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Contact Strategies to Improve Participation via the Web in a Mixed-Mode Mail and Web Survey

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Statistics producers are increasingly using the web as a mode of data collection. The motives to offer a web alternative lie in data quality and cost considerations. Nevertheless, at Statistics Sweden a surprisingly low proportion of respondents in mixed-mode mail and web surveys chose the web as the mode of response. A preparatory study indicated that participants are inclined to select the mode that is immediately at hand, which – in the standard contact strategy applied by Statistics Sweden – is the paper questionnaire. Previous research also indicated that simply not including the paper questionnaire in the initial mailout in such a contact strategy may achieve a considerably higher proportion of web responses. Integrating these findings, we conducted a large-scale experiment embedded in a survey, where we varied the timing and order of providing the sampled persons with access to the two response modes (i.e., varied the contact strategy). The proportion of responses completed by web mode was 15 percent in the standard strategy. It was exceeded substantially by all but one of the experimental strategies, reaching 65 percent in the most "web-intensive" alternative strategy, showing potential for considerable increase in the proportion of responses completed by web mode. Temporary suppression of the mail mode did affect the overall response rate in some of the conditions, decreasing it by at the most about 4 percent. A cost reduction can be expected if using the "web-intensive" strategies.

Key words: Web survey; mail survey; mixed-mode; response rate; proportion responses completed by web mode.

1. Introduction

1.1. Promises of Digital Data Collection Modes

It is generally held that a computer-aided data collection method (CATI, CAPI, Web, etc) offers data quality advantages over its nondigital counterpart (telephone interview and personal interview without computer assistance, questionnaire sent by mail, etc). Among the commonly mentioned advantages are higher level of standardisation of the data

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collection process, reduction of measurement error and respondent burden by a correct routing, possibility of incorporating some level of data editing into the data collection by automatically probing the respondent on submitted values, elimination of some of the processing steps (e.g., scanning), capability of collecting larger amounts of more detailed paradata (Couper 1998; Heerwegh 2003; Couper and Lyberg 2005; de Leeuw 2008). Thus it is generally seen as desirable to transfer the data collection process to its digital version.

When the technical platform for a digital alternative is to be provided by the respondent, as for example in web surveys – where an intended respondent might not have a computer or Internet access – mixed-mode surveys are an option. At a cost of running a more complex survey operation, the advantages of the digital data collection process are applicable to the part of the sample that have access to the equipment and approve the data collection mode, while for the rest of the sample an alternative mode is used. Another situation where a mixed-mode approach is selected, representing a different kind of motive of the surveying organisation, is when the sampled persons all are reachable in all the available modes. However, tailoring the data collection to specific needs of different subsets of the sample may still lead to different modes being offered to the specific subsets in striving to facilitate their participation in the survey and thereby reducing nonresponse in these subsets – such actions constituting aspects of the so-called responsive design (Groves and Heeringa 2006).

Many statistics producers have been adopting, over the past decade, digital data collection methods in single-mode or mixed-mode set-ups. At Statistics Sweden, for instance, it is becoming increasingly common in self-administered social surveys (i.e., surveys of individuals or households) to offer the web as an alternative to the ordinary paper questionnaire sent out by mail. Given that the published values for home access to the Internet in Sweden is in the range of about 75–80 percent for the general population (Findahl 2007; Holmberg and Weibull 2007; Statistics Sweden 2007), one would expect the web alternative to the mail questionnaire to be well accepted.

In previous research offering a web alternative to a mail survey, the choice of mode has not been found to increase the overall response rate, in fact in some cases it was found to decrease the overall response rate relative to a mail-only version (e.g., Griffin, Fischer, and Morgan 2001; Dillman 2008; Gentry and Good 2008; Grigorian and Hoffer 2008). Further, the proportion choosing the web option in a concurrent setup has in general been relatively low, although Griffin, Fischer, and Morgan (2001) found that this could be increased with the use of incentives. Given these results, it is important to explore ways of using mail and web in a mixed-mode survey to raise overall response rates and to increase the proportion of respondents using the web mode. High level of respondent participation reduces reliance on assumptions needed for post-survey nonresponse adjustment, while responding using the web option provides opportunities for the data quality and cost improvements already mentioned.

