METHODOLOGICAL ISSUES IN SURVEY RESEARCH: A HISTORICAL REVIEW (1)

by

Wim de Heer
(Statistics Netherlands)
Edith D. de Leeuw
(MethodikA)
Johannes van der Zouwen
(Vrije Universiteit) (2)

Résumé. Problèmes méthodologiques dans la recherche par enquêtes - Un historique. Dans cet article, nous présentons un survol historique des enquêtes sociales et décrivons le développement historique des statistiques et de la méthodologie *empirique* des enquêtes. Les origines de la recherche par enquetes datent du debut du 19ème siecle: la premiere enquête empirique a été faite en Angleterre en 1912 par Bowley. Les méthodes modernes d'enquête trouvent leurs origines dans les années 1930 quand trois aspects majeurs de l'enquête ont été développés et perfectionnés: techniques d'échantillonnage, techniques de collecte de données et les méthodes statistiques d'analyse de données. Dans les années 1950, l'interview en face-à-face s'est developpé et des manuels ont été publiés. Au debuts des années 1970, l'interview par téléphone est apparu et l'enquête postale s'est répendue. Dans les années 1980-1990, l'interview assiste par ordinateur et les enquêtes électroniques ont été developpées. En meme temps, des progrès dans la mesure de l'erreur, dans l'étude de la non-réponse et dans le controle global de la qualité des données, ont été réalisés. Dans le nouveau millénaire, les principes de base de l'enquete empirique continueront d'avoir cours mais les statisticiens d'enquête, comme Bowley, seraient surpris de voir la structure d'une enquête en 2012. Sans doute, elle s'appuiera sur de nouvelles technologies et concentrerait sur la réduction de la tâche du répondant, tout en améliorant la qualité des données. Bowley apprecierait de voir que des méthodes sophistiquées de réduction de la non-réponse et de l'erreur de mesure incorporées dans la structure de l'enquête pour améliorer la qualité finale des résultats. **Méthode et statistiques d'enquêtes, Enquêtes sociales, Enquêtes empiriques, Nouvelles technologies, Qualité des données, Non-réponse, Tâche du répondent, TQM, CBM**

Abstract. In this paper, we present a historical overview of social surveys and describe the historical development of *scientific* survey methodology and survey statistics. The origins of survey research can be traced back to the early 19th century and the first scientific survey was conducted in England in 1912 by Bowley. Modern survey methods have their roots in the 1930's, when three major aspects of the survey process were developed and refined: sampling techniques, data collection techniques, and statistical methods for data analysis. In the fifties, the scientific face-to-face interview was established, and handbooks were published. In the early seventies, telephone interviewing was introduced and mail-survey methods were updated and refined. This was followed by the development of computer-assisted interviewing and electronic surveys in the eighties and nineties. At the same time, more emphasis was given to concepts such as measurement error, nonresponse, and total quality control. We are now at the brink of a new millennium. Although the basic principles of the scientific survey still hold, survey statisticians from the last millennium, like Bowley, would be surprised to see the design of a survey in 2012. Undoubtedly, this design will incorporate new technologies and will focus on reducing the respondent's burden, while improving data quality. Bowley would certainly be pleased to see that sophisticated methods for the reduction of nonresponse and measurement error have been incorporated in a total quality survey design! **Survey Methods and Statistics, Social Survey, Scientific Survey, New Technologies, Data Quality, Nonresponse, Respondent Burden, TQM, CBM.**

EARLY HISTORY

Through the centuries, administrators have been counting and many civilizations have left us statistics. These statistics had mostly an economic or political origin. In ancient Egypt, in imperial China, and in the Roman empire, "heads" and their possessions were counted, and detailed statistics on young men were collected for military purposes. The first census, or, at least the oldest surviving census publication, is the *Doomsday Book*. Under the orders of William the Conqueror, royal servants counted property and persons between 1085 and 1086. Early "bureaucrats" collected statistical data for taxation, recruitment, and to determine the power of the state and the wealth of newly-founded colonies. Examples are the enumerations of Peru by Spain in 1548 and of Nova Scotia and Quebec by France in 1660. Of course, this information was a highly-guarded secret and privy of the ruling governments only. Statistics was the work of the "secret bureaucrats" (Hacking, 1990).

