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Internet Surveys by Direct Mailing : An Innovative Way of Collecting Data

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What is This?

Internet Surveys by Direct Mailing

An Innovative Way of Collecting Data

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This article describes a new method of collecting data by direct mailing via the Internet. Feasibility and capacities were evaluated through a worldwide opinion poll on global future risks of mankind and potential solutions. Within 1 day, a structured questionnaire was sent to 8,859 randomly selected e-mail addresses. One thousand seven hundred and thirteen were remailed properly completed, 90% within 4 days. Most respondents were residents of North America (64%) and Europe (21%), male (87%), and 30 years old on average. Environmental destruction (52%) was mentioned as the primary problem, followed by violence (45%) and unemployment (45%). Education (71%) was the most frequently proposed solution to future problems. It is obvious that Internet surveys at this time are not representative of the total population. However, they open new dimensions in the interrogation of experts and opinion leaders, especially considering their efficiency and potential for automation.

Keywords: Internet, survey, e-mail, future risks

INTRODUCTION

The worldwide connection of privately and professionally used computers via the Internet can be considered as one of today's greatest innovations in the field of mass communication. At this time, about 20 to 40 million people all over the world have access to the Internet, and the number is rapidly increasing (The Internet Society, 1995).

For population surveys and opinion polls, the capacities of this new medium could open a new dimension in that data collection via the Internet is very fast and inexpensive and allows immediate processing and analysis of incoming data. Considering these technical advantages, computer communication seems to be an ideal basis for rapid survey applications.

The Internet might also enable researchers to conduct "expert interrogations" by addressing highly selected groups of users. The major selection criterion can be the enrollment in one of approximately 8,000 newsgroups established on the net that serve as discussion forums of various specific and nonspecific topics.

To date, however, realization of Internet surveys has been mainly impaired by the impossibility to address members of newsgroups directly because there has been no way to acquire private e-mail addresses at large scale. The only way to use the Internet for opinion polls or population surveys has been to place an impersonal summons in the newsgroups or in WWW pages (indirect mailing). One has had to rely on chance that somebody might come across the questionnaire, become interested in it, copy the document, complete it, and return it. Having to rely on highly motivated individuals, indirect mailing is prone to multiple biases and is therefore unlikely to yield valid and representative results.

To facilitate active mailing Internet surveys, we present a technique that automates the retrieval of e-mail addresses from a sample of newsgroups. This enables the distribution of electronic questionnaires to selected addresses (direct mailing). In addition, we develop a procedure to automatically process returned questionnaires. To test feasibility and impact of this instrument, a questionnaire on mankind's future problems and potential solutions was mailed to a random population sample.

MATERIAL AND METHODS

Sampling

Due to the lack of complete e-mail address directories, an unbiased method for automated retrieval of available addresses had to be devised. The present solution is based on so-called newsgroups. These are discussion forums on the Internet dedicated to specific topics. Every message posted to a newsgroup contains the e-mail address of the sender, which makes newsgroups an ideal source for acquiring e-mail addresses.

Two hundred newsgroups were randomly selected from groups available in Munich via the news server of the Technical University of Munich (news.informatik.tu-muenchen.de). Address sampling started in August 1995 and lasted for 14 days. A parsing program scanned all newsgroup messages for e-mail addresses and automatically stored them to a file (Figure 1).

Questionnaire

To optimize response rates, the questionnaire was preceded by a brief introductory text. The questionnaire was kept as short as possible to avoid refusal. Both introduction and questionnaire are contained in the appendix.

The main items of the questionnaire had to fulfill the following general requirements:

