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Innovations and new technologies in panel research

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Summary

Survey research via the Internet has increased significantly in recent years. Several methods are used to attempt to survey the general public by Internet, including the use of volunteer and RDD samples. However, these methods may not fulfill the demands on coverage, sampling and response posed by scientific researchers. People in volunteer samples are often a rather selective part of the general population. In addition, because of vast increase of mobile-only households and declining response rates, RDD samples may not cover the population anymore.

A newly established Internet panel in the Netherlands uses a different design. A true probability sample of households drawn from a population register by Statistics Netherlands is contacted with a household in-person interview, asking respondents to join the panel. The panel provides a computer and Internet connection to those households that could not otherwise participate (about 85% of households have internet access). This paper presents an overview of this new panel concept and evaluates whether the design would also be feasible in other countries having high Internet penetration rates, and could overcome the coverage problems of volunteer samples. In addition, it reports the results of some experiments carried out on the use of incentives to increase the participation in the panel and on the data quality of internet data compared to telephone and face-to-face data.

Innovations and New Technologies in Panel Research

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1. Introduction

The world of survey research is rapidly changing. Scientific surveys using phone and face-to-face interviews encounter new problems of under-coverage and nonresponse bias. Almost a decade ago, Kalton already questioned the role of telephone data collection in the future, because of the decreasing response rates to telephone surveys (Kalton, 2000). A more recent, additional problem is the diminishing coverage of landline telephone interviews in many Western countries. Figure 1 shows the gradual decrease in fixed telephone lines between 1999 and 2008 for the Netherlands, Switzerland, United Kingdom, the United States[2] and the world average (source: ITU ICT Eye, 2009). Figure 2 shows the steep increase in mobile cellular subscriptions in these countries during the same time period, and figure 3 the increase in Internet users. The diminishing coverage of landline telephones and growth of Internet use are strongest in the Netherlands. In Switzerland, the use of Internet is closer to the United Kingdom and United States and the fixed telephone penetration is still well above the

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[1] This paper combines parts of three other papers of the same author: (1) Scherpenzeel and Das, 2009: True Longitudinal and Probability Based Internet panels: evidence from the Netherlands; (2) Scherpenzeel and Bethlehem, 2009: How representative are online-panels? Problems of coverage and selection and possible solutions; (3) Scherpenzeel, 2009: Recruiting a probability sample for an online panel: effects of contact mode, incentives and information.

[2] The source database contains data of many more countries. For this paper, the data of The Netherlands are shown because all other data in this paper are from the Netherlands; Switzerland is shown because the paper is part of the working paper series of FORS in Switzerland; the United Kingdom and the United States are shown for comparison.

three other countries. The three European countries show a similar trend in mobile phone subscriptions, with the United Kingdom ahead of the other two.

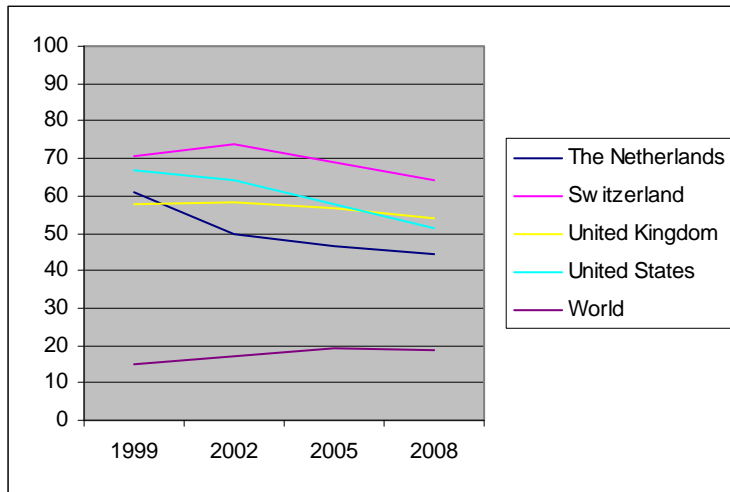Figure 1. Fixed telephone lines per 100 inhabitants.

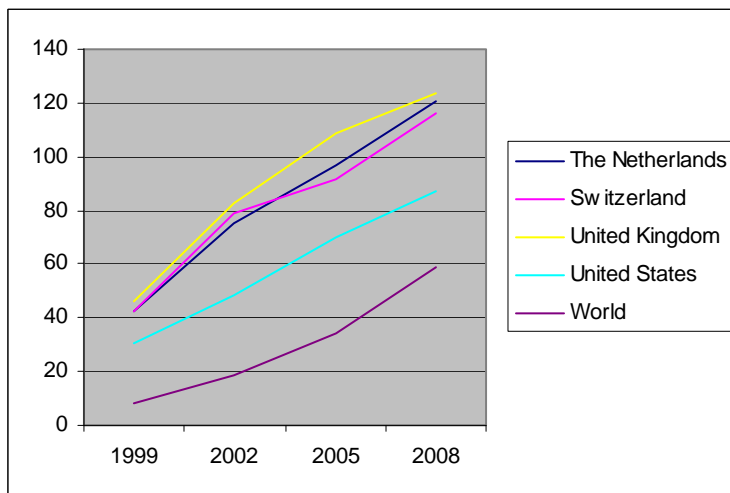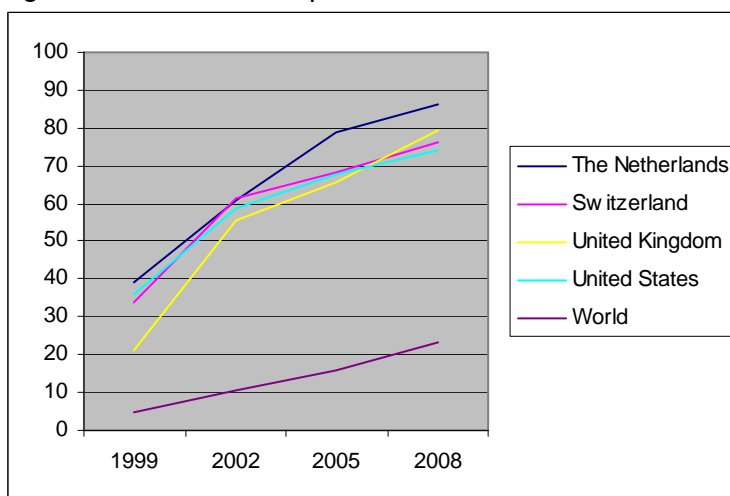Figure 2. Mobile cellular subscriptions per 100 inhabitants.