Those who did publish were the "public amateurs." These amateurs used figures and statistics for quite different goals, such as theological study, social reform, or the gratification of (scientific) curiosity. This is nicely illustrated by the work of two members of the British Royal Society. In 1713, William Derham described in his treatise, *Physico Theology*, how population statistics were a proof of the "divine design". Half a century earlier, John Graunt studied the welfare of the London Community. Graunt, a pious and studious London tradesman, is considered the founding father of modern demography. He reduced a great number of unsystematic lists of deaths, and their causes, to several perspicuous and clear tables which were published in a short pamphlet in 1662. Having no formal training in mathematics, Graunt was not hampered by mathematical tradition and strict rules, and he grouped his figures in new and original ways. In fact, he was the inventor of "survival analysis" and "life tables" (Boorstin, 1985). From Graunt's treatise, we learn that, around 1660, only 25 out of every 100 Londoners reached the age of 26, and a mere 6 of every 100 reached the old age of 66 (Boorstin, 1985).

In the eighteenth century, amateurs and academics described and published demographic statistics widely. Unfortunately, these statistics were not very systematically or scientifically collected. Still, the enthusiasm of amateurs like Sussmilch (3), and his critic, Malthus, prepared the way for modern demography and statistics as we know it today.

At the end of the 18th century, the emerging new nations felt the need for statistical agencies. In the Constitution of the United States

is a provision calling for a national census every ten years, and the United States Census of 1790 is the start of the oldest continuous periodic census (Boorstin, 1985). The US census had, and still has, great political importance. Representation of states in the US Senate is based on the numbers of people counted in each state. But new nations needed more than just "headcounts". They needed publicly available figures to describe their nation and to provide a "statistical" identity (Heiser, 1996). In 1800, the *Bureau de la République* was established in France, which was a predecessor of the *Statistique Générale de la France*, the French Statistical Office (De Mast, 1997). Prussia was a trendsetter for Europe: in 1805, Frederick Wilhelm III, King of Prussia, decreed that a central statistical office should be established and dedicated to "the collection and integration of statistical tables". That was the end of the secret bureaucrats; the data collected were analyzed and published! The Prussian office had many ties with universities, thus stimulating the development of statistical and economic sciences in Germany (Hacking, 1990).

After the fall of Napoleon and the Vienna Congress (1814), the emerging European states established offices to collect and publish statistics about all aspects of life, not only births, deaths, and marriages. This resulted in a flood of printed numbers which stimulated scientific discussion. For instance, in France, the tabulation of "deviants" was started which led to a controversy in 1815. Who are more suicidal, citizens of Paris or London? This debate was only settled more than a decade later when the new statistical institutes had relevant data available (4). Suicide became a recurring theme in medical statistics, and later in statistical sociology of the 19th century, as the work of Durkheim testifies (Hacking, 1990).

The 19th century was the age of the discovery of social laws and structures. The Belgian mathematician-astronomer, Quetelet, began to collect social facts and data about humankind. Following Laplace, he applied established methods from the natural sciences to the political and moral sciences, as they were called at the time. Statistics became social statistics, focussing on utilitarian knowledge: descriptive statistics should serve progress. Quetelet made two important contributions towards the method of social statistics: the concept of the "average" man and the fitting of distributions: the "normal" curve was born. He analyzed such different statistics as death rates, soldiers' chest expansion, length and weight (5). Quetelet also acted as a "passer" between scientific disciplines; borrowing from his background in astronomy, he introduced the concept of "measurement error" in statistics.

Quetelet was an enthusiastic advocate of the new science of "social" statistics. He corresponded with scientists and politicians all over the world, sharing his results and convincing them of the utility of statistics. In 1834, he pleaded for the founding of the London Statistical Society with the mathematician and inventor of the arithmetical machine, Babbage. The goal of this society was to be the "procuring, arranging and publishing of facts calculated to illustrate the condition and prospects of society". The London Statistical Society soon became the now renowned Royal Statistical Society (De Mast, 1997). One of Quetelet's correspondents was Prince Albert, whom he had tutored in mathematics. When Prince Albert promoted the first World Exhibition in the Crystal Palace in 1851, Quetelet grabbed the opportunity for organizing international cooperation. It was on his initiative that, after consultation with many foreign delegates present at the Exhibition, it was decided to have an International Statistical Congress in Belgium in 1853 (Nixon, 1960). Eight more congresses followed and, in 1885, the successor organization, the International Statistical Institute (ISI), was founded (Kenessey, 1997). By 1900, the ISI reported that already 43 percent of the world's population was covered by sixty-eight censuses (Boorstin, 1985). We had entered the age of world statistics.

