MODE EFFECT IN WEB SURVEYS

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INTRODUCTION[1]

One of the aspects of the validity of Web surveys concerns their measurement errors, especially the mode effect error that occurs because Web and not some other mode is used for surveying. In Web surveys a medium of communication when answering the questionnaire differs from that in traditional modes, i.e. it is completed using the Internet. Thus, there are important questions about the impact of the mode of data collection on the respondents' substantive answers and on the quality of data in Web surveys. Eventual different responses can occur due to different reasons. Some of them can be contributed to the fact that Web surveys are *self-administered,* others to their *computerization* aspect. Finally, there are some effects that may be *specific only for Web surveys*. They steam mainly from different channel capacity of the Web (and Internet) itself and from the context effect of the Web (and Internet) usage (Lozar Manfreda and Vehovar, 2002).

Two possible designs to study mode effect can be used. The first refers to the question whether a Web survey would give the same results as another survey, given all the differences in the way these surveys are conducted. This question is more practical and easily measurable therefore it is actually often addressed by Web survey methodologists (Lozar Manfreda and Vehovar, 2002). The second design refers to the question what is the marginal effect of the Web mode on survey statistics, assuming all other attributes of the design are the same as in the survey to which the Web survey is compared. This question tries to identify the inherent properties of the Web mode that might produce differences between the modes that can be attributed to the communication channel only and not to survey design characteristics. Due to the more complicated research design (a re-test on the same individuals is necessary, Lozar Manfreda and Vehovar, 2002) not much research has been produced to answer this question so far.

At this point we will address the second of the above questions. We will use a panel design (re-test): respondents were first administered one survey mode; those who answered were later administered another survey mode. Only those who participated in both waves were compared. In such a case the differences cannot occur due to coverage, sampling or non-response error, since the same individuals are compared. Most likely, they can be attributed to the communication mode itself. Nevertheless, also in this case some caution in the interpretation of results is necessary since the experience from the survey in the first wave may alter the response behavior in the second wave. In addition, the first survey may lead respondents to change their actual behavior towards the survey measures.

METHODOLOGY

The marginal effect of the Web mode was tested within the RIS (Research on Internet in Slovenia, www.ris.org) 2001 annual national Web survey conducted by the University of Ljubljana. This survey is a self-selected Web survey of Internet users in Slovenia. It is advertised on all major Web sites in Slovenia (over 200 sites responded to our invitation and placed a banner ad for the 2001 survey). Email invitations to the survey were also sent to addresses from the public email directories in Slovenia (20.000 email invitations for the 2001 survey were sent). Over 14,000 responses to the survey were obtained between July and October 2001. In this experiment, only respondents who answered the questionnaire before the beginning of September 2001 were included. They were invited to the Web survey through banner ads (email invitations were sent later). These respondents are self-selected respondents, therefore not representative of the general population of Internet users in Slovenia. However, since in this case the same respondents are surveyed twice and the marginal mode effect of their answers is of interest, their representativeness of the larger population is of minor importance. The marginal effect of the mode could nevertheless be measured.

Research design

In this study, a comparison between the Web and mail mode and between the Web and telephone mode is performed. Participants for the two comparisons were recruited during the national RIS 2001 Web survey. At the end of the Web questionnaire, a random sample of respondents was asked to reveal their name and mail address in order to participate in a follow-up mail survey. Another sample of respondents was asked to reveal their name and telephone number in order to participate in a follow-up telephone survey. A few weeks later, the mail and telephone surveys were implemented.

The questionnaires in the mail and the telephone survey repeated some of the questions from the Web questionnaire. Three additional questions were included at the beginning of the mail and the telephone questionnaire, in order to give respondents some sense that they were not answering the same questionnaire once again. Although the Web questionnaire included more questions, the order of questions in all three questionnaires was the same, thus minimizing the question order effect. Also the graphic layout of the Web and the mail questionnaire was as similar as possible. For some of the questions there were minor differences, as explained later.

27 items are included in mode comparisons. Gender and year of birth are not included in the comparison, but used as control variables to assure that it was really the same people who answered the two compared questionnaires.