Figure 3. Internet users per 100 inhabitants

These developments have many effects on survey research methods. Table 1 shows just a few changes that are going on: In many countries, data collection is moving from CATI/CAPI to Internet interviewing and the use of mobile devices. In commercial settings, this has led to the use of access panels. A new development is the use of multiple modes at the same time for one survey, or the use of a sequence of different modes in different stages of the fieldwork. At the same time, we see a trend in scientific research, towards more complex surveys such as longitudinal studies or large international comparative studies. Finally, more and more research institutes and projects (especially the international studies) also provide their data to the scientific public for free, making them directly downloadable from their website. In some countries, we also see more possibilities of access to register data.

Table 1. Developments in survey research

From		To:
CATI/CAPI	➔	Internet, mobile phone
Landline	➔	mobile phone
Cross-sections	➔	access panels
Single mode	➔	multi- or mixed mode
Single dataset	➔	complex surveys
(Re)collect data	➔	open access data, registers

For the future of complex survey research, it is essential to develop data collection methods that make use of the growing possibilities of Internet. Online interviewing can overcome problems of traditional interview modes like telephone and face-to-face interviewing and offer opportunities for innovations that exploit the possibilities of the Internet such as graphical tools and other design features. These tools and features make it possible to collect more information on the respondents in a better and cost efficient way. Crucial issues are sample design, recruitment, and the extent to which the respondents are representative for the population of interest. Traditional phone and face-to-face surveys face more and more new problems of under-coverage and nonresponse bias due to the increase of mobile phone-only households and the universal decline in survey response rates. Simply changing to an Internet survey is not the solution, explaining why academic studies and large-scale population surveys are reluctant to change their methods.

Many Internet surveys are based upon convenience samples of respondents recruited through Internet channels, often for commercial purposes and without the ambition to meet scientific quality demands. And even Internet surveys that do start from a probability sample are often hampered by non-coverage if respondents without Internet access cannot be interviewed.
Ideally, a survey is conducted using a random sample from a population. To that end, a probability sample is selected from a sampling frame and selected persons are invited to participate in a survey or in a panel. Examples of sampling frames are a population register, an address register and a telephone directory. In the United States, Random Digit Dialling (RDD) is often applied. However, telephone directories and RDD may

nowadays not cover the population anymore, because of the increase of mobile-only households[3].

Many Internet panels and Internet surveys are based on some form of non-probability sampling. Major opinion polls in The Netherlands rely on self-selection of respondents. The same is true for the large Dutch 21minutes.nl Internet survey, which is similar to the German Internet survey Perspektive Deutschland. A study across 19 Internet panels of Dutch market research organisations (NOPVO Research) showed that most of them use self-selection, links and banners on websites or snowballing, see Van Ossenbruggen et al. (2006). This all means that most Internet research has two fundamental methodological flaws: under-coverage and self-selection.

However, Internet interviewing can be seen as just another mode of data collection that could also be applied to a proper probability sample. Questions are not asked face-to-face or by telephone, but over the Internet. Is it possible to create an Internet panel that is not affected by under-coverage and self-selection? The LISS (Longitudinal Internet Studies for the Social Sciences) panel administered by CentERdata (Tilburg University, The Netherlands) is the result of such an attempt. This Internet panel has been constructed by selecting a random sample of households from the population register of The Netherlands. Selected households were approached by means of CAPI or CATI. Hence, sample selection is based on true probability sampling instead of self-selection. Moreover, cooperative households without Internet were provided with equipment giving them access to the Internet.

In this paper we introduce the methodology to set up a panel that combines the new technology of Internet surveys with a true longitudinal design

2. Method

To build an Internet panel that fulfills the demands posed by a longitudinal household study and by other academic studies, a number of successive steps need attention: First, a true probability sample of households has to be drawn from a population register with equal probabilities for each sample unit. Secondly, as a direct consequence of the first step, the sample also covers the non-Internet population. Households in this subpopulation must be given a mean to participate in the panel. Thirdly, all households have to be contacted and recruited using another way than the Internet, to cover the complete sample. Fourthly, the response rates and participation rates must be maximized, since selective nonresponse at the start will strongly affect the representativeness of the panel over time. When successfully applied, these steps should lead to a good representativeness of the panel.

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[3] RDD algorithms usually do not generate completely random numbers since that results in too many unusable numbers. Instead, numbers are often chosen within area codes or generated from telephone databases, for example randomizing only the last two digits. In most cases, mobile phone numbers are not included in the RDD sampling frames, although there are currently some techniques that allow inclusion of these numbers

We will now describe how each of these steps has been realized in the LISS panel, as an illustration of the feasibility to incorporate new developments in survey research into the design of a scientific household panel study.