THE HISTORY OF SURVEY RESEARCH: FROM "SOCIAL SURVEY" TO "SAMPLE SURVEY" (1900-1930)

In 1912, Bowley, the first professor of statistics at the London School of Economics and Political Sciences, started a study of the working-class conditions in five British cities: Reading, Northampton, Stanley, Warrington, and Bolton (6). *Samples* of citizens were interviewed using a *structured interview schedule* concerning their spending habits and financial situation (De Mast, 1997). Bowley was extremely care in selecting the sample, and paid serious attention to the potential for *nonresponse bias* through refusal and non-contact (Moser, 1958). The first scientific survey took place only 87 years ago! The roots of the survey are much older, and go back to the idealistic "amateurs" in the 17th, 18th and 19th centuries who went beyond mere headcounts and reported on life and death, sickness and health, and poverty and prosperity.

The first documented *mail survey* dates from 1788. Sir John Sinclair, a Scottish agricultural reformer, returned home enthusiastic about his German travels. During his "grand tour" of the continent, he became convinced that facts and figures were the handmaiden of progress, and he wanted to found a statistical agency for Scotland. Reality forced him to become a one-man

statistical office, and he send out questionnaires with more than a hundred questions to the ministers of all 938 parishes of the Church of Scotland. He pursued them relentlessly with follow-up letters, the last written in blood-red to suggest with "the draconian colour of his ink" what would happen to the nonrespondents. It took 23 (!) reminders but he had a 100% response. This survey resulted in the *Statistical Account of Scotland*, published in 21 volumes between 1791 and 1799. In his *Account*, Sinclair published what we would now call traditional statistics like age distributions, life expectancy and estimates of the total population and its rate of change. But he also published data on "social statistics" and life styles. Thanks to Sinclair, we now know that in the 18th century, the women of Inveresk organized football matches between the married and unmarried women, of whom the former invariably won. (Boorstin, 1985; Hacking, 1990; Heiser, 1996).

Sinclair used *key informants* to collect his information. The social reformer and statistician, Charles Booth, used interviews with key informants and direct observation to collect systematic data on all families with school children. Booth undertook this enterprise as a private person and at his own expense, dividing his time between his work as a ship owner in Liverpool and his studies of London. Two of his faithful assistants were Beatrice Potter-Webb and Seebohm Rowntree, who also played an important role in social reform in the 19th century. Booth's study into the *Life and Labour of the People of London* (7) started in 1866 and was published in 17 volumes in 1902. Its results drew attention to the extent and severity of poverty and had considerable political impact. It was also the inspiration for the "social survey movement" in Europe and the US.

Booth's co-worker, the York merchant, Rowntree, added some important methodological innovations to the social survey. For his 1901 study, *Poverty: A Study of Town Life*, he obtained information *directly* from wage-earning families in York using *interviewers*. Rowntree also *operationalized* his concepts with great precision, resulting in *standardized interview schedules* (Hacking, 1990; De Mast, 1997). Bowley, finally, made the last step towards the scientific survey, and used *sampling*, including the study of potential bias through nonresponse (Moser, 1958). Through his work on sampling (1906, 1926), he ends a discussion of more than a century.

The first to use sampling was Laplace in 1802. Laplace took a systematic sample of communities in 30 departments spread out equally over all of France. He then used the birth registers, which were considered very accurate, to estimate the total number of births in France for the past year. Although Laplace lacked any concept of random sampling, his sampling of communities had

clearly been designed to achieve the goals we now ascribe to random sampling (Stigler, 1986: 164).

Quetelet was clearly attracted to this method and its potential for savings in time and money, and planned to use it to estimate the population of the Netherlands (at that time including Holland and Belgium) in 1824. However, the strong criticism of Baron de Keverberg made him change his opinion and Quetelet started planning a complete census instead. Quetelet was trained as an astronomer and was well acquainted with the concept of "observation error": the precision of an observation increases with the square root of the number of observations. Therefore, he worried about other sources of error and the influence of sampling on the total error.