1.2. Low Proportion of Web Responses in Statistics Sweden's Standard Mixed-mode Contact Strategy

In surveys where the web mode has been offered as an alternative to the mail mode, however, its use has been disappointingly low: in the case of Statistics Sweden, usually between 10 and 15 percent of the respondents are using it. Given the economic investment

involved in providing the web alternative as well as an expected quality improvement and cost reduction when using web mode rather than mail mode, it is reasonable to consider ways of raising the proportion of responses completed in web mode so as to achieve some real return on the investment.

To clarify the situation that faces a sampled person when choosing a data collection mode in these mixed-mode surveys, we present the standard mixed-mode mail and web contact strategy (i.e., timing and order of providing the response modes) applied at Statistics Sweden.

The material for the mail mode component of this mixed-mode strategy is sent out in an envelope containing at least: (*i*) the questionnaire, (*ii*) an invitation letter tailored to the particular survey with the aim of motivating the recipient to participate, and (*iii*) the return envelope. In some surveys, also (*iv*) a separate leaflet or booklet containing instructions is enclosed. Usually no pre-notification letter is sent, but there is a reminder letter sent out usually about 10 days after the initial mailout. Possibly there will be additional mailouts of either the complete package (*i*)–(*iv*) or just the reminder.

Adding the web mode component to the above contact strategy at Statistics Sweden is implemented by putting (*v*) an additional leaflet in the envelope, informing the recipient that participating in the survey may also be done on-line. A URL to the server and a unique user name and password are provided in the leaflet.

The material (*i*)–(*v*) obviously provides a "novice" recipient with a substantial amount of information to read and understand.

1.3. Preparatory Studies

1.3.1. Determinants of the Response Mode

Holmberg and Lorenc (2008) conducted a telephone follow-up in a mixed-mode mail and web survey concerning entrance of academic graduates into the labour force. After the field work ended, the sample was divided – based on the observed response behaviour – into nonrespondents, paper respondents and web respondents. From each of the groups, a subsample of about 300 persons was selected and these were contacted for a telephone interview about their decision to participate or not and their mode choice.

The results obtained indicate that there is a lack of visibility of the web option in the standard mixed-mode contact strategy described above. It was found that the information about a web option in the survey was noticed by only about half of the recipients of the initial mailout. Another factor that was identified as leading to a larger use of the mail mode in this contact strategy was the "mode in the hand" principle: namely, when recipients of the initial mailout of the mixed-mode material (i.e., the material (*i*)–(*v*) above) had understood the data request and had agreed (more or less explicitly) to participate, they often immediately started filling in the questionnaire at hand (that is, the paper questionnaire), some of them initially only for the sake of trying out the task in order to see the extent of the endeavour required.

The authors concluded that the "mode in the hand" principle, in conjunction with sending the paper questionnaire in the first mailout, worked against Statistics Sweden's intention to raise the proportion of responses completed by web mode.

1.3.2. Influencing the Data Collection Mode Choice

These results of Holmberg and Lorenc (2008) are corroborated by evidence from an empirical study by Werner (2005), who – also in a concurrent mixed-mode mail and web survey – achieved a considerably higher proportion of responses completed in the web mode by simply not including the paper questionnaire in the initial mailout.

In an experiment embedded in a survey of students' housing conditions at Linköping University, Werner randomly divided a probability sample of size 2,250 from the population into four contact strategy groups, distinguished by the timing of the data collection mode offers and the content of two mailouts (Werner 2005):

- Mixed-mode strategy I (Concurrent, sample size 750). The first mailout included a paper questionnaire and a cover letter offering a Web response option. The reminder mailout only contained the Web response option.
- Mixed-mode strategy IIa (Paper questionnaire delayed, with information about later mail mode option, sample size 375). The first mailout only included a cover letter with the Web response option, but informed the recipients that a paper questionnaire was to be sent out in about a week to those who would not be responding using the Web. The reminder mailout included a paper questionnaire as well as the Web response option.
- Mixed-mode strategy IIb (Paper questionnaire delayed, without information about later mail mode option, sample size 375). Identical to the preceding strategy with one small but potentially important exception: the cover letter contained no information about the forthcoming paper questionnaire.
- Reference strategy, R (Mail, sample size 750). A standard mail strategy not providing a Web response option. Both of the mailouts included a paper questionnaire.

These four strategies (as well as an e-mail contact strategy, not reported below) were compared with each other with respect to response rates and costs (the latter being also omitted here).