The time interval between each pair of the compared surveys is variable across individual participants due to the long data collection period for the Web survey (8 weeks) and the two follow-up surveys (4 weeks for the mail survey with two follow-up mailings, and 2 weeks for the telephone survey). The time difference between the Web and mail survey therefore varies from 14 to 93 days with an average of 47 days: and for the Web and telephone survey from 18 to 79 days with an average of 39 days. To check for possible interaction of time difference between the two compared surveys, the Pearson correlation coefficient between the time interval and absolute difference between the two answers for each item was tested. For the Web-mail comparison, the correlation was not statistically significant at $p<0.05$ for any of the items, and statistically significant at $p<0.1$ for 2 of the items. For the Web-telephone comparison, the correlation was statistically significant at $p<0.05$ for 1 of the items, and statistically significant at $p<0.1$ for another item. Time thus seems to have a minimal impact on differences between the two compared surveys.

Sample size

In the Web survey, a random sample (n=987) of respondents was asked to reveal their name and address in order to participate in a follow-up mail survey, and another random sample (n=3458) to reveal their name and telephone number in order to participate in a follow-up telephone survey. This data was revealed by 34.5% of the respondents for the mail survey and 20.4% of the respondents for the telephone survey.

The paper questionnaire was sent to 341 participants. 4 envelopes were returned as undeliverable; the others presumably reached their intended recipients. 285 completed questionnaires were returned, representing a 84% completion rate (% of responses among all sent questionnaires), and an 85% response rate (% of responses among all delivered questionnaires).

The telephone survey was implemented on 705 participants. 576 Web respondents actually participated in it. Among the non-respondents, the telephone number was not existent in 32% of the cases; nobody answered the phone in 18% of cases; or somebody answered the phone, but the person participating in the Web survey was not found in 19% of the cases. In the remaining 31% of cases, the participants refused to participate. The refusal rate for the telephone survey was therefore 6% (refusals among all telephone numbers).

The analysis would therefore ideally be performed on 285 participants for the Web-mail comparison, and 576 participants for the Web-telephone comparison. However, we had to further limit the number of cases by excluding those cases whose answers to questions on gender and year of birth did not match (15 cases), and cases for which matching could not be performed on any of these variables (because of missing data for both variables) (12 cases). For all other cases, either the data matched on both variables or for at least one of them (while being unavailable for the other). Regarding the year of birth, we also retained 10 cases where the year of birth differed by one year, but the data on gender and also education and employment matched. Namely, in the Web questionnaire respondents had to choose their year of birth from a drop-down menu. We assume these individuals mistakenly chose an option next to their actual year of birth. This is therefore already an error that can occur in Web surveys due to the mode effect if drop-down menus are used.

270 cases were finally included in the Web-mail comparison and 564 cases in the Web-telephone comparison. For them we assume the same respondents for both compared questionnaires. For specific items the number of cases varies slightly owing to some item non-response, because some of the items were presented only to a random sub-sample of respondents, or because a skip was included.

Description of participants

Participants in our study are specific, i.e., a convenience sample. They are Internet users who decided to participate in the national RIS 2001 Web survey after had they noticed banner ads. They were very co-operative, since they revealed their mail address or telephone number for further research. Nevertheless, in social-demographic characteristics they do not differ much from the general population of Internet users in Slovenia (Table 1). However, they differ significantly in the frequency of Internet usage. Our participants are very intensive Internet users, mostly using the Internet every day. This presents a limitation since the results cannot be inferred to the general population of Internet users without caution. Nevertheless, we believe that this study can provide a valuable insight into the possible mode effects of the Web mode when surveying individual Internet users.

	Web-mail comparison	Web-telephone comparison	General population of Internet users[2]
% men	61%	65%	59%
% with university education	44%	30%	30%
Average age	33	29	30
% employed	59%	51%	57%
% still attending school /faculty	35%	42%	41%
% daily users	82%	85%	47%

Table 1. Comparison of background variables among participants in two mode effect studies and the general population of Internet users

Research questions and analysis

The following hypotheses were formulated:

1. In general, substantial differences in answers will be smaller for the Web-mail than for the Web-telephone comparison.
2. The substantial differences will be larger for qualitative than for quantitative variables.
3. In the Web-telephone comparison, the substantial differences will be higher for items with a larger number of answer categories. No effect is expected in the Web-mail comparison.
4. Owing to the interviewer effect, differences in results will occur for sensitive questions in the Web-telephone comparison, but not for the Web-mail comparison.
5. Differences in results will be larger for survey questions putting a larger burden on the respondents.