Quetelet and his contemporaries did not have a satisfactory solution for this question and the general opinion was that one should count every member of the population, sampling was unscientific (8). A sentiment that was heard only two years ago in the US Senate during the discussion of the coming census. At the end of the 19th century, a debate took place at the International Statistical Institute on statistical methods, and Andres Kiaer opened again the discussion on sampling. Kiaer, director of the Norwegian Statistical Office, presented papers on his experience with systematic sampling and was a dedicated advocate of the "new" method. But it was only after the 1906 publication of Bowley's work on sampling that the method took off. Bowley's work was continued by Neyman, who further developed the concept of sampling error and published an influential paper in the *Journal of the Royal Statistical Society* in 1934. This work was continued by other eminent statisticians, including Mahalanobis, Yates, Cochran, Hansen and Kish (O'Muircheartaigh, 1997: 2), who gave us the tools to use sampling in surveys as a scientific and accurate substitute for complete enumeration (Lessler and Kalsbeek, 1992).

THE SURVEY INTERVIEW (1930-1970)

Although the survey method was conceived and born in Europe, it grew up in the United States. Inspired by Booth, Jane Adams started the Hull House project in Chicago. This was the beginning of the "social survey movement" in the US. Important benchmarks were the founding of the Russel Sage Foundation in 1907, Paul Kellog's survey of Pittsburgh in 1908 and the Rockefeller Institute of Social and Religious Research in Chicago in 1921 (for an overview see De Mast, 1997; Converse, 1986; Plat, 1996). The Depression, and the resulting lack of funds, put an end to the "social survey

movement" in the thirties. However, at the same time, the government started using survey data. Also, consumer market research and newspaper "polls" started using survey methods.

The survey method became another word for face-to-face interview. The first interviews were short (around 5 minutes) and simple. Techniques for question writing, interviewing, and analysis were still rather primitive (Rossi *et al.*, 1983). In the 1930s, the interview survey developed rapidly. At the end of the fifties, the interview had come of age and the first handbooks were published. Examples are: *The Art of Asking Questions* (Payne, 1951), *Interviewing in Social Research* (Hyman, 1954), *The Dynamics of Interviewing* (Kahn and Cannell, 1957), and *Survey Sampling* (Kish, 1965).

From 1930 to 1950, three major developments in the US were of great importance for the establishment of the modern survey interview. At the US Bureau of Census, sampling techniques were tried and sampling schemes developed. Market research institutes, such as Gallup and Roper, were instrumental in the implementation and development of data collection techniques. The growing demand for valid information on society created a need for standardized instruments to measure attitudes and opinions. Pioneers in social psychology and psychometries, such as Thurstone, Likert, Guttman, Cantril, and Stevens, provided scientific measurement techniques and scales (Green, 1954; O'Muircheartaigh, 1997). With these instruments came statistical techniques.

Classic statistical techniques from psychology and "mental measurement" were adopted in other fields. A prime example is factor analysis. In addition, special techniques for survey data were developed (9). For instance, Stouffer and, in later years, Goodman focussed on the analysis of cross-classified data, and the work of Lazersfeld was of great importance for the development of path analysis (Babbie, 1973). The rapid development in the sixties of electronic computers, closely followed by the development of statistical packages, such as SPSS, brought rapid data processing and more complicated analysis within the reach of survey practitioners.

The increasing need of the US federal government for knowledge and information on social trends and public opinion stimulated the rapid growth of the survey method. Existing market and opinion research firms, such as Gallup, expanded. At the same time, new survey research institutes were founded at universities. In 1940, the Office of Public Opinion Research was established at Princeton by Cantril. Cantril, together with Gallup, conducted hundreds of split ballot experiments, and was one of the first to study and improve survey methodology. Again with Gallup, he founded *Public Opinion*

Quarterly which is still one of the leading journals in the field (De Mast, 1997). In 1941, the National Opinion Research Center (NORC) in Chicago was established by Field, and supported by eminent social researchers such as Stouffer and Cantrill. It was followed in 1949 by the Survey Research Center (SRC-ISR) in Ann Arbor, Michigan, with Likert, Campbell, Cannell and Kish (De Mast, 1997; O'Muircheartaigh, 1997). Today, these institutes still play a major role. For a thorough historical review of American survey research, see Converse (1986) and Platt (1996).

After the Second World War, the new survey method was introduced in Europe. In many countries, market research firms were founded and were the first to use sample interviews. Statistical agencies were also interested in the new method. In the early sixties, survey research was introduced and used at European universities. Almost immediately, methodological research concerning the survey interview began, inspired by studies at NORC and SRC-ISR in the US. The goal was to improve the survey method and to find new and better techniques for question wording, interviewing and statistical analysis. Until the mid-seventies, the survey interview was the leading method and the number of face-to-face interviews grew exponentially. This was followed by a period of critical assessment, and, in the eighties, the development and reevaluation of alternative methods.