Werner's (2005) response rates and proportions of respondents that used the web mode for the four groups, at two stages of data collection, are given in Table 1: prior to the

Table 1. Results of Werner (2005), percentages

Mode:	Mixed			
Stages of data collection:	Concurrent (MI)	Paper Q delay, with information (MIIa)	Paper Q delay, without information (MIIb)	Single, mail (R)
Response rate before 2nd mailout	41	33	23	36
Response rate at close of ordinary data collection	62	64	63	66
Proportion of responses completed by web mode at close of ordinary data collection	35	67	58	na*

* not applicable

second mailout and at close of the ordinary data collection (a telephone follow-up was however conducted afterwards to further increase the response rate).

Werner observed that, after the two phases of data collection, the overall response rates were quite similar between the groups (no statistically significant differences). However, differences in proportion of responses completed by web mode between MI and each of the two variants of MII were statistically significant and large, in particular the difference between MI and MIIa. The difference between MIIa and MIIb was not statistically significant.

1.4. Rationale for the Study

The two prior studies provided useful insights. First they provided information about possible motives for the low proportion of web responses: (a) poor visibility of the web mode option, (b) dominance of the mode ready at hand. Second they suggested a way to improve the proportion of web responses: by postponing the mail mode option. However, both studies were performed on somewhat special populations: the one by Holmberg and Lorenc (2008) on university graduates three years after graduation, Werner's (2005) on university students. Both studies had relatively small sample sizes, moreover Werner's was done in the context of a relatively small statistics producer. As the latter study was the only one of the two studies that was quantitative in nature with respect to inference about the effects of contact strategies on response rates and proportions of responses obtained through the web, it was of interest to investigate whether the results would replicate in the context of a survey by a large statistics producer, with a target population more closely resembling the general population, and with sample sizes enabling stronger statistical inference.

Based on the qualitative results regarding determinants of the mode choice (Holmberg and Lorenc 2008) and the idea of influencing mode choice by varying the content of initial and follow-up mailouts (Werner 2005), we designed a large-scale experiment to study, in a mixed-mode mail and web survey, the effect of timing and order of providing the two response modes to the sample on (a) overall response rate and (b) proportion of responses completed by web mode.

The current study bears similarities – including the main aim of the experiment conducted – with that of Millar, O'Neill, and Dillman (2009). However, the current study was carried out in 2007 and its first results were reported at the same time (Holmberg, Lorenc, and Werner 2007).

2. Method

The study was designed as an experiment embedded in a mixed-mode survey, with data collection carried out by Statistics Sweden.

2.1. The Survey's Target Population and Content

The survey within which the experiment was embedded was the 2007 follow-up of the 2002 Stockholm County Council Public Health Survey (SCCPHS02). The follow-up was part of an ongoing project carried out by Karolinska Institutet on behalf of the survey's

sponsor, Stockholm County Council (Magnusson 2008), still going on in 2010. It aims at establishing the Stockholm Public Health Cohort as a means of conducting prospective health studies.

The target population of the 2002 survey was persons living in the County of Stockholm aged 18 to 84 years. The sample size was 50,000, of which about 31,200 persons (62%) responded. Even if response rates *per se* are not the main subject of the present report, it is important to note that the cohort aspect of the surveys was introduced to the participants only in 2007, thus not affecting the 2002 response rates. The 2007 follow-up (SCCPHS07) had as its population the set of all respondents in the 2002 survey, with the aim to establish a longitudinal cohort.

In an effort to attract larger respondent participation, the data collection was chosen to be a mixed-mode mail and web strategy (described in more detail in Section 1.2), in contrast to the 2002 survey which was a mail only survey.

SCCPHS07 was a survey on health and well-being, covering areas such as: established diagnoses, customary daily activities, smoking and drinking habits, mental health and security, work, and family and social relations.

For subject matter reasons, partially different sets of questions were given to those up to the age of 64 years inclusive (the "younger" group) and those 65 years and above. As the majority of social surveys carried out by Statistics Sweden have target populations up to the age of 64 years inclusive, our experiment was embedded in this "younger" group of the SCCPHS07, consisting of 22,509 persons.

2.2. *Contact Strategies in the Experiments*

The experiment compared the standard mixed-mode mail and web contact strategy (introduced in Section 1.2, here denoted S) with a number of alternative strategies in terms of overall response rate and proportion of responses completed by web mode. Varying in the alternatives (denoted A1-A4) was the timing of presentation of the two modes (mail and web) to the participants.