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[2] Source: June 2001 RIS telephone survey (RIS, 1996-2002).

6. Differences in results will occur more often for attitudinal, somewhat less often for behavioral and least often for factual survey questions.
7. Differences between the compared modes will be larger for respondents with lower Internet usage experience.

In order to test the above hypotheses, analysis was performed from two aspects. First, the differences in responses for individual survey items were compared (a particular survey item is the unit of interest). Then, the differences across the respondents were compared to test the possible interaction of mode effect and error due to respondents.

RESULTS

27 identical items were used in the comparisons. For the Web–mail comparison, the percentage of respondents that gave identical answers ranges from 38% to 85% across compared items, with an average of 60%. For the Web–telephone comparison, this percentage ranges from 29% to 93%, with an average of 56%. The match is therefore somewhat larger for the Web-mail comparison, confirming the first hypothesis. The presence of the interviewer introduces specific effects when self-administered Web surveys are compared to interviewer-administered telephone surveys. However, beside this, the match greatly depends also on the item characteristics as presented below.

Quantitative variables
Items from 22 close-ended one-choice survey questions are ordinal with at least five answer categories, intervals or ratios. We work with them as with quantitative variables. Two additional questions have two possible answers (yes, no); we coded them as dummy variables and also work with them as with quantitative variables.

The percentage of participants that have exactly the same value on these variables varies from 38% to 85% for the Web-mail comparison (average 62%), and from 39% to 93% for the Web-telephone comparison (average 56%). Average percentages of matching cases are slightly higher than when all variables are taken into account. That suggests that differences are smaller for quantitative than for qualitative variables, confirming the second hypothesis.

Although for some items the percentage of cases with identical responses is rather low, the differences between individual values are not extreme. The Pearson correlation coefficients for answers from the two compared questionnaires are positive and statistically significant ($p<0.05$) for all items in both comparisons. However, if estimates were to be given from the two compared surveys, statistically significant difference (paired samples t test) would occur for some variables. For the Web-mail comparison, statistically significant results (at $p<0.05$) would occur for 11 (46%) variables. For the Web-telephone comparison, the difference would occur for 8 (33%) variables. The differences in results for quantitative variables would thus occur more often when a Web survey is compared to a mail survey and less often when a Web survey is compared to a telephone survey. This result is the opposite of the result if only the percentage of cases with identical answers is taken into account. As suggested below, the differences in results actually depend on additional characteristics of the tested items, not only on their quantitative/qualitative nature.

We tested whether differences are larger for those quantitative items that have a larger number of possible values. The Pearson correlation coefficient measuring correlation between the number of possible values and the percentage of matched cases for each item is calculated. For the Web-mail comparison, this correlation is low ($r=0.025$) and not statistically significant ($p=0.907$). Therefore, for the Web-mail comparison, the percentage of matched cases does not decrease with the number of possible values. For the Web-telephone comparison, this correlation is larger ($r=-0.398$) and statistically significant ($p=0.054$). For the Web-telephone comparison, the differences therefore occur more often for survey questions with a higher number of possible answers, confirming the third hypothesis. It probably has to do with the fact that in both self-administered questionnaires respondents see all the answer categories, while they have to listen carefully to the interviewer to remember all the categories in the telephone interview. A lower match among the answers from a self-administered and an interviewer-administered survey is therefore more probable.