- Simplicity: no special training is necessary to understand and answer the questions.
- Cultural independence: the questions should be understood in a similar way all over the world.
- Completeness: the categories should be complete in terms of covering the major possible answers (this was achieved by pretesting the questionnaire).
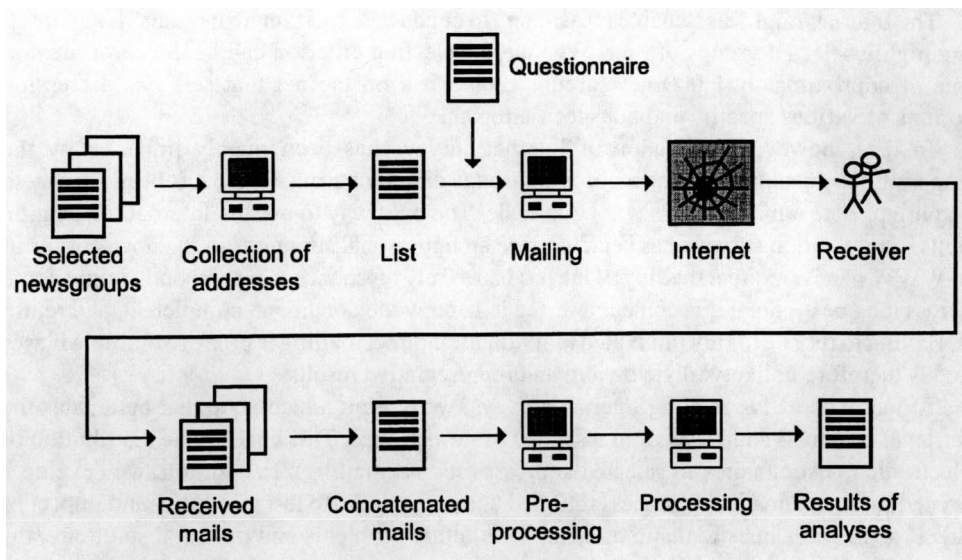
Figure 1: Processes and Data Flow

- Relevance: the questions should focus on problems and solutions generally considered relevant for a broad range of people, countries, and regions.
- Neutrality: the questions should not contain or suggest any political or other bias of the researchers; also ethical, racial, and moral feelings should not be violated as far as possible.

The introductory text served to answer the following questions of a potential respondent:

- Who is conducting this survey?
- Is it commercial or scientific?
- How did I get into the sample?
- How was my e-mail address acquired?

The title following this general information contains the major scope of the study: It is a global survey about future risks of the world and of mankind. After a short sentence aimed at improving the motivation of potential respondents, some socioeconomic data about study participants are requested (age, sex, profession, and country). These questions are followed by two major groups of items, inquiring about future risks and their possible solutions. Whereas the latter items were not further categorized, the former are divided into the categories world, society and health, politics, and economy. An open category for other items not provided was included for both problems and solutions.

To assess the predictive power of Internet surveys, we asked the sample whether they believe that international pressure could suffice to prevent French nuclear testing in the Pacific in 1995. The question concerning the French atomic testing, not yet carried out but announced and discussed worldwide at the time of the survey, was conceived as a calibration question. Because most large-scale surveys are nowadays conducted through telephone interviews, the next question focused on the issue of whether responders of Internet surveys would also respond to telephone surveys. Finally, the last question asked about the

```
echo "New posting: " >> OutputFile
date >> OutputFile

while read Address
do
        echo mailing to "$Address"! tee >> OutputFile
        mail $Address < Questionnaire 2>> ErrorFile
done < ListOfAddresses
```

Figure 2: UNIX-Shell script for mailing the questionnaires

degree of personal interest in Internet surveys and offered information on any results of the study.

Forwarding the Questionnaires

To avoid conflicts with other users of our local computer facilities, forwarding of the questionnaires was scheduled for a Friday afternoon (August 25). A UNIX shell script was used to mail the questionnaire to all 8,859 addresses (Figure 2). Incoming mail was accepted for 2 weeks after the original mailing.

Data Preprocessing

All returned mailings were concatenated to a single file. In a further step, this 10 MB file was evaluated by a parsing program. The program read every single mail and located predefined keywords, denoting selected phrases or words of the questions in the question-naire. Usable entries were written into an output file for further processing.

In our questionnaire, there were three different types of questions to deal with, free-text, multiple-choice, and yes or no questions. The answers to free-text questions were directly written to the output file. Among multiple-choice questions, the following cases had to be handled separately:

- Field checked: encoded with 2 in the output file,
- Field not checked: encoded with 1,
- Field not identified: encoded with 0.

In case of yes or no questions, the following cases had to be handled:

- Positive answer: encoded with 3,
- Negative answer: encoded with 2,
- No answer provided: encoded with 1,
- Answer not identified: encoded with 0.

Although the program was prepared to handle a variety of unformatted questionnaires and many kinds of particular situations, 50 questionnaires had to be handled manually. However, it turned out that none of them were useful for further processing. The output file

produced by the parsing program contained all information of the questionnaires for further statistical processing.