S, the standard contact strategy, consisted of offering a choice of modes by including both the paper questionnaire and web login data in Mailout 1, a reminder about both modes in Mailout 2, then again a choice of modes by including the paper questionnaire in Mailout 3, and then again the reminder of both modes in Mailout 4. The web mode option was kept viable throughout by providing web login data in each mailout.

A1, the most "web conservative" strategy, began as a single-mode mail survey in Mailout 1, then made a promise of a forthcoming web mode option in Mailout 2, and fulfilled this promise by including web login data in Mailout 3 in parallel with sending out a new copy of the paper questionnaire. Mailout 4 was a reminder which also reiterated the possibility of a web response (by reprinting the web login data).

A2 and A3 both began by providing in Mailout 1 a web mode option only, but also informing about a mail option to be made available to those who did not respond within a week. The mail option was then provided in Mailout 2, still keeping the web mode option viable by again including web login data. The remaining two mailouts consisted in A2 of sending the paper questionnaire and web login data again (Mailout 3), followed by a reminder with web login data only (Mailout 4), while in A3 the order of these two steps

was reversed (thus it was expected that in A3 somewhat less of the paper questionnaires would be used).

A4, the most "web intensive" strategy, began by inviting responses only through the web (Mailout 1), without mentioning a mail mode alternative. Only in Mailout 2, a reminder, was information given about a forthcoming mail option for those who did not respond within two weeks. The mail mode option was provided in Mailout 3 by including the paper questionnaire, which was then repeated in Mailout 4. The web mode option was kept viable throughout by providing web login data in each mailout.

Thus all strategies had four mailouts, on days 1 (Mailout 1), 10 (Mailout 2), 23 (Mailout 3) and 38 (Mailout 4) of the survey field operations. The mailouts can be summarised as consisting of one or more of the following items:

- M - The paper questionnaire with an accompanying introductory letter (in Mailout 1) or with a reminder (in Mailouts 2–4)
- r - A reminder without a paper questionnaire included
- r* - As "r", but with information about a forthcoming web mode option
- W - Information about the existence of a web mode option, with login data; it could accompany an introductory letter (in Mailout 1) or be part of a reminder (in Mailouts 2–4)
- W* - As "W", but with information about a forthcoming mail mode option.

The strategies can be viewed as representing an increase in "web intensity" and corresponding decrease in "mail intensity" of the contact strategies: from no web mode option given in the initial mailout in A1, over the standard approach of concurrent existence of the two modes in S, to delay of the mail option by one week in A2 and A3 and by three weeks after the initial mailout in A4. The setup is schematically presented in Table 2.

Table 2. Strategies in the experiment, in an increasing order of "web intensity". (The symbols used in the table are explained in the text)

		Strategy				
Time	Action	A1	S	A2	A3	A4
Day 1	Mailout 1	M	M+W	W*	W*	W
Day 10	Mailout 2	r*	r+W	M+W	M+W	W*
Day 23	Mailout 3	M+W	M+W	M+W	r+W	M+W
Day 38	Mailout 4	r+W	r+W	r+W	M+W	M+W

2.2.1. Experimental Groups

The sample for the experiment, consisting of 22,509 persons (the "young" part of the SCCPHS07 sample, below the age of 65; see Section 2.1 for details), was randomly assigned to the (fixed size) experimental groups, controlling for three variables of potential influence on the tendency to respond and the tendency to use the web mode. These variables were: sex, age (the classes 18–29 years, 30–44 years and 45–64 years), and whether having been sampled to participate in a large related health survey conducted in

Stockholm County in 2006 or not. (About 1,100 of the SCCPHS07 sample members in the "younger" group were in fact sampled for that survey too. The concern was that a recent request to participate in a similar survey might be perceived as burdensome and increase the nonresponse rate in that subset of the sample). The randomisation procedure ensured that the five experimental groups were identical with respect to the joint distribution of these three variables.

Approved by the survey stakeholder, the experimental groups A1-A4 were assigned the sizes of 2,000[3]; the remainder of the sample, its majority consisting of 14,509 persons, was assigned to the standard strategy S.

2.2.2. Calculating Response Rates, Proportions of Responses Completed by Web Mode, and Their Differences

Suppose that each person exposed to strategy g responds with probability θ_{gm} using the mail mode and with probability θ_{gw} using the web mode, so that $\theta_g = \theta_{gm} + \theta_{gw}$ is the probability that the person responds (using any of the two modes). Suppose further that each person decides whether to participate independently of any other person.