The average difference between the values from the two compared questionnaires was also calculated for each tested item. For the Web-mail comparison, the statistically significant average differences between the values

		Web – mail	Web -telephone
% of respondents with same answer for specific item in both questionnaires	Min	37,6%	38,6%
	Max	84,8%	92.9%
	Average	61,5%	56,2%
% of items with statistically significant (p<0.05) positive Pearson correlation coefficient between answers from two modes		100% (24)	100% (24)
Pearson correlation coefficient between number of possible values and percentage of matched cases		0.025 (p=0.907)	-0.398 (p=0.054)
% of items that would give statistically significantly (p<0.05) different estimates (paired samples t test)	Positive dif.	0% (0)	4% (1)
	Negative dif.	46% (11)	29% (7)

Table 2. Differences in responses for quantitative variables from one-choice close-ended questions

(paired sample t test) are all negative. In the Web questionnaire respondents therefore tended to answer with somewhat lower answer categories. For example, on the Web they agreed less with the statements such as "I'm worried about data security on the Internet", "Costs limit my Internet usage", and "I'm bothered by slow downloading". They also reported using certain Internet services and searching for certain content less often. In general, problems with the Internet are rated as less salient and specific Internet usages are rated lower in the Web than in the mail survey. This may be due to the

fact that people compare to other people when they answer a survey questionnaire. When they are answering the mail questionnaire, they may compare themselves with other people from the general population, therefore they rate themselves higher as regards their Internet usage and related problems. On the other hand, when they are answering a Web questionnaire, they may compare themselves to other Internet users and they may therefore rate their Internet usage and related problems somewhat lower in comparison to the perceived average.

For the Web-telephone comparison, the statistically significant average differences are negative for 7 items and positive for 1 item. Just as above, the Web respondents tend to rate their Internet usage as lower. In addition, they also rate their education and knowledge of English as lower. The reason might be the same as above. The only positive difference occurs for one sensitive question, i.e. the question about the frequency of searching for erotic content on the Internet. Here, the respondents were more likely to admit looking for erotic material on the Internet in the Web than in the telephone questionnaire. This confirms the fourth hypothesis regarding the sensitive questions and social desirability. The issue is also further discussed below.

Qualitative variables
Two survey questions, both close-ended multiple-choice, result in qualitative variables:
Q1: Respondents were asked to tell where they access the Internet from (7 possible answers).

Q2: Respondents who had shopped in Slovenia during the last 12 months were asked to name online shops where they shopped (16 possible answers). (Actually, only half of the respondents were presented with a close-ended question Q2, while the other half were confronted with an open-ended version of this question. See the section on open-ended question.)
In the Web and the mail questionnaire, the respondents entered their answers by checking the check boxes. In the telephone survey, another mean was used. Question Q1 was actually an open-ended question. Respondents named one or more accesses and the interviewer coded them using the available coding scheme (7 possible answers). Question Q2 was a set of 16 questions with 'yes' and 'no' answers (each read by the interviewer) in order to avoid the recency effect.

The percentage of respondents that gave exactly the same answers in the Web and the mail questionnaires for Q1 is 60%, and Q2 48%. On average, the number of checked answers was similar in the Web and the mail questionnaire for both questions. If estimates were to be given from the two surveys, the results obtained would be the same. That is, the ranks of the possible categories (Spearman correlation coefficient) match in the mail and the Web questionnaire for both questions. Slightly larger discrepancies are characteristic for Q2 which is probably due to the fact that more possible answers were available and that the question was cognitively more difficult. Actually, 13% of all respondents did not check any answer in the Web and 13% in the mail questionnaire.

		Web – mail	Web –telephone
% of respondents with the same answer in both	**Q1**	60%	68%
questionnaires	**Q2**	48%	29%
Correlation between ranges of values from two	**Q1**	1 (completely the same range)	1 (completely the same range)
questionnaires (Spearman correlation coefficient)	**Q2**	0.881 (p<0.0005)	0.895 (p<0.0005)
% of cases with no category checked (no answer) (Web	**Q1**	1%, 2%	0.2%, 0.4%
questionnaire, mail questionnaire)	**Q2**	13%, 13%	17%, 0%
Average number of categories checked (Web questionnaire,	**Q1**	2.10, 2.14	2.25, 2.25
mail questionnaire)	**Q2**	1.23, 1,58	1,43, 2.18

Table 3. Differences in responses for qualitative variables from close-ended multiple-choice questions

For the Web-telephone comparison, the answers for question Q1 mostly match (68% of respondents gave exactly the same answer), despite the difference how this questions was asked. Since this question is relatively simple, small differences in results were obtained. On the other hand, for question Q2, the answers do not match. Only 29% of all respondents gave exactly the same answer in both surveys. Still, the range of categories obtained from the two surveys would be the same if estimates were to be given (Spearman correlation coefficient is positive and statistically significant). The difference actually occurs in the item (non)response. In the Web questionnaire, 17% of respondents did not check any answer, while there was no such respondent in the telephone survey. On average, respondents checked 1.43 answers in the Web questionnaire and 2.18 answers in the telephone survey. For this more difficult question, help from the interviewer significantly

influenced the results in terms of their data quality (larger response); however it did not influence the substantive answers.

