collection method. The impact was analysed on the basis of item response rates and response content. The analysis compared the data of people who were present in both the 2001 Census and the 2004 Census Test, where the 2001 data were collected by paper and the 2004 data were collected via the Internet. These comparisons enabled us to measure the Internet mode effect on item response rates and content. This paper presents some features of the Internet questionnaire and the analysis of the 2004 Census Test data.

Keywords: Internet, response mode, mode effect, questionnaire, census.

1. Introduction

The Canadian Census of Population is conducted every five years. The last one was held in May 2006. The option to complete the census questionnaire via the Internet was one of the major changes for 2006. The 2004 Census Test tested almost all of the systems and operations to be used in the 2006 Census. Following the 2004 Census Test, a number of analyses have been carried out to measure the impact of the data from the Internet response mode compared with the traditional paper response mode. De Leeuw (2005) mentioned the mode itself can cause measurement differences. In some cases, Web users can be impatient and have more than one screen open at the same time. This may cause more superficial cognitive processing. Looking ahead to the 2006 Census, we needed to know what impact the Internet response mode had on the data as opposed to the traditional paper response mode. The impact of the Internet response mode was analyzed for each question on the basis of response rates and response content.

For the Census of Population, two types of self-administered questionnaires are distributed to private households: a short questionnaire, referred to as the 2A (distributed to 80% of the population), and a long questionnaire, referred to as the 2B (distributed to 20% of the population). The short questionnaire contains seven questions covering demographic information for each member of the household. The long questionnaire contains nearly 68 questions (including sub questions) for each household member including the demographic questions from the short questionnaire, as well as questions on education, occupation, language knowledge, income, etc. Table 1 shows the number of questions (including sub questions) per subject on the long form for questions related to each member. There is also a 16-question section on housing characteristics. In recent censuses, both short and long questionnaires have been in a paper matrix format (topic-based format).

Table 1: Number of questions per section of the long form

Section of the long form	Number of questions per person
Demographic information	5
Activity limitations	4
Socio-cultural – part 1	4
Languages	5
Socio-cultural – part 2	5
Mobility	2
Socio-cultural – part 3	2
Education	7
Unpaid work	3
Labour Market activity – part 1	6
Labour Market activity – part 2	10
Consent	2
Income	13

In the 2006 Census, the option to complete the census questionnaire via the Internet was offered to all Canadian households for the first time. The 2004 Census Test was conducted in a limited number of test areas in Canada located in four provinces: Nova Scotia, Quebec, Manitoba and Saskatchewan. In the

test, the Internet response mode was offered to all respondents.

2. Characteristics of the Internet Questionnaire

In the 2004 Census Test, each household received a paper questionnaire (the 2A or 2B). The paper questionnaires contained an access code and the Internet questionnaire's website address. Hence, on receiving the paper questionnaire, the respondent could choose to complete it and mail it back or complete it on the Internet. The main features of the Internet questionnaire application are described in the following sections.

2.1 Description of the Internet Questionnaire

The electronic questionnaire is identical to the paper questionnaire in terms of question wording, instructions and response options. The Internet application was made to be as consistent as possible with standards and guidelines for presentation of federal government websites.

The first screen is a welcome page giving users the opportunity to verify their computer requirements and settings. The second screen is the access code page. Respondents navigate throughout the questionnaire using control buttons located at the bottom of each screen. The following control buttons are presented:

- « **Cancel** »: To exit a session. No data are saved if the respondent exits in this manner.
- « **Next** »: The data are encrypted and sent to Statistics Canada's secure server, where they are then decrypted and verified. If no problem is detected with the answers, the server sends to the respondent's browser the next appropriate screen.
- « **Go back** »: Return to the previous screen.
- « **Stop and Finish Later** »: Save a partially completed questionnaire and fill in the remainder later.

A help function appears in the form of a link in the left-hand column on the screen under a completion status bar. Respondents can click the help link for assistance with the current question being viewed. In addition to the help link, the left-hand column is configured with explanations for respondents as to why they are being asked each question and how the information they provide will be used. Questions and the response options appear in a box at the centre of the screen.