CRITIQUE OF THE SURVEY INTERVIEW (1970-1980)

The dominance of the survey interview in the seventies is illustrated by the following figures: Turner and Martin (1984, vol. 1, p. 30) estimated that within the United States, during the period between 1971 and 1976, a minimum of 100 million survey interviews were conducted; the gross revenue of the survey industry was estimated at $4 billion in 1978.

The popularity of the survey method was also reflected in the growing number of articles in leading social science journals based on survey data. According to Presser (1984: 96), for sociology, the percentage of articles using survey data increased from 24 per cent in 1949/50, to 55 per cent in 1964/65, and then to 56 per cent in 1979/80. For political science, the increase is even sharper: from 3 per cent, to 19 per cent, and then to 35 per cent.

In the seventies, the application of the survey interview reached its limits. 't Hart (1972) has calculated that the probability of a Dutch household being included in a survey in a particular year was about one in three. As a result, a certain "interview fatigue" arose.

Moreover, the seventies were characterized by distrust of large societal organizations, and especially the national government. With the Orwellian year 1984 coming, people wanted to safeguard their privacy. They hesitated, or even objected, to giving confidential information for purposes that were not clearly in the interest of the respondent. How can the prevention of misuse of personal information be guaranteed? These, and similar considerations (Bulmer, 1979), seemed to have a serious effect on the willingness of respondents to cooperate. As a case in point, as a result of many active protests, the Netherlands National Census of 1980 was postponed indefinitely (Dijkstra and Van der Zouwen, 1982: 3). Survey nonresponse was becoming an issue.

The main reason for the popularity of the standardized survey interview in the seventies was its applicability. One can use survey interviews to collect data about the behavior of people, to reconstruct the past of the respondent, and even to assess values on variables which are not directly observable (subjective phenomena) like opinions and attitudes. But this can only be adequately done if certain conditions are fulfilled or, stated otherwise, if certain auxiliary hypotheses are true. Only if the interviewers ask the questions as they are worded in the questionnaire, only if the respondents understand them in the same way as intended by the questionnaire designer, only if respondents' choices of a response category are affected solely by their value for the variable the question is meant to measure, and similarities and differences between answers of different respondents may validly be interpreted as similarities or differences between the respondents with respect to the variables concerned. If these conditions are not fulfilled, responses become incomparable, and response bias occurs. In the seventies, not only the application of survey interviews increased, but also critical research concerning the degree to which the conditions mentioned above are fulfilled (Schaeffer, 1991).

In survey interviews, the stimuli, that is, the questions and items, should be presented to all respondents in exactly the same way. But do all interviewers follow the question wordings and further instructions provided by the researcher? To answer that question, Michael Brenner, expanding on work started by Hyman (1954) and Cannell and his colleagues (1975), conducted a detailed action-by-action analysis of audio tapes of survey interviews. Brenner (1978, 1982) showed that a normal standardized survey interview is far less standardized than the survey researcher likes to admit: interviewers alter the wording of questions, respondents respond to other questions than intended by the researcher, interviewers suggest response options, etc. In later years, his conclusions were corroborated in several countries (Billiet and Loosveldt, 1988; Dijkstra and Van der Zouwen, 1988; Sykes and Collins, 1992;

Houtkoop-Steenstra, 1996). For a statistical treatment of the detection of interviewer effects, see Fowler (1991), Groves (1989), and Hox, De Leeuw and Kreft (1991).

A second condition is that all respondents understand the questions exactly as intended by the questionnaire designer. But are the questions indeed understood in the same way? To answer that question, Belson (1981) constructed a questionnaire including seven or eight "test questions". This questionnaire was delivered to a sample of survey respondents in the usual way by ordinary market research interviewers. Next day this interview was followed by a second interview conducted by a different person, namely an intensive interviewer. The latter spent an hour or more attempting to find out how well or badly the respondent understood the test questions, and the nature of such misunderstandings as occurred (1981: 22). Although the market research interviewers did not observe any signs of uncertainty or difficulty respondents had with answering the questions, the intensive interviews showed major misunderstandings for each of the test questions. Belson's research was followed by a long series of research findings concerning the linguistic and cognitive aspects of understanding and answering survey questions; cognitive interviewing, for short (Forsyth and Lessler, 1991; Schwarz and Sudman, 1996; Sudman, Bradburn and Schwarz, 1996). For a state of the art overview of cognitive interviewing, see the special issue of the *Bulletin de Méthodologie Sociologique* (*BMS*) on testing survey questions (guest editor, Pamela Campanelli, 1997).