A response rate (i.e., the estimate $\hat{\theta}_g$ within a strategy) was obtained using RR2 of AAPOR, as applied to mail surveys of specifically named persons (AAPOR 2008). Note that the sample consisted of respondents in a previous survey, thus these persons were known.

The proportion of responses completed by web mode within a strategy was obtained using

$$\frac{\hat{\theta}_{gw}}{\hat{\theta}_g} = \frac{I_w + P_w}{I + P},$$

where I and P are the number of complete and partially filled-in questionnaires respectively within a strategy, and I_w and P_w are the corresponding number of questionnaires completed using the web.

Further, under the assumptions at the outset of this section, $1 - \alpha$ confidence intervals ($\alpha = 0.05$) for (1) differences between response rates ($\hat{\theta}_g - \hat{\theta}_{g'}$) and (2) differences between conditional proportions of respondents using the web ($\hat{\theta}_{gw}/\hat{\theta}_g - \hat{\theta}_{g'w}/\hat{\theta}_{g'}$) were constructed. An interval that did not contain the value 0 was considered to indicate a statistically significant difference. The confidence levels for each of the 20 comparisons were adjusted according to the Bonferroni method (Miller 1991).

3. Results

3.1. Response Rates and Proportions of Responses Completed by Web Mode

Data collection with respect to the current experiment ended after 58 days of field work. (The SCCPHS07 data collection continued with a fifth mailout, which included a simplified questionnaire). The results of the experiment are presented in Tables 3 and 4.

[3] Even with a response rate of only 50 percent, a 95% confidence interval would be approximately ± 3% around a proportion estimate.

Table 3. Overall response rates in the experimental groups

Strategy	A1	S	A2	A3	A4
# Responses	1,490	10,964	1,426	1,436	1,466
Sample size[a]	1,993	14,479	1,997	1,995	1,999
Response rate	74.8	75.7	71.4	72.0	73.3

[a] After exclusion of non-eligible units.

With respect to the possibility of a deteriorating effect of the alternative contact strategies on the overall response rate (Table 3), the standard approach had a 75.7% response rate while the four alternative approaches had rates of 74.8%, 71.4%, 72.0% and 73.3% respectively in A1-A4. Two of the differences are statistically significant: those between S and A2, and S and A3. The largest of these differences is 4.3 percentage points. Thus the alternative approaches seem to have had at most a minor negative effect on the overall response rate.

The results show further that the standard approach had a proportion of responses completed by web mode of 14.5% (Table 4). The proportion of responses by web mode in the alternative approaches varied from a low of 2.6% in A1, over 45.0% and 44.6% in A2 and A3 respectively, to a high of 64.7% in A4, thus showing the potential for a considerable increase in the proportion of responses completed by web mode by employing some of the alternative contact strategies.

Interestingly, the response rate pattern across experimental groups (see Table 3) is roughly the same within subsets of the sample defined by gender, age (3 subgroups), marital status (2 subgroups) and income (3 subgroups). In each of the ten subgroups examined, the highest response rate was generated by either the standard approach or approach A1. Furthermore, in all subgroups but one (the age category 30–44 years), approach A4 resulted in a higher response rate than each of the two approaches A2 and A3. Similarly, concerning the proportion of respondents using the web mode, the distinct pattern seen in Table 4 reappears in each of the ten subgroups; ordering the approaches by proportion of responses completed by web mode from lowest to highest gives the sequence {A1, S, A2 (or A3), A3 (or A2), A4}.

Table 4. Proportion of responses completed by web mode in the experimental groups

Strategy	A1	S	A2	A3	A4
# Web responses	38	1,595	641	640	948
# Responses	1,490	10,964	1,426	1,436	1,466
Proportion responses completed by web mode (%)	2.6	14.5	45.0	44.6	64.7

3.2. A Temporal Analysis

An analysis of the progress of the two measures – response rate and proportion of responses completed by web mode – in the course of the field work was conducted in order to gain a better understanding of how the respondents act under the studied conditions. Additionally, this provided the basis for a simplified cost comparison.