2.2 Validation Messages

Four types of validation messages are possible. *Non-response messages* appear when respondents have not answered a question. *Partial response messages* appear when respondents provide only a partial response to a question, for example, if they omit the city name from their address. *Invalid response messages* appear for numerical responses when respondents enter a number outside of the range established for a question. Finally, *soft edit messages* appear only for questions relating to money amounts whenever the amount in a response appears unusual. This type of message asks respondents to verify that they have entered the correct amount. All of these messages follow the same approach. When respondents click the *Next* button, the information on the current page is validated, and, if necessary, the application displays the same screen again noting any problems at the top of the page in red text, for example, "*Please answer question 5 about John Doe.*" The question and field requiring attention appear in red, and a red arrow highlights the missing response to assist the respondent, who can then either fill in the missing information or continue on to the next screen. If the respondent chooses to move on without making any changes, then the next screen is presented. If the respondent adds or changes any information, then the responses are validated again.

2.3 Format of the Internet Questionnaire

The electronic questionnaire follows primarily the matrix format but also, in places, the sequential format (person-based format). With the matrix format, each question appears only once, and response options are repeated under the name of each person in the household. Usability tests before the 2004 Census Test have demonstrated that this format reduces the response burden, since respondents have to read each question only once and can then respond for all members of the household. Another advantage of the matrix approach is that it reduces the number of screens and, as a result, requirements with regard to system infrastructure. With the sequential format, questions are asked about one person at a time. As a result, questions are repeated as many times as there are persons in the household. The sequential format supports increased customization of questionnaires. For one, it allows a respondent's name to be directly incorporated into each question. The sequential format is used in two places on the electronic version of form 2B: questions concerning labour market activities and income. Usability tests have indicated that it is easier for respondents to focus on one person at a time in responding to these particular questions. Also, the skips in the Internet questionnaire are automated,

meaning that questions that do not apply because of the answer to a filter question are not presented to the respondent.

3. Analysis of the 2004 Census Test Data

The findings of this report are based on the 2004 Census Test. It is important, therefore, to note the test’s principal limitations. First, unlike the census, the 2004 Census Test was a voluntary survey, and the respondent was not required by law to provide answers. Second, there was no promotion campaign such as would normally be conducted in a real census. The test areas were not representative of the Canadian population. They were chosen for the purpose of testing collection operations and not to test questionnaire content or measure response mode effects.

3.1 Number of Questionnaires Received by Response Mode in the 2004 Census Test

The data analysis was based on the data from returned questionnaires. Table 2 shows the number of respondent households, by response mode and type of questionnaire. In the case of the “paper” and “Internet” categories, the respondent completed and returned a questionnaire without follow-up required. The data obtained via follow-up were excluded from the analysis of the Internet response mode effect. In addition, only persons living in private households were considered. The total response rate, i.e. the number of private occupied dwellings that did return a questionnaire was 65% for the short form and 55% for the long form.

Table 2: Number of respondent households, by response mode and type of questionnaire

Response mode	Questionnaire	
	Short (2A)	Long (2B)
Paper	109,270	23,923
Internet	11,423	2,883
Total	120,693	26,806

Of the households that responded without follow-up required (paper + Internet), the proportion of households that chose the Internet mode was 9.5% for the 2A and 10.8% for the 2B.

The analysis of mode effect was based primarily on the long questionnaire (2B). An initial weighting was carried out to compensate for the 2B sampling (20% of households), and the weights were adjusted for non-response, particularly in relation to household size, age and labour force activity.

In the Census, follow-up for partial non-response is carried out in cases where certain questions have not been answered. Partial non-response follow-up cases are determined by specific unanswered questions and by the number of unanswered questions. There are two different phases for the data in partial non-response cases: pre-follow-up and post-follow-up. The post-follow-up data were used for the analysis of the Internet mode effect. The 2004 Census Test data were available for both phases. We decided to use the post-follow-up data since comparison with 2001 Census data was an important component of the analysis and pre-follow-up data were not available for the 2001 Census. Consequently, to minimize the impact of follow-up on the comparison of 2001 data and 2004 data, post-follow-up data were used in both cases.

3.2 Comparison of People with Data Reported on the Internet and on Paper

Before comparing the quality of the data for people with data reported on the Internet and on paper, it is important to note that there are certain differences between the people in the two groups. Without presenting a comprehensive list, we offer a few observations on the differences between the people in the two groups. The estimates presented here and in the rest of the report are weighted estimates.