A third auxiliary hypothesis behind the survey interview is that the respondent's answer is only dependent on the "true" value of the variable the question is meant to measure. Other variables, such as characteristics of the interviewer, or the place where the interview is conducted, should not affect the response, or, as the jargon goes, should not have response effects. But are these response effects absent in survey practice? That question is asked in dozens of methodological studies, and quite often answered in the negative.

For example, Phillips (1971, 1973) found that responses given by men, respectively women, to questions regarding mental health were less informative about differences with respect to their mental health than they are informative about differences between men and women regarding the social desirability of endorsing certain items of a mental health questionnaire. These response effects induced Phillips to put a large question mark behind the credibility of survey data, as the title of his 1971 book, *Knowledge from What?*, testifies. In a book published two years later, *Abandoning Method*, he also places a question mark behind the usefulness of methodological research concerning response (in)validity. But, other methodologists

have not abandoned the survey method. They continue their split ballot experiments concerning the effects of question wording, mode of administration of the questionnaire, style of interviewing, etc. The number of these studies has increased so rapidly that it has become possible, and necessary, to perform some kind of meta-analysis, or theoretical synthesis, of the research results. Atteslander and Kneubuhler (1975) constructed an early theory of measurement errors in surveys, and Sudman and Bradburn published a very influential overview of response effects in surveys, based on over nine hundred studies. The book by Sudman and Bradburn (1974) shows the salience of the information required of the respondent, the cognitive difficulty of the task for the respondent, the degree to which the task involves problems of self-presentation, and how these are related to respondents' responses, or, in other words, determine the occurrence of response effects.

The critique of the survey interview, as it was clearly voiced in the seventies, has opened new lines of methodological research: research into the causes of nonresponse due to refusals, interaction analysis of the behavior of the interviewers and respondents, and cognitive laboratory research concerning the processes by which respondents search for the proper meaning of a question and for a response alternative that best reflects their opinion or situation.

NEW METHODS AND A NEW TECHNOLOGY (1980-1990)

Despite the critique of the survey interview in the seventies, in the eighties the survey industry was still booming. There was a growing need for facts and figures in government and the commercial world. To fulfil this need, new survey methods and techniques were developed. Mail and telephone surveys become increasingly popular with government agencies and research firms. The increased costs of face-to-face interviewing make it virtually impossible, or, at least, extremely costly to utilize the face-to-face survey to its full potential when national surveys or large surveys in geographically dispersed areas are required. This has led to a renewed interest in alternatives, and a renewed research effort to optimize mail and telephone surveys (De Leeuw, 1992).

The publication in 1978 of Dillman's book did much to increase the respectability of mail surveys and contributed greatly to the reduction of nonresponse and the enhancement of data quality in mail surveys. In his book, Dillman (1978) gives an inspired account of mail survey research methodology with a clear and precise description of how to optimize mail surveys by using the Total Design Method or TDM. Dillman's TDM proved to be effective in

both the US, Asia, and Europe (De Leeuw and Hox, 1988), and is popular in academic research and official statistics.

Telephone surveys started in market research in the US, but soon became increasingly popular in governmental and academic research in the US. This was encouraged by improved technology, by the development of random digit dialing as a sampling technique, and, above all, by the general public's increased availability and access to telephones (De Leeuw, 1992). Telephone interviewing quickly changed into Computer-Assisted Telephone Interviewing (CATI): an interviewer sits in front of a terminal and asks questions that appear on the screen; the respondent's answer is then typed into the computer by the interviewer. Supervisors are present for quality control and to assist with specific problems. The first CATI systems were developed in the US, primarily in market research. Soon CATI systems were developed at American universities, and finally introduced in government surveys (Nicholls, 1988). Europe followed later. In the mid-eighties, telephone surveys were the major data collection mode in market research in the US, Canada and Australia, and increasingly popular in market research in Europe. Finally, telephone interviewing came of age in 1987 with a large international conference (10) and a subsequent monograph published in 1988 (Groves *et al.*, 1988). This monograph soon became the standard textbook for telephone research.