Data Processing

All preprocessed data were converted to an SAS data file for formatting and labeling. To establish a final data set, the following steps were performed on the raw input data provided by the C-language parsing program. First, all duplicate responses were deleted by dismissing all but the first questionnaire from a given address. Second, records containing biologically implausible age information were identified and checked manually. Three records turned out to contain no valid information at all and were deleted. Finally, textual data were coded and categorized. The contents of the variables "profession," "country," "other problems," and "other solutions" were counted and assigned a numerical code. Then, codes with similar content were concatenated. Textual answers to problems and solutions were assigned to existing categories if possible. Frequently appearing codes deviating from preexisting categories were summarized into new categories, rare ones were classified as "other."

Data Analysis

To calculate response rates, questionnaires returned empty were separated into deliverable and undeliverable. Mail from "demon," "mailer-demon," or "postmaster" was classified undeliverable. Nonresponse frequency was determined by subtracting the sum of undeliverable and responded mails from the total number of outgoing mails. The response rate was calculated as follows: number of answered mails times 100, divided by number of deliverable mails.

Due to uncertainties on the net, not all mails with undeliverable addresses are reliably returned to sender. To quantify this type of bias, we forwarded 118 mails with nonexisting addresses. After 2 weeks, 91 of these came back as "undeliverable mails." This means that 23% of undeliverable mails somehow got lost on the net, unnoticed by the sender. To compensate for this underreporting, the number of undeliverable mails was multiplied by 1.3 ($118 = 91 \times 1.3$) to calculate an unbiased response rate.

Statistical analysis was solely descriptive. Variables were treated according to their scaling. Absolute and relative frequencies were computed for categorical and nominal data, including categorized text data. Age was treated as both continuous and categorized. Age categories were less than or equal to 20 years, 21 to 30 years, 31 to 40 years, and more than 40 years. Stratification was performed according to age, sex, nationality, and profession.

RESULTS

Survey Sample

In July 1995, the newsserver of the Technical University in Munich enabled access to 8,017 newsgroups. For our study, we randomly selected 200 newsgroups. To demonstrate that selection of newsgroups offers an opportunity to focus on specific interests, we categorized all groups into branches of interest. Mostly, this was done according to the newsgroups' titles, only in some cases a closer look was necessary. Table 1 shows the distribution of interests in the random sample, giving a crude overview of the variety of

TABLE 1
Overview of the randomly selected sample of 200 newsgroups from a total of 8,017 groups

Branch of Interest	Selected Newsgroups		Address-Providing Newsgroups		Addresses Including Duplicates		Addresses Without Duplicates	
	n	%	n	%	n	%	n	%
Body/fashion	2	1.0	2	1.7	288	1.5	177	2.0
Computer	57	28.5	44	38.3	11,336	59.7	4,707	53.1
Culture/politics	15	7.5	3	2.6	93	0.5	61	0.7
Fan/hate	31	15.5	14	12.2	948	5.0	518	5.8
Games	7	3.5	5	4.3	1,511	8.0	734	8.3
Hobby	21	10.5	17	14.8	2,237	11.8	1,362	15.4
Miscellaneous	21	10.5	9	7.8	996	5.2	454	5.1
Science/technology	16	8.0	8	7.0	197	1.0	121	1.4
Sports	12	6.0	8	7.0	1,159	6.1	589	6.6
Other	18	9.0	5	4.3	228	1.2	136	1.5
Total	200	100	115	100	18,993	100	8,859	100

NOTE: Newsgroups accessible through the newsserver of the Technical University of Munich July 19th, 1995.

topics discussed in Internet newsgroups. Of the selected newsgroups, 28.8% were related to computer and software, 15.5% were dealing with various "fan" or "hate" topics, 10.5% referred to certain hobbies, another 15.5% discussed miscellaneous topics.

As shown in Table 1, not every selected newsgroup contained postings. Therefore, not all of the 200 selected groups yielded addresses. In cultural and political newsgroups, only every fifth newsgroup contained postings. Columns 4 and 5 of Table 1 describe the number of extracted addresses of each category. It should be noted that the number of duplicate addresses exceeds 50% in some cases. After eliminating duplicates, the final sample contained 8,859 e-mail addresses, 53.1% of them derived from computer-related newsgroups, 15.4% from hobby groups.