2.1. Drawing the probability sample

The reference population for the LISS panel is the Dutch speaking population permanently residing in the Netherlands. The sampling and survey units of the LISS panel are the independent, private households, thereby excluding institutions and other forms of collective households. The reference population does not include households in which no adult is capable of understanding the Dutch language. The sample frame is the nationwide address frame of Statistics Netherlands. From this address frame, a simple random sample of 10,150 addresses was drawn.

For each address in the sample, a telephone number was searched in a contact database containing landline information only. Landline numbers were found for about 70% of addresses, as was expected. It is known that about 30% of addresses in the population registers has no or unregistered landline telephone numbers.

2.2. Coverage of the non-Internet population

The sample from the population registers naturally includes individuals and households who do not (yet) have Internet access (about 85% of Dutch households in 2007 had Internet access, Statistics Netherlands, 2007). These participants are loaned equipment to provide access to the Internet. The computer provided is especially developed for elderly people having no experience with computers. It is a small and simple device using centralized support and maintenance, and it is operated by large "buttons" for the most frequently used functions. The computer and the broadband Internet connection are installed for the panel participants. If necessary, they can also get help at home to show them how to fill in the questionnaires on screen.

2.3. Recruiting in a traditional way

Recruitment of the sampled households was done from May until December 2007. Households were contacted in a traditional way: first, an announcement letter was sent in combination with a brochure explaining the nature of the panel study. A 10 euro note was included with the letter, because a pilot study (described below) had shown that a prepaid, 10 euro incentive effectively increased the willingness to participate in the panel (Scherpenzeel, 2009). Next, respondents were contacted by an interviewer in a mixed mode design. Those households for which a telephone number was known were contacted by telephone (CATI). The remaining households were visited by an interviewer and thus contacted face-to-face (CAPI).

Once contacted, the interviewer asked the respondents to participate in a 10-minute interview, after which the request to participate in the panel was made. The interview consisted of a few questions about demographics, the presence of a computer and Internet connection in the household, and a series of survey questions about social integration, political interest, leisure activities, survey attitudes, loneliness, and

personality. Within one to two weeks after the interview, the respondents with Internet access who agreed to participate in the panel received a confirmation e-mail, and a letter with login code, an information booklet and a reply card. With the login code provided in the letter they could confirm their willingness to participate and immediately start the first interview. Respondents without Internet or computer could confirm their willingness to participate by returning the signed reply card, after which CentERdata provided them the equipment and/or broadband connection necessary to participate. The confirmation procedure ensured the double consent of each respondent. In the confirmation e-mail and letter, respondents were promised an additional 10 euro incentive for logging in or sending back the reply card, to minimize the loss of respondents resulting from the double consent procedure. Figure 4 summarizes the recruitment process.

Figure 4. Overview of the recruitment process for the LISS panel
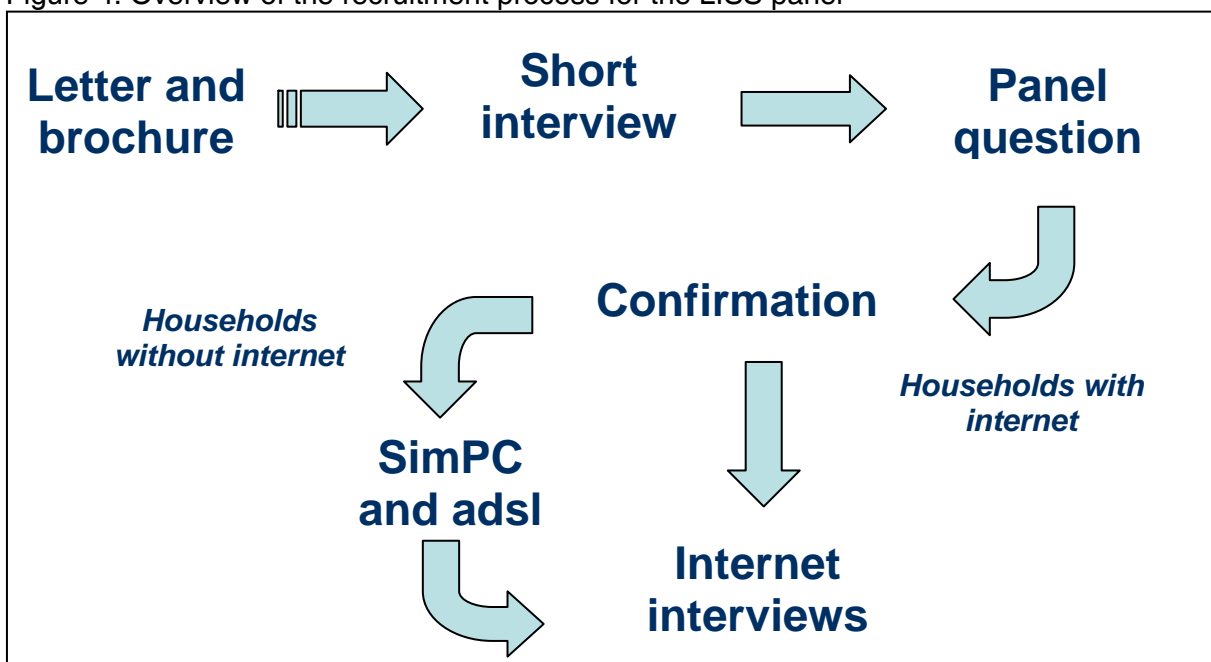
2.4. Maximizing the response rates

To meet scientific demands, the panel is based on a traditional probability sample. However, since the quality of the final sample is also determined by the response rates in the recruitment stage, the optimal recruitment strategy was tested in a pilot experiment. The recruitment variables considered were: contact mode, incentive amount, timing of the incentive, content of the information letter and timing of the panel participation request. The study focused on the effects of these experimental factors on the contact rates and the willingness of respondents to become a panel member. The highest response rate was found with an incentive of 10 euro; 20 euro and 50 euro incentives did not substantially increase response rates beyond those seen at the 10 euro level. All incentives were found to have much stronger effects on response rates when they were included with the announcement letter than when they were paid later. It was decided that the most efficient prepaid incentive was 10 euro.