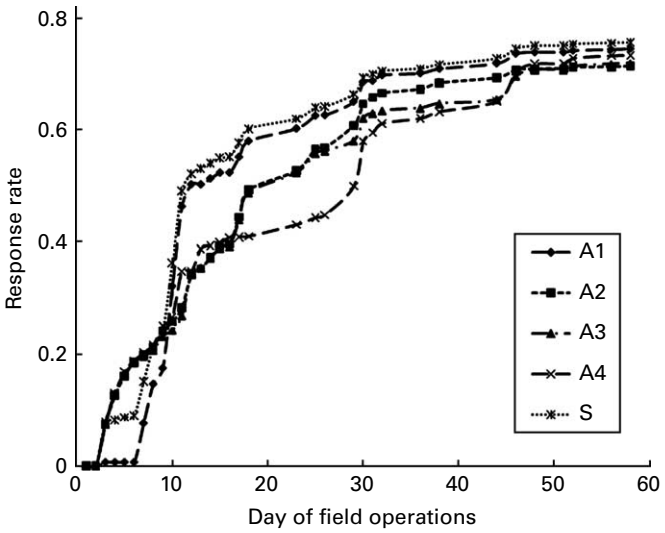

Fig. 1. Change in response rates over the period of field operations

Data for the analysis come from the data collection systems: the scanning system for the mail mode and the web data collection instrument for the web mode. In interpreting the data it is worth noticing that time data from the scanning system reflect respondent behaviour less accurately than do data from the web instrument, as arrival of completed paper questionnaires is dependent on the postal service: Statistics Sweden uses economy mail for prepaid return of questionnaires in postal surveys, with delivery within three working days from posting.

Figure 1 displays changes in response rate over the period of field operations. In an exploratory interpretation of these results, some general remarks can be made.

The two kinds of strategies, the web-intensive ones on the one hand (A2-A4) and those with a dominant use of paper questionnaires on the other (S and A1), have somewhat different patterns in terms of response rate progress. The patterns are, of course, a consequence of our experimental manipulations. While there is a period of inertia before the response rate accelerates strongly for the "paper-intensive" modes S and A1, early web responders of A2-A4 are more pronounced within the first week or so of the field period.[4] The effect of the mailouts (indicated by the vertical lines) is observed by the increase in response rates some days later. Just after the second mailout there is a big gap in response rates between S and A1 on the one hand and A2-A4 on the other. However, when the paper questionnaire is introduced in A2 and A3 and later in A4, the gap in response rates to the S and A1 strategies decreases. The effect of later mailouts (3 and 4) is larger in the web-intensive groups than in the paper-intensive ones, leading to the former groups' closing in and achieving similar overall final response rates.

[4] The very low response rate displayed for the group A1 (constant 0.7% during the first six days of field operations) we believe is an artefact of some slight unidentified error in the experimental procedure or in the collection of time data rather than a reflection of a real difference between S and A1 in the propensity to respond by mail within the first week of the survey. We suspect a glitch in postal delivery, though in spite of trying we were not able to pinpoint the cause.

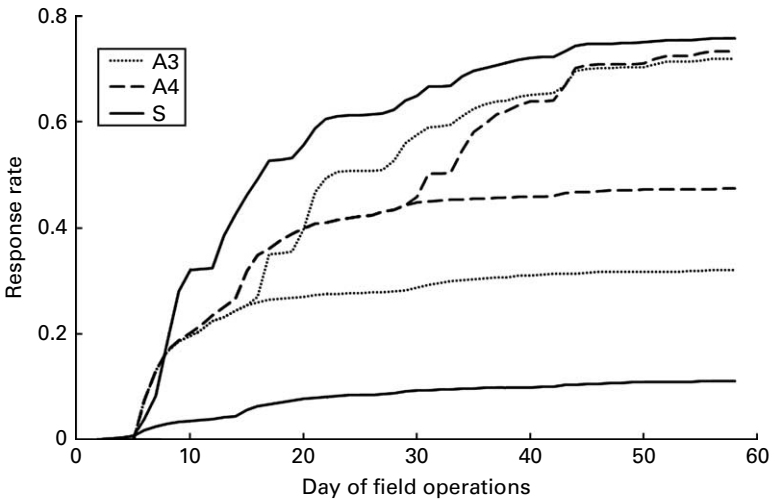

Fig. 2. Contribution to the overall response rate (the upper line of a pair of lines) of the two data collection modes (web mode is represented with the lower line of a pair of lines, mail mode with the difference between the two lines of a pair)

An interesting observation pertains to the difference between A2 and A3 on the one hand and A4 on the other from about the 17th to the 30th day of field operations. While the response rates of the former two increase in this period, in part due to continued inflow of mail responses (see also Figure 2), that of A4 stagnates. Then, there is a mild immediate effect of Mailout 3 on A4's response rate, through web responses that came prior to day 26, but a real push comes from paper responses, between days 26 and 30. We are inclined to conclude that a portion of sampled persons in A4 actually waited for the promised paper questionnaire before participating in the survey.