Overall, 1,713 completed questionnaires could be analyzed. The mean age ($\pm$ standard deviation) of this sample was 30 ± 10 years. Stratification into age groups yielded 13% ($n = 229$) of the participants 20 years or younger, 43% ($n = 729$) between 21 and 30 years, 26% ($n = 440$) between 31 and 40 years, and 15% ($n = 260$) older than 40 years. Three percent ($n = 55$) of the sample did not specify their age. About 87% of the responders ($n = 1,494$) were men, 8% ($n = 135$) women, and 5% ($n = 84$) did not give information on gender.

The group of responders consisted of 64% ($n = 1,098$) North Americans, 21% ($n = 359$) citizens of the European Community, and 4% ($n = 76$) inhabitants of Australia and New Zealand. Citizens of the former Eastern European countries made up 2% ($n = 40$), Asians 3% ($n = 46$), and Africans 1% ($n = 23$). Of the participants, 0.8% ($n = 14$) did not fall into the above categories (i.e., South America, European Countries outside the European Community), and 3% ($n = 57$) did not specify their origin.

Twenty-five percent ($n = 420$) of the responders were students, 34% ($n = 581$) technicians, and 9% ($n = 155$) dealt with science and teaching. Fifteen percent ($n = 260$) of the participants represented the business and administration branch, 4% ($n = 75$) were working in the areas of art and culture, 1% ($n = 22$) answered as having no profession, 8% ($n = 144$) could not be classified, and 3% ($n = 56$) did not state their profession.
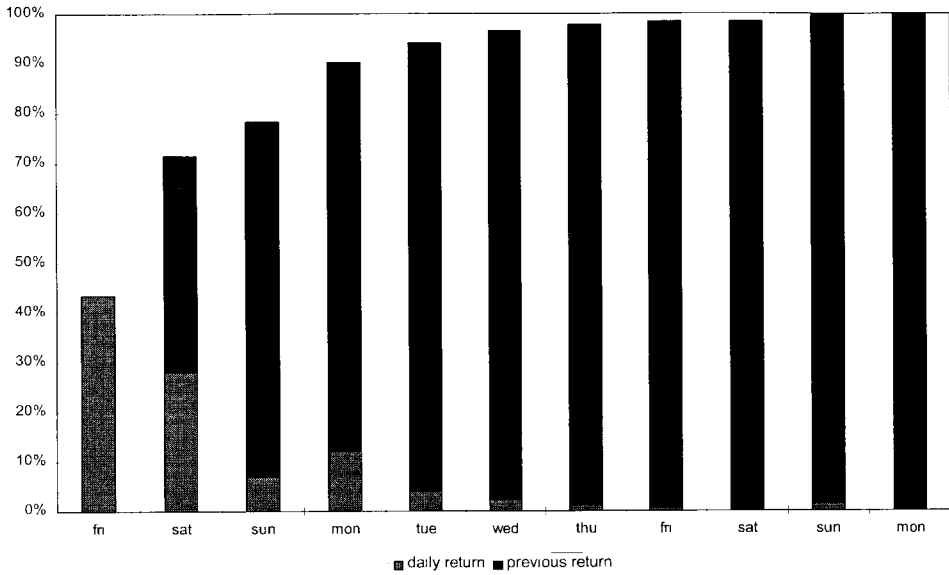
Response Rate

daily return ■ previous return

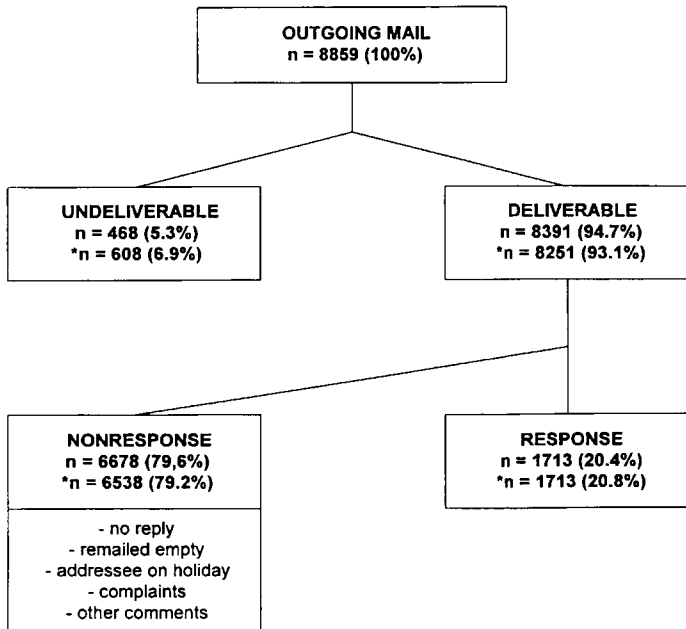**Figure 3: Response Distribution Within the Follow-Up Period**