Technological developments in Europe differed from those in North America. In the US, telephone interviewing started earlier and is more prominent than in Europe. Also, most computer-assisted "mail" surveys, including use of the Internet for data collection, are more prominent in the US, especially in market research.

Computer-assisted mail surveys are part of CASI (Computer-Assisted Self Interviewing), also called Computerized Self-Administered Questionnaires or CSAQ. A characteristic of CASI is that the respondents read the questions on the screen and enter the answers. There is no interviewer; the interviewing program guides the respondent through the questionnaire. CASI can appear as part of a CAPI session where the interviewer hands over the computer to the respondent for a short period, but remains available for instructions and assistance. This is equivalent to the procedure used in traditional paper and pencil face-to-face interviews, where an interviewer might give the respondent a paper questionnaire containing sensitive questions.

In the Netherlands, a special form of CASI was developed: the tele-interview. This is a form of computer-assisted panel research (CAPAR) where respondents fill in an electronic questionnaire about once a week. During the panel study, selected households receive a

microcomputer and a modem; questionnaires are regularly sent to the respondents by modem and, when completed, sent back to the remote computer. The administration and transmission is all done automatically by the program; respondents only have to read the questions and type in the answers. The first tests were done in 1985, and, in 1986, a commercial telepanel was working at a large Dutch market research firm (Saris, 1991).

The first computer-assisted version of the mail survey was the Disk-By-Mail survey (DBM). In DBM, a disk containing the interviewing program is sent by post to the respondent who runs the program on his or her computer, and then returns the disk, with the responses, by post. Disk-By-Mail surveys have been successfully done in market research in the US. In the Netherlands, a Disk-By-Mail survey in primary schools was very successful; teachers and pupils enjoyed the experience and produced high-quality data (Van Hattum and De Leeuw, 1996). At statistical agencies, such as Statistics Netherlands, the electronic equivalent of a business survey is being developed: the Electronic Data Interchange (EDI). The latest version of the computerized mail survey is the Internet survey. This is still experimental, although the first surveys, using the net have been performed (Witt, 1997; De Leeuw, 1997a). For an extensive review of computer-assisted data collection and data quality see De Leeuw, Hox and Snijkers (1995) and De Leeuw and Nicholls (1996).

FROM DATA COLLECTION TO DATA QUALITY (1990-1998)

The 1980s was the decade of the development of new data collection techniques. Moving toward the new millennium, the focus is shifting toward measurement and data quality. An important contribution comes from Groves (1989) who published a comprehensive review of survey errors and possible causes, based on a synthesis of knowledge from psychometrics, statistics, and the social sciences. Groves (1989: 6) emphasizes error estimation and the incorporation of survey error and survey costs: "only by formally assessing the costs of alternative methods (*jointly assessing quality*) can the 'best' method be identified." (11)

Nineteen hundred ninety was the year of two important conferences. In the spirit of Groves' book, an international conference in Tucson, Arizona, was dedicated to measurement errors in surveys; both error estimation and error reduction were emphasized. The resulting monograph was published in 1991 (Biemer *et al.*, 1991). Also in 1990, the first "International Workshop on Household Survey Nonresponse" was organized in Stockholm by Statistics Sweden. These workshops became a yearly event. At the first workshops, the

main interest was the exchange of information, but soon the emphasis shifted to the integration of knowledge and the initiation of new research. A large international conference was planned for 1999, and the resulting monograph will certainly be the handbook on survey nonresponse for the next decade. For a review of research on nonresponse, see de Leeuw (1997b) and Groves and Couper (1998); for an international comparison of nonresponse figures over the last 15 years, see De Heer (1996, 1999) and Maas and De Heer (1995).

Recent research changed our view of measurement error and the treatment of it. Going back to the early work of Deming (1944, 1982), quality became the central issue in survey methodology. Of course, methodological studies and post-survey quality assessments, such as reliability, validity, and bias estimates, are important indicators of accuracy, but may be of little value for *improving* survey data (Lyberg *et al.*, 1997: 111). Prevention is the better cure, and interest should shift from post-survey quality evaluation to controlling the survey processes, such as questionnaire construction, interviewing, data collection, coding, data capture, editing, and analysis. Given the importance of data quality and quality control, an international conference on "Survey Measurement and Process Quality" was organized in 1994; in 1997, the monograph of this conference was published (Lyberg *et al.*, 1997). The central concept was "Total Quality Management" (TQM); the philosophy is that process quality generates product quality. As stated above, TQM is concerned with monitoring and controlling the *whole* process, from the first formulation of the research question to the final publication and dissemination of the results.