Open-ended question
There was one open-ended question. Half of the respondents who had shopped in Slovenia in the last 12 months were asked to name no more than three stores where they shopped. In the Web and the paper questionnaires, there were three separate entry boxes for the three shops. In the telephone questionnaire, the interviewer asked respondents to name no more than three shops.

The percentage of respondents who gave exactly the same answer is higher in the Web-mail than in the Web-telephone comparison (45% versus 32%). However, if estimates were to be given from the two surveys, the ranges of values would be the same in both cases (for both

comparisons). In both comparisons, item non-response for this open-ended question was larger in the Web questionnaire. This is in contrast with the results of previous studies, which showed that responses to open-ended questions are richer in Web

questionnaires (Reja et al., 2002). Maybe here it has to do with the fact that the question was difficult and on the Web respondents were more careless in answering it.

		Web – mail	Web -telephone
% of respondents with the same answers in both questionnaires	Q3	45%	32%
Spearman correlation between ranges of values from two questionnaires	Q3	0.701 (p=0.011)	0.820 (p<0.0005)
% of cases with no answer (Web questionnaire, mail questionnaire)	Q3	7%, 0%	6%, 2%
Average number of answers (shops) given (Web questionnaire, mail questionnaire)	Q3	1.22, 1.59	1.6, 1.6

Table 4. Differences in responses for an open-ended survey question

Results regarding this open-ended question and also the two closed ended-questions with several possible answer categories (previous section) confirm the fifth hypothesis that the differences in results will be larger for survey questions placing a larger burden on the respondents, i.e., for more

'difficult to answer' questions in this case. The hypothesis is also further tested below.

Attitudinal, behavioral and factual questions
The 27 items can be divided into three groups according to

	Type of variable	Web – mail	Web –telephone
% of respondents with the same answers on both questionnaires	Attitudinal	43.7%	46.3%
	Behavioral	61.5%	54.9%
	Factual	81.1%	69.6%
	Dunnett test	p<0.028 for all pairs	p=0.005 for pair 1-3 and p=0.004 for pair 2-3

Table 5. Differences in responses for different types of survey questions

the kind of information they ask for: 4 attitudinal, 21 behavioral, and 2 factual questions. Table 5 presents the average percentage of matching cases for the three groups. In both comparisons, the higher match is characteristic for the two factual, i.e., socio-demographic variables (education and economic status). For variables measuring behavior, the percentage of completely matching cases is smaller, and for variables measuring attitudes it is the smallest. The difference in percentages among the groups of items is statistically significant (analysis of variance used). The sixth hypothesis is therefore confirmed.

Social desirability of answers
There was one question that could be regarded as a sensitive question probably revealing some socially desirable answers: 'How often do you use the Internet for searching for erotic content?' (scale 1 – never, 5 – regularly).

For the Web-mail comparison, the percentage of cases where answers match completely is rather high (76%). The differences between the answers are in both directions with an average difference of only 0.02 on a scale from 1 to 5.

For the Web-telephone comparison, on the other hand, the match is lower, only 66%. The average difference is 0.17 on a scale from 1 to 5 with lower answers in the telephone survey. Respondents were less likely to admit looking for erotic content on the Internet during the telephone interview than in the Web questionnaire (the difference in estimates would be statistically significant at p<0.05). In the telephone interview, respondents especially tended to say 'never'. This again confirms the fourth hypothesis and is consistent with the general finding about the mode effect on social desirability when self- and interviewer-administered surveys are compared (de Leeuw, 1992: 205).