Figure 4: Response and Response Rate Calculation (* = corrected for underreporting of undeliverable mail)

All answers arriving within 2 weeks following the mailing were included into the study. Figure 3 displays the distribution of responses within the follow-up period. Within 24 hours of mailing, 43.4% of the answers arrived; 90% arrived within the first 4 days. The incision on the third day reflects reduced response activity on Sundays.

Figure 4 contains the overall study response. The number of undeliverable questionnaires was 468. Of the remaining 8,391 questionnaires, 1,713 were completed correctly. These figures correspond to a response rate of 20.4%. If underreporting of undeliverable mails is taken into account, the response rate is elevated to 20.8%.

In the nonresponse group, the majority of addressees did not respond at all. 1,026 empty and 333 unreadable questionnaires were returned. The latter group consisted mainly of deteriorated questionnaires, nonsense responses, complaints, or other comments. Some respondents sent duplicate or multiple mails. In total, 31 (0.3%) persons complained about the survey at large, mostly considering the survey as bad "netiquette" or "unsolicited mail." Some sent advice for improvement.

Survey Results

Based on all 1,713 questionnaires, Figure 5 shows the frequency of responses on major problems of the next decade. The most frequently named global problem was environmental destruction (52%). Asian respondents were most concerned about environmental destruction (72%), whereas African participants seemed to be worried least (35%).

Violence and unemployment were named second most frequently, each category being mentioned by 45% of the sample. Persons who did not specify a profession were especially worried about these problems (violence 64%, unemployment, 73%). Stratified by geography, Europeans (60%) especially regarded unemployment a major problem.

Forty percent of the sample considered overpopulation an important problem. Maximum concern was found in African citizens (61%). Inhabitants of former communist countries showed minimum concern (10%).

About 30% of the sample expected religious dogmatism, political corruption, loss of familiar structure, and limited energy resources to be future problems. Europeans were more afraid of religious dogmatism (40%), Africans of political corruption (43%). North Americans and Asians were substantially more worried about the loss of familial structure (35%). The limitation of energy resources was a problem most frequently reported by Asian participants (52%).

Wars, infectious diseases, and recession were mentioned by approximately 20% of the participants. Stratification in these categories revealed some deviations from the overall result. For example, stronger concern about wars was expressed by citizens of the former Eastern bloc (43%), by women (33%), and by members of younger age groups (32%). Infectious diseases were named by 35% of African respondents. Recession was named by 28% of the Eastern bloc residents. Other problems were mentioned less frequently (< 10%) and are not further described here. The categories "political dogmatism," "social conflict," and "other" derived from textual answers that could not be summarized under preexisting categories. Therefore, these post-hoc categories are most likely underrepresented.