An insight from these data is that with any of the web-intensive strategies it took *longer* to reach a certain, reasonably high response rate, than it did with the two paper-intensive strategies. Only as a speculation, we might assume that there is a proportion of the population who are able, or inclined, to participate only using the mail mode. As mailouts of paper questionnaires were delayed in all the web-intensive strategies, giving this group of the population only a late possibility of participating, this might account for the observed slower attainment of a high response rate in the web-intensive strategies.

Figure 2 displays contributions of the two data collection modes to the overall response rate per strategy. (For clarity of display, data for strategies A2, quite similar to A3, and A1, quite similar to S, were omitted). Each of the three lines branches after a concurrent mode has been introduced. (Before lines split, A3 and A4 represent single-mode data collections, however with information introduced – as per the design – about a forthcoming alternative mode; S represents a mixed-mode survey throughout). The lower line in a pair of lines represents the (unconditional) response rate for responses completed by web mode for the strategy ($\hat{\theta}_{gw}$ of Section 2.2.2), while the upper represents the overall response rate for the strategy ($\hat{\theta}_{g}$), the difference between the two lines representing the (unconditional) response rate for responses completed by mail mode ($\hat{\theta}_{gm}$).

Figure 2 reveals that after providing a mode choice, there is little contribution to the response rates from the web mode, instead most of the increase stems from the inflow of paper questionnaires.

3.3. An Appraisal of Costs

Cost calculations were performed as a basis for an internal Statistics Sweden report (Holmberg, Lorenc, and Werner 2007).

All the strategies made use of both data collection modes (mail and web), thus the costs to make these modes available were the same for all the strategies. The differences in costs between the strategies depend on the number of units processed in the different modes. In our model for cost estimation and comparison we included the costs of printing, packaging and postage, preparatory handling of received paper questionnaires, and scanning.

On the basis of input data, the largest cost difference between the standard strategy and the web-intensive strategies pertained to the cost of scanning. Thus considerable savings can be made by adopting more web-intensive strategies and increasing the proportion of responses completed by web mode. For instance, Figure 2 indicates that strategy A4 requires about 40 percent fewer printed questionnaires than strategy S and also a similar percent reduction of scanning work. Preparatory handling and printing were also factors with a lowering effect on costs in A2-A4, compared to the standard strategy S. Calculations done using a sample size of 20,000 units showed that the alternatives A2-A4 could lead to a cost reduction of between 12% and 20% compared to the cost of the standard strategy. More specific determination of amounts will of course depend on the actual costs that a statistics producer has for carrying out these processes.

4. Conclusion

Taking the view that an increase in the proportion of responses completed by web mode leads to improved data quality and reduced cost, the present study was carried out in order to experimentally verify a way of increasing the proportion of web responses in a concurrent mixed-mode mail and web surveys. This was done by making the web mode more prominent. The prominence was here achieved by a delay in introducing the paper questionnaire to the sample. The results show that there was a considerable increase in the *proportion of web responses* in all of the "web-intensive" strategies and a marginal negative effect on overall response rates in some of the contact strategies. A preliminary cost analysis indicated an overall saving potential of 12–20% with the use of strategies A2-A4, calculated on the basis of specific survey procedures used at Statistics Sweden.

The validity of these results needs to be interpreted in the light of the population on which the experiment was conducted. While being similar to the general (Swedish) population, the study's population still differed from the general population in three respects: it consisted of respondents to a previous health survey (SCCPHS02), who were from the most urban county in Sweden, and who were in a group not exceeding 64 years of age. To what extent these differences influenced the overall response rate in the experiment we can only speculate. However, the effects of these specific factors on the overall response rate seem to go in opposing directions. If tendency to respond is a

permanent trait, then we have obtained higher response rates than in the population in general. (On the other hand, too frequent requests for participation might burden even regular responders and lead to a nonresponse. For this reason, we stratified the sample on the basis of participation in a health study a year prior to SCCPHS07). Finally, response rates in urban areas are below the average for the country according to unpublished technical reports at Statistics Sweden. Consequently, we would expect a higher response rate in a sample drawn from the whole country than what was obtained in the experiment.