The second most important factor was found to be the contact mode used. Contact was made either by telephone (CATI) or face-to-face (CAPI). While the contact rate was somewhat higher with CATI, the CAPI interviewers were more successful in obtaining panel participation. On the basis of these findings we decided to contact households with a known telephone connection in CATI, as originally planned, but to combine this primary approach with an extensive CAPI follow-up for the secondary nonresponse in the CATI condition.

Figure 5 depicts the increase in primary response over the different incentive levels in the different modes, and in the promised versus prepaid conditions of payment. The data for the subpopulation with known telephone number are shown. Independent of mode, the response increases steeply from 0 to 10 euro and then gradually from 10 to 20 and 50 euro. In addition, the graph shows parallel patterns of response in the promised and prepaid condition, but at a much higher level in the prepaid condition. In the prepaid condition, the 10 euro incentive can make a difference of almost 25% response compared to the null condition.

Figure 5. Estimated mean primary response by mode, incentive payment and incentive amount.
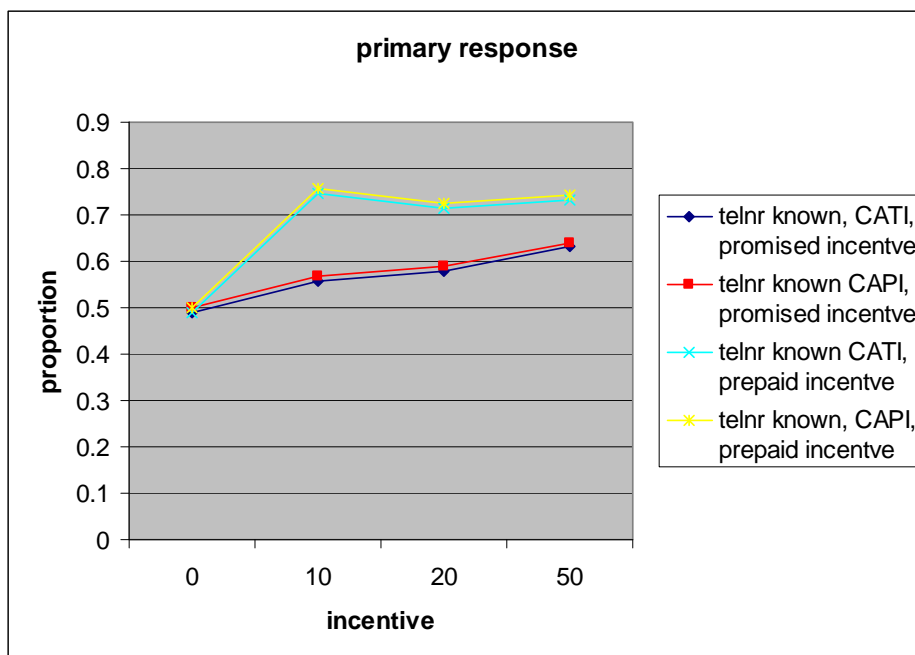
The response rates were not affected by the content of the information letter. Response rates were also independent of whether the nature of the panel study was explained before or after the recruitment interview was completed. However, many respondents in the informed group reported that they had not read or even seen the brochure. Hence, it appeared that the brochure did not draw much attention and/or was not very appealing for a large group of respondents. As a consequence, for the main recruitment a copywriting and design bureau was hired to make the brochure visually more appealing and to shorten the letter and make it easier to read. In

addition, a request was made in the advance letter asking for the letter and brochure to be shown to other family members.

One of the most important findings of this experiment was the loss of respondents between the moment they agreed to participate and the actual registration and start in the panel. For the main recruitment, several measures were taken to decrease this loss: First, the time between the recruitment interview and the registration was shortened-- instead of a confirmation letter with the login code, respondents with Internet access received an e-mail with a login code and a direct link to the registration site. Second, in addition to the prepaid incentive of 10 euro included with the introductory letter, an additional promised incentive of 10 euro was given upon registration. Figure 6 shows that these measures were quite successful in increasing the response rates in the main recruitment compared to the pilot study. The final panel membership rate was 48% of the total sample (see also table 2), a rather satisfactory result for a probability-based Internet panel in the Netherlands.