Figure 6 shows the frequency of proposed solutions to global problems. Most participants (71%) regarded education an important issue. No profound deviations from that overall result were found in strata of country, age, sex, and occupation.
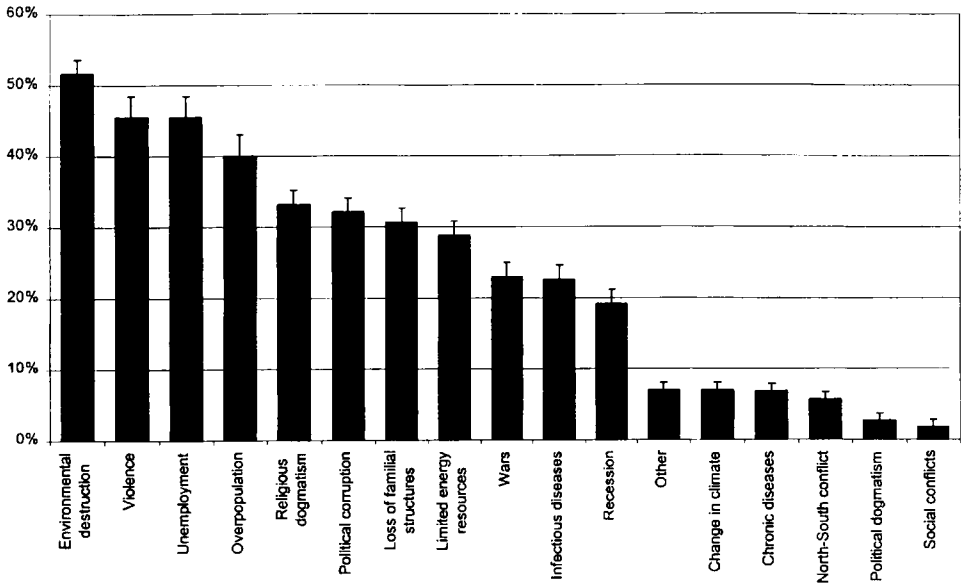
Figure 5: Frequency Distribution of Future Problems Named by Survey Participants, including 95% confidence intervals

NOTE: Multiple answers were possible; the categories "political dogmatism," "social conflicts," and "other" were created post-hoc from textual answers.
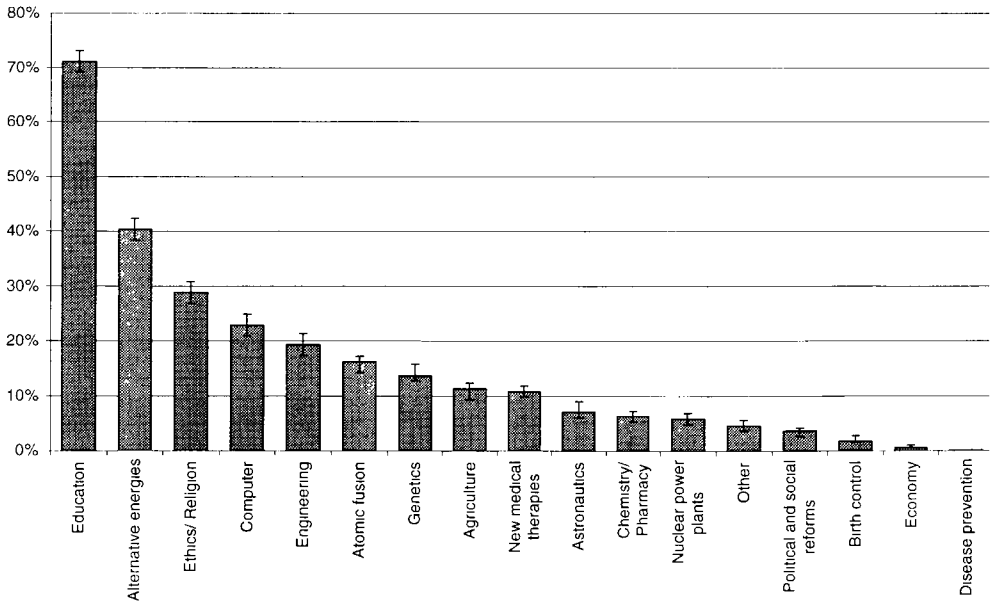

Figure 6: Frequency Distribution of Votes for Different Problem Solutions Named by Survey Participants, including 95% confidence intervals

NOTE: Multiple answers were possible; the categories "political and social reforms," "birth control," "economy," and "other" were created post-hoc from textual answers.

TABLE 2
Answers to the Last Three Survey Questions (*n* = 1,713)

	yes (%)	no (%)	not answered (%)
Will the international pressure suffice to stop further French nuclear testing?	444 (25.9)	1,077 (62.9)	192 (11.2)
Would you have answered these questions if this was a telephone interview?	881 (51.4)	696 (40.6)	136 (8.0)
Do you want the results of this survey mailed as soon as they are available?	1,324 (77.3)	282 (16.5)	107 (6.2)

NOTE: Runs on Apple Macintosh (system version 7.0 or higher, microprocessor 68030 or higher, 8 MB RAM, 80 MB HD) available only for shipping fees from the authors).