In yet another way our sample differed from the general population in the age bracket 18–64 years: as SCCPHS07 is the second wave of a panel survey with no replenishing, our youngest sample members were 23 years of age. As young people in Sweden have a higher than average tendency for nonresponse, our sample may have resulted in a somewhat higher response rate than a sample from the general population would have done.

Another potential effect of using participants in SCCPHS02 in the study could be a priming of the sample to expect the mail mode (the sole data collection mode used in that earlier survey), thus leading to a lower use of the web than if the sample had been independently selected from the general population.

In summary, while these factors could have had some weak influence on overall response rates, we have little reason to believe that they influenced any of the *differences* found in this study. However, this experiment does not provide ground for extrapolation of the results to the age group 65 years and over.

Two sources support external validity of these results. One is a recent study (Millar et al. 2009) which observed a similar potential to boost the proportion of web responses, however with the use of a monetary incentive to enhance the response rates in that study. Another is an actual application of our strategy A2. In a Statistics Sweden survey of academic graduates conducted in 2008, the proportion of responses completed by web mode was 51%, compared to 15% in the previous 2006 round of the survey. Hence parts of our results have been replicated empirically.

In the literature, a distinction is made between sequential mixed-mode designs and concurrent mixed-mode designs (Dillman 2000). Further, there is evidence that sequential mixed-mode designs might give higher response rates than concurrent mixed-mode designs (e.g., Dillman et al. 2001). In our experiment, the strategies A1 and A4 were, from the perspective of the sampled person, single mode surveys in Mailout 1 and just informed of another mode in Mailout 2 – thus not becoming concurrent mixed-mode surveys until Mailout 3. The strategies A2 and A3, on the other hand, were concurrent mixed-mode surveys starting from Mailout 2. They were also those that had a small but significant drop in response rate, corroborating findings already reported in the literature (Griffin, Fischer, and Morgan 2001; Dillman 2008; Gentry and Good 2008; Grigorian and Hoffer 2008). But this does not tell the full story, as S – the strategy with the highest response rate – also had a concurrent mixed-mode design throughout, from Mailout 1 to 4. This group was also the largest, leaving little doubt about the power of the finding. The results thus indicate that a complete and coherent picture, enabling strong conclusions about response rate levels based on number and combination of modes used, is still lacking.

This study was designed to enhance cost-effectiveness of a mixed-mode data collection while keeping track of the response rate as an indicator of data quality.

Unit response rate is one aspect of data quality, however other aspects of data quality would need to be addressed as well (item nonresponse, measurement error, satisficing, etc) before it should become possible to recommend a change to a new standard strategy on a large scale. For instance, do any of the strategies, by raising the proportion of responses completed by a particular mode, introduce a significant bias associated with that specific mode? An answer can be given through specific studies that investigate the data collection instrument and process. Such investgation ought to be routinely done in the course of producing statistics using mixed-modes. At Statistics Sweden, a number of studies in this direction have been initiated; however these results – when available – will be reported separately.

Even if none of the modes influences the measurement, it is possible that a particular strategy attracts a subset of the sample that is significantly different from the rest of the sample (e.g., Diment and Garrett-Jones 2007; Millar et al. 2009) and leads to a higher nonresponse in the rest of the sample. If so, does this affect the final estimates? The basis for an answer to this question is contained in works in the field of treatment of nonresponse, with the conceptual distinction made between missingness completely at random, missingness at random, and nonignorable nonresponse (Little and Rubin 2002). Specifically, just because respondents in some respects are different from the rest of the sample, it does not automatically mean that they are also different in other respects linked to the parameters of the study – this can be known only through dedicated studies. Such studies ought also to be standard when it comes to the production of statistics using mixed-modes.

Further replications of this or similar experimental designs might put results reported herein on a firmer empirical ground. It would also be of interest to tackle theoretically and practically the issue of the small (significant in some of the alternatives) but still occurring decrease in the overall response rate with web-intensive strategies in comparison to the standard strategy: for instance, whether a better motivated and more appealing presentation of the web alternative to sampled persons could counteract the drop.

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