The differences noted between people with data reported on the Internet and people with data reported on paper are mostly related to age, education, marital status and labour force activity. For example, 23% of the people with data reported on the Internet were under 15, compared with 17% of the people with data reported on paper. We also find differences when we analyze population subgroups. For example, 16% of people aged 35 to 54 with data reported on the Internet do not live with a partner, compared with 22% of people with data reported on paper. For the same age group, 37% of the people with data reported on the Internet had a university degree, compared with 23% of those with data reported on paper. For persons aged 35 to 54 who did not finish high school, 75% of individuals with data reported on Internet had a job (at least 5 hours a week), compared with 66% of individuals with data reported on paper. We were unable to make a comparison based on income level because, even though the questionnaire contains questions on income, the data were not available for analysis.

3.3 Question-level Non-response for the Paper and Internet Modes

To measure the effect of the Internet response mode on completed questionnaires, the non-response rate for each question was calculated and compared with the paper mode. The purpose was to determine whether there was a mode effect on the non-response rates. In this section, we present the non-response rates for each question by response mode. In general, there is non-response for a question when a response is required but not provided. According to this definition, skips affect non-response. The non-response rates in this report are actual rates, since they include only responses for which we are certain that a response is required.

A total of 66 questions (questions and sub questions) were considered in this analysis. A statistical T test was carried out for each question to test the following hypothesis:

- H_0 = the paper non-response rate is equal to the Internet non-response rate.

SUDAAN was used for these tests, and the Taylor linearization method was used to calculate the variance of the non-response rate estimates.

For 60 of the 66 questions considered, the Internet non-response rate was at least 1% lower than the paper non-response rate. For all questions except one, the difference between Internet and paper was significant at the 1% level (p -value < 1%). In general, when the income section was excluded, the question-level non-response rate was between 0% and 7% for the Internet mode and between 1% and 15% for the paper mode. The differences between paper and Internet ranged between 1% and 8%, and they were reasonably steady throughout the questionnaire; in other words, the difference between Internet and paper was effectively the same from beginning to end. It should be noted that the analysis of non-response rates before partial non-response follow-up yielded similar results.

Thus, we found differences in the observations for the paper and Internet groups. The question is whether the differences between the observed non-response rates are due to the response mode or the people that used the two modes. Is it possible to ascribe the differences exclusively to the people reported by the two modes? To answer this question, we used 2001 Census data, for which only the paper mode was available and we selected people appearing on the long questionnaire in both the 2001 Census and the 2004 Census Test.

3.4 Comparison between 2001 and 2004 data for Question-level Non-response

One of the objectives in analyzing the 2004 Census Test data was to measure the effect that the Internet collection mode had on census data. To that end, analyses were carried out in two phases: comparison of the 2004 Census Test data received via the Internet and on paper questionnaires (see previous section), and comparison of the 2004 Census Test data and 2001 Census data.

The comparison of 2004 Census Test data and 2001 Census data was based on people with data reported on a long questionnaire in both 2004 and 2001. It was impossible to identify and compare 2001 data for every person reported in 2004. The analysis was consequently carried out on a non-random sub-sample of people with data reported on a long form in the 2004 Census Test and 2001 Census. This sub-sample contained most, but not all people reported on a long form for both years. Within the sub-sample, two groups were formed: the **PI group** (paper-Internet), composed of people with data reported on paper in 2001 and on the Internet in 2004, and the **PP group** (paper-paper), consisting of people with data reported on paper in both 2001 and 2004. For these groups, it was impossible to determine whether it was the same respondent in both cases. For example, in a given household, member X may have reported the household's members on paper in 2001, while member Y did so on the Internet in 2004. For the purposes of this analysis, we regard this change in respondents as a mode effect and it was not possible to measure it. Table 3 shows the number of people with data reported in both 2001 and 2004 by response mode and type of questionnaire. For this comparison, only questions with no wording change from 2001 to 2006 were analyzed. Therefore, 43 questions were considered.

In addition, for each of the 43 questions considered, the actual non-response rates were computed for the PP and PI groups with 2001 and 2004 data. With respect to 2004 data, the analysis showed that for 19 questions, the non-response rate was significantly lower (at the 1% level) for the PI group than for the PP group. For 26 questions, the PI non-response rate was at least 1% lower than the PP non-response rate.

For the same PP and PI groups, the question-level non-response rates were calculated using data reported on paper questionnaires in 2001. Analysis of the non-response rates produced the following findings. For 12 questions (out of a total of 43), the 2001 non-response rate was at least 1% lower for the PI group than for the PP group, in other words, these type of people are

better respondents. There were also three questions for which the 2001 non-response rate was at least 1% lower for the PP group than for the PI group (none of the three differences was significant at the 1% level). For all of these questions, a total of 12 differences were statistically significant at the 1% level, all of them in favour of the PI group (PI non-response < PP non-response).