Alternative energies were stated second most frequently by 40%. Especially, citizens of Australia and New Zealand (66%) stressed this point.

Twenty-nine percent of the study population mentioned ethics and religion as possible solutions. People older than 40 years of age (36%) put slightly more weight on that issue than younger ones (22%).

About 20% proposed computer technology and engineering. In both categories, inhabitants of former Eastern bloc countries were overrepresented (45%, 23%). Computers were also favored strongly by persons below 20 years of age (43%).

A total of 16%, especially Europeans (21%), placed confidence in atomic fusion. Nuclear power plants were named by only 6% of the respondents but by 20% of Eastern Europeans.

Fourteen percent expected genetics to solve global problems. Women put less trust in this science (7%). Slightly more than 10% of the sample mentioned agriculture and new medical therapies. Other solutions were mentioned less frequently (< 10%) and are not further described. Post-hoc created and therefore underrepresented categories are "political and social reforms," "birth control," "economy," and "others."

Table 2 summarizes the answers to the final three survey questions. To assess the predictive power of Internet surveys, we asked the sample whether they believe that the international pressure would suffice to prevent French nuclear testing. Data collection was closed 1 week before the French conducted nuclear tests on the Mururoa Atoll. Twenty-six percent believed that international pressure could suffice to prevent the testing. Sixty-three percent answered "no," 11% did not answer the question.

Another question asked whether participants of Internet surveys would have been equally willing to respond to a telephone interview. Forty-one percent answered no to this question, 8% did not answer it.

To assess the degree of personal interest in the survey at large, people were asked whether the results of the survey should be mailed to them. Seventy-seven percent were interested in the results.

All results about future problems and their solutions were separately computed for persons who gave a correct prediction regarding the French nuclear testing or who showed interest in the study results. There were no significant differences in any category.

DISCUSSION

The objective of the present study was to transfer traditional survey methodology to the Internet. A method of recruiting random as well as highly selected samples of the Internet population was introduced. The feasibility and capacity of a direct-mailing procedure was demonstrated through a worldwide survey on global future risks of mankind and potential solutions. With minor expenditure, almost 2,000 filled-in questionnaires were obtained from all over the world, 90% returning within only 4 days. The survey technique differed from more traditional methods by its high degree of automation in both data acquisition and processing.

Responses from all parts of the world demonstrated that English-language Internet surveys can easily overcome geographical barriers. Although limited response rates question the generalizability of results, the responses may be useful for hypothesis generation and identification of trends. The results of the present study support the notion of a general use of the Internet for gathering survey data in an extremely global and rapid manner. A major advantage to traditional survey techniques is the immediate availability for further processing. Surveys on current issues can be conducted at a worldwide scale, which is presently hard to achieve by any other method.

For example, in this study, environmental destruction was considered a major problem in developed countries and much less in Africa. European participants were most worried about unemployment (60%) and religious dogmatism (40%). African participants considered overpopulation (61%) and political corruption (43%) as major problems, whereas 43% of Eastern European residents were concerned about wars. These findings seem to fit general expectations. With respect to possible solutions of worldwide problems, results were even more accentuated. Education, alternative energy resources, and ethics or religion were considered the most important keys to solve future problems. Interestingly, elder participants tended to favor ethics or religion, and males preferred technical solutions.

There are, however, some problems associated with this Internet survey. First, the response rate of 20% is less than half of that usually obtained by mail or phone surveys (Dillman, 1978; Frey, 1985). We assume that this might be related to a general reluctance of Internet users toward nontraditional (i.e., scientific, entertainment, and communication-related) manners of using the system. There is a strong sensitivity for attempts to change the basic character of the net, especially in terms of commercialization and also of censorship. In a way, this can be perceived as a sort of liberal conservative attitude resulting in low cooperation to all innovative uses of the net. It can be assumed that this situation will change along with ongoing developments on the Internet, possibly yielding a higher cooperation comparable to traditional surveys. Considering the low response rate, Internet surveys are still strongly susceptible to selection bias, challenging generalizability of results.