Figure 6. Effects of recommendations from the pilot study on response rates in the recruitment
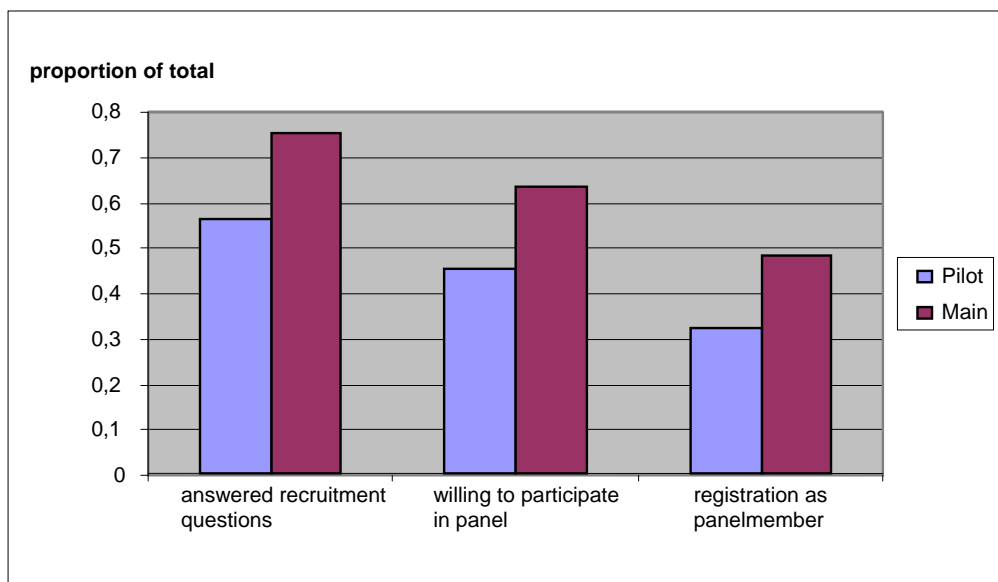
The interviewers who recruited the panel members were instructed to focus on obtaining the cooperation of the selected households, and not on maximizing the response/interview time ratio as they would do for commercial surveys. In the telephone recruiting the maximum number of contact attempts was 15, at regular intervals, spread over several weeks. When a household had not been reached after 15 calls, the address was transferred to face-to-face recruiting. In the face-to-face recruiting, a first series of 8 contact attempts was made by the interviewer. A second series of 7 attempts was made after a few weeks pause. The interviewer proposed to ask only one to three central questions if respondents refused the complete interview. If this was successful, the questions were followed by the request to participate in the panel. This method was extensively used in the nonresponse follow-up stage.

An refusal conversion procedure was designed in cooperation with the field work institute that carried out the recruitment. The procedure was tailored to the type of refusal recorded. If the reason for refusal was, for example, feeling too old to use the Internet, the respondent would be visited at home by an (elderly) interviewer with a demonstration video. If the refusal reason was "no time", the respondent would get an Internet link to a shortened interview.

The intensive efforts to re-contact and motivate respondents to participate resulted in satisfactory response rates. Table 2 shows that the response to the short CATI or CAPI interview or to the "central questions" (the first stage response) is 75% in total (51% completed interviews, 24% completed central questions). The willingness to participate in the panel among respondents who answered the recruitment interview or the central questions is quite high: 84% of those participating in the recruitment interview (or 63% of the total gross sample) told the interviewer they were willing to participate in the panel.

Table 2. Household response in successive stages of recruitment. Percentage of the total gross sample minus non-usable addresses.*

	% of total gross sample
Contact person completed CATI or CAPI recruitment interview or answered central questions	75
Contact person expressed willingness to participate in panel	63
Household registered as panel member	48
Total gross sample	9,844

* Non-usable includes, among other things, non-existing or non-inhabited addresses, companies, long term infirm or disabled respondents, language problems. In total, 306 (3%) addresses in the total gross sample were coded as 'Not usable'.

3. Results: Quality of the Internet panel

The question to be answered is whether application of a proper sampling design with complete coverage and traditional recruitment can help to create a panel that more closely resembles the population, and that therefore produces more reliable estimates. To this end, the LISS panel will be compared with the population, traditional surveys, self selection panels, and self selection surveys.

For all comparisons, we selected those demographic characteristics in which two studies of the representativity of the LISS panel, by De Vos & Knoef (2008) and Van der Laan (2009), found the largest bias:
- Percentage of elderly (70+),
- Percentage of single person households,
- Percentage of non-western immigrants.

In addition, we looked at so-called 'psychographic' variables, in contrast to 'demographic' variables, or also called 'webographic': specifically related to participation in web surveys. We have chosen the following measures of voting behaviour, which were available in all the studies in our comparison:

- Percentage of voters in the last general elections (2006). Note that this is reported voting behaviour and not necessarily true voting behaviour. Voters are usually overestimated in surveys;
- Percentage of voters for the Socialist Party (SP). These people are typically over-represented in online surveys;
- Percentage of voters for the Christian Democratic Party (CDA). These people are typically under-represented in online surveys;
- Percentage of people having access to the Internet. These people are obviously over-represented in online surveys.

3.1. Representation of the population

Representativity is defined here as representativity with respect to specific variables. For example, a panel is representative with respect to age, if the age distribution in the panel is equal to the age distribution in the population.

De Vos & Knoef (2008) compare the composition of the LISS panel with that of the population based on demographic variables. They find differences by household size, age, education, marital status, gender, and level of urbanization. The elderly are underrepresented, especially the elderly women. In addition, single person households are underrepresented. The degree of underrepresentation is largest among elderly single persons. Couples younger than 65 without children and couples with two children are overrepresented.

The comparison by De Vos and Knoef of the education levels for several age groups in LISS and in the Dutch population shows that persons with tertiary education are somewhat overrepresented in all age groups.

Finally, non-western immigrants, and more specifically first generation immigrants, are somewhat underrepresented. This may come as no surprise as the LISS panel only includes households where the adult persons master the Dutch language sufficiently. When looking more specifically to the country of origin, it appears that especially Turkish and Moroccan immigrants are underrepresented. However, people from the Netherlands Antilles are not underrepresented at all. This may indicate that language probably plays a role in the recruitment process.

In another study of the representativity of the LISS panel, Van der Laan (2009) investigates a set of variables that was known from the population register for both respondents and non-respondents. Looking at the overall response in the recruitment of the panel, he found differences between the different types of households. Especially the response for single person households was lower than that of the other types of households. Furthermore, the response depends on the average age of the household members, the generations of immigrants present in the household, number of persons in the household, possession of a registered telephone, number of minors in the household, and status of the neighbourhood. In addition to the study of the response in the recruitment of the panel, Van der Laan also investigated the effect of

giving access to Internet to people without computer or Internet access at the time of the recruitment. Results showed that the representativity of the panel, especially the representativity of households with older members, was improved by this strategy (for a complete description, see Van der Laan, 2009).