Table 3: Number of people with data reported in both the 2001 Census and the 2004 Census Test long form by response mode in 2004

Response mode	People with data reported in both the 2001 Census and 2004 Census Test long form	
	Unweighted counts	Weighted counts
Paper in 2001 and 2004 (PP group)	6,670	59,963
Paper in 2001 and Internet in 2004 (PI group)	730	7,496
Total	8,472	77,387

These analyses show that the observed differences between the question-level non-response rates of the PP and PI groups were larger in 2004 than in 2001. The PI group’s non-response rate was at least 1% lower than the PP group’s non-response rate in 26 questions in 2004 and only 12 questions in 2001. The PI group had 19 questions in 2004 with a non-response rate significantly lower than the PP group (at 1% level) and the PI group had 12 questions in 2001 with a non-response rate significantly lower than the PP group (at 1% level). This suggests that there is an Internet mode effect and that the observed differences were not just due to differences between the people with data reported on the Internet and the people with data reported on paper. If there were no mode effect, we would have seen the same number of questions with a significant difference in 2001 and 2004, and the same number of questions with a difference in excess of 1%.

3.5 Computing the Internet Mode Effect

The foregoing comparisons make it possible to measure the effect that the introduction of the Internet collection mode had on response. To measure this effect, we need only look at the PI group, i.e., the people with data reported on paper in 2001 and on the Internet in 2004. The following factors were considered. Participation was voluntary for the 2004 Test and compulsory for the 2001 Census. The

specifications for partial non-response follow-up changed between 2001 and 2004. These differences may account for the fact that for identical questions, the 2004 response rates are different from the 2001 response rates. To measure the Internet mode effect, we first have to calculate the effect of the differences between 2001 and 2004. This calculation was based on the persons in the PP group. For each question, the effect is defined as the 2001 response rate minus the 2004 response rate for the PP group.

The analysis showed that the effect was almost non-existent for the questions in the first two thirds of the questionnaire (from the “demographic information” section to the “unpaid work” section), as the non-response rates for people with data reported on paper in both 2001 and 2004 were similar. For the last third (the “Labour Market Activity 1” and “Labour Market Activity 2” sections), the non-response rates were about 1% to 4% higher in 2004 than in 2001. This result is interesting because whether or not the survey was voluntary or mandatory had little effect on item non response. The compulsory/voluntary effect is more evident in total response (number of questionnaires returned).

Thus, we have measured the Internet mode effect for the PI group. The effect is measured by the difference between the PI group’s 2001 and 2004 response rates minus the effect of the differences between 2001 and 2004, calculated from the PP group (described in the preceding paragraph). In other words, the Internet mode effect is given by:

$$\text{Internet mode effect for question X} = (\text{2004 PI non-response} - \text{2001 PI non-response}) - (\text{2004 PP non-response} - \text{2001 PP non-response})$$

Table 4 shows the Internet mode effect for each section of the questionnaire. A negative value indicates that the Internet mode lowered the non-response for the questions concerned.

In the table 4, the right-hand column shows the Internet response mode effect on the non-response rate. For the “demographic information” section, for example, the Internet mode effect is measured as 1.12%, which means that the non-response rate is lower with the Internet mode than with the paper mode. Hence, response is higher with the Internet mode.

Our analysis of the Internet mode effect on question-level response rates has produced the following results: the effect reduced non-response for the first eight sections of the questionnaire (except “languages” and

“unpaid work”). The decrease ranged between 0.55% and 1.92%. The effect was larger for the last two sections (“Labour Market Activity 1” and “Labour Market Activity 2”), for which non-response declined by 2.71% and 4.25%. Hence, the Internet mode effect is stronger at the end of the questionnaire (the gain is larger for the last section). This result suggests that there could be fewer dropouts with an Internet questionnaire than with a paper questionnaire. The same person would be more likely to drop out with a paper questionnaire than with an Internet questionnaire. However, no analysis has been done to support this hypothesis.