Internet surveys seem to be useful for pilot purposes, for example, testing the questionnaire. In our pilot to the present study, 120 participants pointed out that the category "education" was missing as a possible strategy to overcome the world's problems. As described above, education turned out to be the most frequent answer. New lines of research

might become conceivable, for example, building selected brain trusts that are dedicated to and focused on special questions. This might be done in a similar way to what we have done in the present study with respect to nuclear testing. Here, the predictability could be validated by an external event. To give a simple example, a selection of volunteer Internet users could be asked to subscribe to a series of surveys focusing on the stock market. Their prognoses could be compared to reality, and multiplicative credit weights could be assigned or subtracted for true or false prediction. A sort of increasingly refined multipersonal and at the same time anonymous neutral network might emerge, which could be used in several ways for a variety of purposes. Further research is definitely needed. Other, more interesting and possibly noncommercial applications of such a virtual closed-group advisory board could of course be devised with yet unknown utility. Even basic democratic ways of general and public opinion expressions, beyond the present interfaces and filters proposed by political parties, making up the level of political discussion at this point, can be imagined.

In some countries, this potential seems to be recognized—not always without panic—by certain interest groups trying with rapidly increased intensity to cast some sort of control on the net.

Although there are now up to 20 to 40 million users on the Internet, this number is far from including a representative sample of citizens of any country. Rather, Internet users must be considered a highly selective group of young, upper class, highly educated males. This implies strong selection bias for any survey conducted with the intention of being representative for a country or a group of countries. In consequence, representative Internet surveys are not possible at this point in time. However, if the interest is focused on selected opinion leaders, selected professionals (i.e., computer scientists), and the like, the method of Internet-based surveys might already now be superior to any other research methodology. There is other evidence that the method of Internet surveys is useful despite its limitations. First, the predictive utility of the sample as a whole seems to be rather striking. Among those answering the question on whether or not the French nuclear testing would take place, more than 70% answered with yes, which was correct, as we know today. Second, it could well be possible that the participants of Internet surveys are the nonparticipants of traditional surveys. This notion is supported by the finding of almost 41% of the sample stating that they would not have taken part in a telephone interview. To keep response rates high, Internet surveys might turn out as a requisite component of future multimodal surveys. Third, unlike other largely labor-intensive methods, Internet surveys bear the potential of complete automation, including data acquisition, analysis, and reporting.

Since surveys gain more and more importance in industrialized democracies, a variety of applications—possibly focused on repeated measurements, special samples, or certain specific research questions and target groups—are conceivable. There are many methodological and procedural questions, but most of them should turn out solvable in principle. The present study is a starting point for further research.

APPENDIX

```
                                                          #0895

Dear Internet user:
We are a research team at the University of Munich, FRG, exploring
the scientific usability of the Internet for opinion polls and surveys.

Your address was randomly selected for the present noncommercial use.
Please help us to complete our study by answering the below questions.

Please return to nys@ibe.med.uni-muenchen.de
Thank you for your kind support.


GLOBAL NETLAND SURVEY ON FUTURE RISKS

PLEASE: In order to yield representative results, take the short time
to answer and return the form immediately.

How old are you: _____ (years)
Your gender: o female o male
Your profession: _____ (one word only)
Your country: _____

What are the major problems of the next decade? Check (X) one in each
group.

WORLD                             SOCIETY + HEALTH
o Environmental destruction       o Violence
o Overpopulation                  o Infectious diseases
o Changes in climate              o Chronic diseases
POLITICS                          o Loss of familial structures
o Wars                            ECONOMY
o Religious dogmatism             o Limits of energy
o North-South conflict            o Unemployment
o Political corruption            o Recession
o OTHER: _____

What are the most important fields to solve these problems?
Check (X) up to three:

o Alternative energies            o Disease prevention
o Nuclear power plants            o New medical therapies
o Atomic fusion                   o Genetics
o Engineering                     o Chemistry/Pharmacy
o Computer                        o Agriculture
o Astronautics                    o Ethics/Religion
o OTHER: _____          o Education

Will the international pressure suffice to stop further French atomic
testing?  o yes o no

Would you have answered these questions if this was a telephone
interview?  o yes o no

Do you want the results of this survey mailed as soon as they are
available?  o yes o no
```

NOTE: Contents mailed to every address selected for participation. The number in the upper right corner identifies the date of the present mailing (month and year). The questionnaire itself is proceeded by an introductory text, informing potential respondents about the scope of the study.

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