In conclusion, the LISS panel does have some biases in sample composition, even though it was based on a proper probability sample and recruited with much attention to coverage and response rates. The comparison with population statistics by De Vos and Knoef and the estimation of response probabilities by register characteristics by Van der Laan both show biases in the same variables. In table 3 we summarise the biases by concentrating on the categories we selected above as the basis of comparison with other studies. The estimations are based on 8089 LISS panel members of 18 years and older. The same selection of 18 years and older applies to all following tables[4]. Bias is simply calculated as the difference between the percentage found in the LISS panel and the population percentage.

Table 3. Comparing the LISS panel with the population(%)

Group	LISS Panel	Population	Bias
Age >=70	7	13	-6
Living alone	15	20	-5
Non-western immigrant	4	7	-3
Did not vote at election	13	20	-7
Voted SP at election	17	17	0
Voted CDA at election	25	26	-1
Has Internet access	93	85	+8

In addition to the underrepresentation of elderly, single person households and non-western immigrants, table 3 shows there also is an overrepresentation of voters in the panel. This does not come as a surprise, as literature shows there often is a positive correlation between voting and responding in a survey. Apparently, there is little bias with respect to voting for the political parties SP and CDA. As could be expected, Internet access is overrepresented in the LISS panel, although it still is less than 100%. The population proportion of persons having Internet access in the Netherlands is not known exactly, but the 85% resulting from the face-to-face surveys of Statistics Netherlands (2007) are generally used as estimator.

Almost all surveys and panels have some underrepresentation of certain groups. Therefore, the question is whether the LISS panel is closer to traditional non-Internet studies than Internet studies using self-selected, non-probability based samples. For that purpose, we compared the LISS panel with a major traditional national survey in the Netherlands, with a very large Internet survey, and with a comprehensive evaluation study across 19 commercial market research panels. This comparison is not meant to judge the other online studies and panels, but to evaluate the worth of a large investment in sample and recruitment as was done for the LISS panel.

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[4] The age range in the studies differed. To keep the tables comparable, the same lower age limit was applied to all research data and population data.

3.2. Worse than a traditional survey?

We first compared the LISS panel with a major traditional national survey in the Netherlands, the Dutch Parliamentary Electoral Study (DPES) conducted in 2006. Sample selection and fieldwork were carried out by Statistics Netherlands (Aarts et al., 2007). A true (two-stage) probability sample was selected. Data were collected by means of CAPI (face-to-face interviews with a laptop computer). The response rate was relatively high: about 70%, resulting in 2806 completed questionnaires. We used the publicly available data of the DPES 2006 to calculate the percentages in our categories of comparison (DPES, 2006). The results are summarized in Table 4.

Table 4. Comparing the LISS panel with the DPES. Bias defined as the difference between the observed percentage and the population percentage.

	LISS Panel	DPES
Group	Bias	Bias
Age >=70	-6	1
Living alone	-5	-4
Non-western immigrant	-3	-2
Did not vote at election	-7	-13
Voted SP at election	0	1
Voted CDA at election	-1	1
Has Internet access	8	-2

Compared to the DPES 2006, the LISS panel is more biased in the oldest age category and in Internet access. Note that the DPES data are one year older than the LISS panel data, and Internet access increases strongly each year. The single person households and non-western immigrant group are just as much underrepresented in the DPES as in the LISS panel.

The number of people who say they did not vote is usually much lower in surveys than the number of actual non-voters in elections. This is also the case in the LISS panel and in the DPES. However, the percentage non-voters in the LISS panel is closer to the election results than the percentage in the DPES. Note that the LISS panel respondents completed the questionnaire in December 2007, one year after the election. In contrast, DPES respondents were asked about their voting behaviour just after the elections of November 2006. The relation between voting and survey participation might be stronger in the case of the DPES because of the subject of this survey than in the LISS panel which covers a much broader range of topics. The percentage of SP voters and the percentage of CDA voters are approximately equally biased in the LISS panel and in the DPES.

In conclusion, the LISS panel is quite close to a traditional face-to-face survey, except for the coverage of the elderly, non-Internet population.

3.3. Better than a volunteer Internet survey?

One of the largest Internet surveys in The Netherlands until now was *21minuten.nl*. This yearly survey is set up to supply answers to questions about important problems in Dutch society. In 2007, it solicited the opinion of Dutch citizens on the subject of democracy and government. Between August 10 and October 1, more than a hundred thousand people completed the questionnaire (21minutes.nl, 2007a). That is a very large sample size, but entirely built on self-selection of respondents. Several television stations paid attention to it, making people aware they could visit the 21minutes website and fill in the questionnaire. Table 5 shows a comparison of the LISS panel and the unweighted 21minutes.nl respondents of 2007 (21minutes.nl, 2009).

Table 5. Comparing the LISS panel with 21minutes.nl. Bias defined as the difference between the observed percentage and the population percentage.

	LISS Panel	21minutes
Group	Bias	Bias
Age >=70	-6	-9
Living alone	-5	3
Non-western immigrant	-3	-5
Did not vote at election	-7	-14
Voted SP at election	0	2
Voted CDA at election	-1	-13
Has Internet access	8	15

In the analyses of the poll results and the published report (21minutes.nl, 2007a) the sample was weighted based on population data of Statistics Netherlands and two reference studies (21minutes.nl, 2007b). According to 21minutes, the weighted results are representative for the opinions of the Dutch population aged 15 to 69 years (21minutes.nl, 2007b). The 4000 respondents of age 70 and older who filled in the 21minutes.nl questionnaire were studied as a separate group for the general report (21minutes.nl, 2007a).