Table 4: Measurement of the Internet mode effect for persons in the PI group (people with data reported on paper in 2001 and on the Internet in 2004)

Section of the questionnaire	Internet mode effect on non-response
Demographic information (3 questions: Q4 – Q6)	-1.12%
Activity limitations (4 questions: Q7 – Q8C)	-0.55%
Socio-cultural 1 (4 questions: Q9 – Q12)	-1.26%
Languages (5 questions: Q13 – Q16)	0.44%
Socio-cultural 2 (5 questions: Q17 – Q21)	-1.92%
Mobility (2 questions: Q23, Q24)	-0.58%
Socio-cultural 3 (2 questions: Q25A, Q25B)	-0.64%
Unpaid work (3 questions: Q33A – Q33C)	0.23%
Labour Market Activity 1 (6 questions: Q34 – Q39)	-2.71%
Labour Market Activity 2 (9 questions: Q40 – Q50)	-4.25%

3.6 Comparison of answers for people with data reported in 2001 and 2004

The foregoing results have shown the Internet mode effect on data quality measured with non-response rates. What about the quality of the responses themselves? Do respondents answer an Internet questionnaire differently? It is conceivable that respondents behave differently with an Internet questionnaire. When a person is completing the census questionnaire, he or she may have to check with household members. Do Internet and paper questionnaire respondents behave in similar ways in

such cases? Dillman and Christian (2005) said the visual presentation or layout of questions can influence respondent answers similarly across mail and the Internet. In an effort to answer this question, we compared 2004 Census Test responses with 2001 Census responses for the PI and PP groups. The aim was to compute, for selected questions, the rate of change in responses for people with data reported on the long questionnaire in both 2001 and 2004. The questions selected for this analysis were divided into two groups: questions whose responses should not be different, and questions for which the rate of different responses should be low. Table 5 shows the list of questions for each group. Six questions were chosen for the first group, and nine for the second. Most of the omitted questions had to do with education and labour market activity. Our view was that differing responses between 2001 and 2004 for the Labour Market Activity sections could be very frequent, or more frequent for the Internet group or the paper group. The education questions could have been used, but since major changes had been made in their content (new wording); we decided not to consider them.

Table 5: List of questions by group for comparing 2001 and 2004 responses

Group	Questions included in the group
Questions whose response was expected to be the same in 2001 and 2004	Q9 Place of birth Q12 Year of immigration Q16 Mother tongue Q19 Visible minority Q25A Father’s place of birth Q25B Mother’s place of birth
Questions with a low rate of differing responses	Q10 Citizenship Q11 Immigrant status Q13 Official languages known Q15A Language spoken most often at home Q15B Other language used at home Q17 Ethnic origin Q18 Aboriginal status Q20 Indian Band status Q21 Registered Indian status

Next, the rates of response changes for persons in the PI and PP groups were calculated. The objective was to determine whether there are any significant differences between the two groups. In computing the changes, we excluded cases where the question was not answered in one of the two years. In other words, for each question, we considered only those persons for whom the question was answered in both 2001 and 2004.

For the questions for which no change was expected, our analysis showed that the rates of change ranged between 1% and 3% for all questions except year of immigration (higher rate of change). That is, for each question where no change was expected, between 1% and 3% of respondents changed their answer between 2001 and 2004. The difference in rates of change between the PI group and the PP group was not significant (at the 1% level) for any of the questions. Consequently, changes were not more frequent for Internet or for paper. For the second group of questions, the rates of change were higher (between 1% and 7%, except for the ethnic-origin question), but there was no question for which the rates of change were significantly different for the PI and PP groups. These results indicate that response changes are not more frequent for the Internet questionnaire and that if there are any differences in the behaviour involved in completing an Internet questionnaire, those differences do not seem to affect the responses for the questions studied.

Conclusion

In general, we were able to measure the Internet mode effect on question-level non-response rates and to show that the effect is positive since non-response is lower. We were also able to show that for specific questions, responses were no different on the Internet than on paper. Internet data are not of a poorer quality. All of the features of the Internet questionnaire (edits, Help, explanations to questions) are improving the item response rates. Further study will be required using 2006 Census data in preparation of the 2011 Census to evaluate the mode effect on content for all questions using approach such as standardization or propensity scores.

Acknowledgements

The authors would like to thank the following people at Statistics Canada for their comments and suggestions in writing this paper or their support in this study: David Dolson, Sarah Franklin, Graeme Gilmour, Linda Howatson-Leo, Yves Lafortune, Jean-Pierre Morin and Michael Ng.

References

- de Leeuw, E.D. (2005). "To Mix or Not to Mix Data Collection Modes in Surveys." *Journal of Official Statistics*, Vol. 21, 233-255.
- Dillman, D. and Christian, L.M. (2005). "Survey Mode as a Source of Instability in Response across Surveys." *Field Methods*, Vol. 17, 30-52.