Another set of items known to be subject to social desirability was tested only in the Web-telephone comparison, i.e., items measuring impression management from the 'Balanced Inventory of Desirable Responding' (BIDR) scale (Robinson et al., 1991: 37-41). In another paper we showed that on average these items are subject to significantly larger social desirability in the telephone than in the Web survey (Lozar Manfreda et al., 2002).

Burden on respondents
One possible burden for the respondents may stem from the course of the questionnaire itself: later questions present a larger burden than the initial ones. Therefore the Spearman correlation coefficient was calculated between the percentage of matched cases and the place of the item within the questionnaire. For the Web-mail comparison, the coefficient is negative (r=-0.390) and statistically significant (p=0.044). Thus, the later the question appears in the questionnaire, the larger the mismatch between the Web and the mail answers, probably due to less attention when answering these questions in both of the surveys.

For the Web-telephone comparison, the coefficient is 0.267 and not statistically significant (p=0.178). Perhaps on account of the interviewer's presence and probing, the respondents do not become as annoyed during the telephone interview. Therefore, in the telephone interview they answer the questions that appear later on with the same attention. Even if they answer the later questions in the Web questionnaire with less attention, the differences are nevertheless smaller than in the Web-mail comparison where less attention was probably present in both surveys.

Another burdensome aspect involves questions that are difficult to answer, for example the question about online shops. We already showed that the match is lower for this question in comparison to other ones. We also showed that the discrepancies in substantial answers occur more often in the Web-telephone comparison. In addition, item non-response is larger in the Web than in the telephone survey. The presence of the interviewer during the telephone interview probably helped the respondents to more carefully answer this difficult question, while not taking such care when completing self-administered questionnaires (Web and mail).

Effect of respondents

In order to test the hypothesis on the interaction of mode effect and error due to the respondents, the respondents - and not individual items - are the subjects of interest. We assume that the respondents' experience with Internet usage (measured with the frequency of usage) might have an influence on the differences between the modes.

For the Web-mail comparison, Pearson correlation coefficients between the frequency of Internet usage and differences between the answers from the two survey modes are statistically significant at $p<0.05$ for 3 and at $p<0.1$ for 1 of the quantitative variables. In these cases, the correlation is negative, suggesting that for these variables higher experience decrease the differences in responses. For the qualitative variables, there is no difference (independent samples t test) among those with the same answers and those with different answers from the two modes.

Similarly, for the Web-telephone comparison the correlation between the frequency of Internet usage and differences in responses is rather low; the coefficient is statistically significant for 6 quantitative variables at $p<0.05$ and for 3 quantitative variables at $p<0.1$, while for none of the qualitative variables. Again, where the correlation occurs, it is negative.

The hypothesis of the combined effect of mode and respondents' error thus cannot be confirmed, since the correlation occurs at a minor part of items. However, if it does occur, the correlation is negative as expected: higher frequency of Internet usage of individual respondents decreases the differences in their responses in the two modes.

CONCLUSIONS

The paper deals with the differences in the respondents' answers to a Web and a mail questionnaire and to a Web and a telephone questionnaire. Results are mixed, greatly depending on the type of the survey questions compared. In general, the percentages of respondents that gave exactly the same answers in the two compared modes are on average rather low (60% for the Web-mail comparison and 56% for the Web-telephone comparison). This suggests that in addition to the validity of the survey mode itself, the reliability (extent to which different measures give the same results) of the individual survey questions compared is questionable.

We also showed that substantial differences in responses in general are smaller for the two self-administered modes compared than for the self- and interviewer-administered modes compared. This is consistent with some other studies that also showed the differences in answers between a Web survey and another interviewer-administered survey (Willke et al., 1999; Wydra 1999). For the Web-telephone comparison, the substantial differences in answers are especially larger for items with a larger number of answer categories, for sensitive questions and for difficult-to-answer questions. In both comparisons, the differences were also the largest for variables measuring attitudes while somewhat lower for behavioral and the lowest for factual variables.

A limitation of the presented study is that it tests the effect of the Web mode only with the Web mode administered first and another mode administered secondly. There may be an effect from the order of modes compared. In the future, the marginal effect of the Web survey mode can be therefore tested using MTMM models (Campbell and Fiske, 1959), especially a split ballot MTMM design (Saris, 1999) which decreases the problem of too high costs and too many repeated measures on the same respondents.

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