Table 5 shows that the unweighted version of 21minutes.nl has a stronger underrepresentation of respondents of 70 or older than the LISS panel. However, the study did not target at this group, it was meant to be representative for the 15 to 69 years old. Remarkably, the 21minutes.nl actually has an overrepresentation of single person households, in contrast to the LISS panel and the DPES underrepresentation. Non-western immigrants and non-voters are better represented in the LISS panel than in the 21minutes.nl. We expected to find an over-representation of socialist party voters, as Bethlehem (2008b) showed that this category of voters often tends to participate more than others in self-selection based Internet surveys. However, we find only a very slight bias in the 21minutes.nl survey. In contrast, the christian-democratic party voters are strongly underrepresented in the unweighted 21minutes.nl study while almost correctly represented in the LISS panel. The percentage that has Internet access is, by definition, 100% in the 21minutes.nl study.

To conclude, the LISS panel better represents the elderly, non-Internet group, non-western immigrant groups and christian-democratic party voters than the unweighted

21minutes.nl Internet survey. Other groups, such as socialist party voters and single person households were just as well or better represented in the 21minutes.nl survey.

3.4. Comparison with samples from 19 online panels

In 2006, Van Ossenbruggen et al. (2006) carried out an evaluation study across 19 online panels of Dutch market research organisations, called Nederlands Online Panel Vergelijkings Onderzoek (NOPVO; Dutch online panel comparison study). The study comprised two parts (Vonk et al., 2008): First, an inventory of all online panels in the Netherlands based on ESOMAR's 25 questions[5] was made. All participating panels provided information about recruitment of their panel members, incentives, panel size, response rates, etc. An overview of this information is available at the website of the Dutch Market Research Association (MOA). The second part was an empirical study for which samples of the same gross sample size of 1000 panel members were drawn from the 19 panels, and the same survey was conducted in each of these samples. The agencies that administer these panels use different methods to recruit panel members, but the main recruitment is done online, through links on websites and snowball methods among participating panel members (Van Ossenbruggen, 2006). The agencies were asked to provide a sample that would generate a representative net sample for age, gender, education and region. In total, 18,999 persons from the different panels were selected and invited to participate; 9514 persons responded. For our comparison, we use some data from the empirical study (Vonk, 2009). A description of the sampling, response, data collection and outcomes can be found in Vonk et al. (2008). Our comparison is restricted to the bias in the demographic and webographic categories we identified before, averaged over all 19 samples. We use the averaged bias across all 19 samples because we think it gives a more general standard of comparison than the bias of a single online panel or a small selection of panels. Table 6 presents the results.

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[5] The European Society for Opinion and Marketing Research (ESOMAR) is a world body of market research professionals and organizations. In 2005, ESOMAR published a set of 25 questions about research methodology which all online sample providers should be able to answer. A revised set of now 26 questions can be found at the ESOMAR website: http://www.esomar.org/uploads/pdf/professional-standards/26questions.pdf

Table 6. Comparing the LISS panel with NOPVO. Bias defined as the difference between the average observed percentage and the population percentage.

	LISS Panel	NOPVO
Group	Bias	Bias
Age >=70	-6	Not included
Living alone	-5	-1
Non-western immigrant	-3	-5
Intends not to vote at election	-7	-12
Intends to vote SP at election	0	1
Intends to vote CDA at election	-1	-17
Has Internet access	8	15

Since the NOPVO samples were restricted to the age range 18 to 65, no comparison can be made for the elderly over 70 years. The NOPVO panel samples are, on average, better than the LISS panel with regard to the representation of single person households. The underrepresentation of non-western immigrants and non-voters is similar to the 21minutes.nl study in table 5 and thus stronger than in the LISS panel. With respect to voting behaviour and party choice, we have used the results of the questions about intention to vote at the next elections instead of the reported voting in the elections of 2003. Since these elections were held three years before the study, we considered the voting intentions in 2006 a better comparison to the results of the LISS panel, the DPES, and the 21minutes.nl study, which were all carried out after the elections of 2006. Socialist party voters are well represented in the NOPVO samples but christian-democratic party voters are very much underrepresented. Like in the 21minutes.nl study, this underrepresentation might be partly due to the age limit of the study and partly to the sampling strategy of some of the panels. The percentage that has Internet access is, by definition, 100% in the samples from the online panels.

In summary, existing online access panels in the Netherlands on average differ more from the population than the new LISS panel on four of the six characteristics tested.

4. Results: Quality of the data?

The transition to online interviews as a mode of interviewing has in itself some consequences for the design of surveys. A list of some consequences is given in Table 7. Firstly, the definition and calculation of the response rate is not always clear for these new methods and AAPOR definitions do not yet take the new developments in designs and sampling into account. This makes it difficult to compare response rates across Internet studies and between Internet and traditional panels. At the same time, nonresponse conversion can profit from the new possibilities of combining different modes. The recruitment of the LISS panel is an example of how multi modes can be used to re-approach households in a tailored way, adapted to the type of nonresponse. A third consequence of the use of modern techniques of interviewing is a shift in the groups that are difficult to reach and convince. Generally, the non-western immigrants remain an underrepresented group in most surveys. However, the elderly are often rather willing to participate in traditional surveys, but in Internet surveys they are the

most difficult group to include, as we saw above. The young, working singles are, on the other hand, easier to reach by new or mixed modes than by traditional modes (mobile phones replace landlines in this group, for example). Furthermore, it becomes more important to collect "webographics" in addition to demographics to establish the representativeness of a survey.

The development of questionnaires has, within the context of Internet interviews, shifted to issues of visual design, and technical issues (type of screens, browsers, and programs such as flash player which respondents have or do not have). Moreover, a different respondent segmentation arises based on respondent's abilities on computer, Internet and other devices. We can already segmentate panel members on the basis of paradata such as speed of mouse movements and efficiency of clicks, which vary greatly over individuals and groups of individuals. In addition, question formats cannot always remain exactly identical when a traditional questionnaire, which has been used in previous waves of a panel study, is changed into an Internet questionnaire. A 'don't know' category, for example, that normally is not read aloud to respondents but visible to the interviewer, has to be presented on the screen in some way or another. The positive effect is that experimentation with different visual layouts etc. is much easier in online interviews. Finally, we can register and analyze a lot of new paradata in Internet surveys, such as mouse clicks and movements, time spent on answering a question, movements back and forth through the questionnaire, etc.

Table 7. Consequences of transition to Internet surveys

1	Possibly: Selective sample with unknown probabilities, not covering population
2	(Yet) incomparable response rates across studies
3	Multi mode approach to nonresponse conversion
4	Shift in some underrepresented groups
5	Questionnaire development shifts to visual design and technical issues
6	Segmentation of respondents by cognitive abilities and skillfulness in using mouse, Internet, tools
7	Question formats often change
8	Easier experimentation with different visual designs
9	Availability of paradata such as mouse clicks and movements

5. Results: data richness

A traditional interview method, such as a telephone interview or face-to-face interview is strongly limited by time. Most people do not accept an interviewer in their home for hours, nor answer lengthy questionnaires by telephone. The particular design of the LISS panel allows the use of a much longer core questionnaire than can be used in a traditional panel interview. The panel respondents are contacted each month and asked to fill in online questionnaires of about 20 to 30 minutes in total. They can fill in these questionnaires at any time during the month and at the pace they wish. In addition, respondents can take a break and continue with the interview at some other time. The complete core panel questionnaire is split into shorter parts, of about 20

minutes each, and spread over 8 months. Thus, it can be as long as 150 minutes of interviewing in total, summed over the 8 monthly parts. Each monthly part represents one module, containing questions that are all in the same domain of research. The eight thematic modules are:

1. Family and Household
2. Economic Situation and Housing
3. Work and Schooling
4. Social Integration and Leisure
5. Health
6. Personality
7. Religion and Ethnicity
8. Politics and Values

Each core module consists of about 100 questions; hence the various domains are covered in more depth than usual. The core modules are repeated yearly: The first wave of the panel core questionnaire has been carried out between November 2007 and June 2008, the second wave between November 2008 and June 2009. Of course, it is also possible to use a shorter questionnaire, spread over one or two months if political events or economic development might affect the relationship between some variables of interest.

On a yearly basis, the eight parts of the core questionnaire use only half of the total interview time that is available when respondents participate 30 minutes each month. The other half of available interview time per year is offered as open access data collection to the academic world. Researchers are invited to submit research proposals that, after they are approved by a scientific board, can be carried out in the panel at no cost. During its first year of existence already a large number of proposals, from a wide range of disciplines, were accepted and presented to the LISS panel.

All LISS data, collected for the core study or other studies, are published on the website www.lissdata.nl and freely available for academic researchers.

6.   Conclusions

In the eighties, a major breakthrough was accomplished by the introduction of remote computer assisted interviewing in the Telepanel of the University of Amsterdam and later the CentERpanel at Tilburg University (Hoogendoorn and Daalmans, 2009). This development stimulated similar initiatives in other countries, for example the Knowledge Network Panel and the RAND American Life Panel in the U.S. This paper has shown that today, it is possible to use Internet interviewing while complying with the high quality demands on coverage, sample composition and data quality. We have

shown that it is possible to correctly apply sampling theory to the construction of an online panel. For a new panel, a true probability sample of households was drawn from a population register by Statistics Netherlands and contacted with a household in-person interview, asking respondents to join the panel. The panel provides a computer and Internet connection to those households that could not otherwise participate. Hence, this panel uses online interviewing as just another way of asking questions and not as a sampling frame.

The question then is whether this strategy is good enough to be used in other countries, that is: does it result in an online panel that is a real alternative to the traditional panel survey methods and to existing online panels? We have compared the composition of the new panel to a high standard traditional survey and to Internet surveys based on non-probability self-selected samples. The new panel was close to the traditional survey and better than the two online surveys on five of the seven characteristics we tested. The exceptions were found in the oldest age group, over 70 years, and in the non-Internet households, two characteristics which are strongly correlated. The elderly, non-Internet group was, although far better covered in the new panel than in the other online studies, clearly better represented in the traditional, face-to-face survey. On the other hand, socialist party voters were well represented in all studies and single person households were in fact better represented in the online studies based on non-probability samples than in both the new, probability panel and the traditional survey. It might be that online self-selection sampling reaches those single persons that are not well reached with other recruitment methods. The result cannot be explained by the exclusion of elderly above 65 in the two non-probability based online studies. If we select only panel members younger than 66 from the LISS panel, the percentage single person households decreases from 15% to 14%, still much lower than in the online samples based on self-selection and closer to the face-to-face DPES data.

Our conclusion thus is that an online panel can come quite close to a traditional survey when a correct sample design is used, but the under-coverage of the elderly, non-Internet population is not entirely solved by providing these households with equipment and Internet connection to participate. The under-coverage is, in the case of this panel, not present in the gross sample but is caused by nonresponse: The oldest respondents were more reluctant to accept the equipment offered to them and unwilling to participate in the online panel. It has to be noted, however, that this type of panel demands a larger financial investment than a regular, non-probability based Internet panel.

In addition, we have shown that using Internet-interviews poses some new demands on the design of panel surveys, for example on the visual layout, the question format and the programming and testing of questionnaires for all different types of computers and browsers. At the same time, it offers a new richness of data by the possibility of using longer questionnaires spread over time, the low costs of interviewing large samples of respondents, the availability of paradata and the easy implementation of experiments.

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