Very important in the TQM approach is the quick implementation in survey practice of recently-developed "state-of-the-art" methods. New developments in survey methodology should be documented and implemented as "Current Best Methods" (Hox, 1997). An excellent example of the successful implementation of a new "state-of-the-art technology" in practical "current best methods" is the "cognitive laboratory approach" for testing and improving questionnaires.

In the cognitive laboratory approach, recent developments from survey methodology and cognitive psychology are combined with more traditional methods for questionnaire evaluation. Goal is to detect disturbances in the question-answer process *and* find solutions to the problems identified. For an overview of the techniques used, see the special issue of *BMS* of June 1997 (Campanelli, 1997). The first experiments with the cognitive laboratory approach took place in 1988 at the National Center for Health Statistics in America (Willis *et al.*, 1991), in 1990. The first

review of the methods used was presented at the Tucson conference on survey error, and was subsequently published in the monograph (Forsyth and Lessler, 1991). Large survey agencies adopt these "state-of-the-art" methods quickly; for instance, in 1992, Statistics Netherlands started a "cognitive laboratory" to test and improve questionnaires. Although "cognitive laboratory methods" are still not standard practice in the survey industry, they are among the current best methods of official statistics agencies and large survey institutes (Campanelli, 1997).

The re-evaluation of the survey process and the recent emphasis on Total Quality Management has led to a new optimism in the survey industry. Problems, like nonresponse, are studied and solutions are examined. At the same time, new technologies are developed and tested to improve survey quality (such as automated data capture). In the history of science, one often can discern distinct stages in the study of scientific phenomena. The first stage is description and classification as found in the work of Deming (1944) and Kish (1965). The second stage is a search for causes and theory formation; good examples are the books by Groves (1989) and Biemer *et al.* (1991). We have now moved into the third stage -- coping, controlling and improving -- and interest has shifted to managing survey errors (Lyberg *et al.*, 1997).

SURVEYING IN THE NEXT MILLENNIUM (2001 AND BEYOND)

In 1956, the British "Astronomer Royal" predicted that space travel would be technologically impossible for a long time. A year later, the first Sputnik was successfully launched, and, in 1968, the first man walked on the moon. Predicting the future is hazardous. Still there are some clearly discernable trends in survey methodology that should be mentioned.

Survey nonresponse, in general, will remain an issue in the next millennium. Changes in society make it more difficult to reach potential respondents, the growing number of survey requests will make respondents less enthusiastic and willing. The utility of telephone surveys is being threatened especially, and telephone interviews will become less efficient, particularly "cold-contact" interviews, where respondents are called without any prior contact or notification. "Hot-contacts", such as in a telephone follow-up in a mixed mode design or a panel survey, will suffer less from unwilling respondents.

The increase of unsolicited telephone calls (call-centers, telemarketing, interviews) negatively effects willingness to cooperate.

Also, households may start screening incoming telephone calls through answering machines to protect against unwanted calls. Technological advances (such as CATI), which helped telephone interviewers for a long time, are now being turned against them. Special telephones that show which number is calling and that can be blocked against certain numbers are already available in the US. A recent (telephone) survey in the US shows that these "gadgets" are being welcomed (Simonetta, 1997). A very large majority of persons (93%) believe they should have the right to block calls from telemarketeers, and a small majority (65%) believe they should also be allowed to block scientific surveys. Whether blocking will be really used on such a large scale remains to be seen. When asked whether they would be willing to pay $5 for blocking, the percentages were more than halved: 47% said yes for blocking against telemarketers, and 21% still wanted blocking against scientific research polls. In the US, people want the right to block unwanted calls, but a clear distinction is made in the type of calls they wish to block. This is encouraging, at least for scientific and government research. By emphasizing the legitimacy of the survey and its scientific nature, it should be possible to maintain adequate response rates. There is still a future for telephone surveys, but it is not as brilliant as it was in 1989.

In general, survey quality and process management will remain an issue in official statistics. Sophisticated statistical modelling has given us tools to model error sources. At the other end, advances in data collection have given us tools for reducing error (O'Muircheartaigh, 1997). New technologies will undoubtedly influence future survey methodology further. Certainly forms of computer-assisted data collection will come of age, and will provide opportunities not feasible with paper-and-pen surveys. Examples are "tailored" interviews, in which responses to earlier questions are used to select the next question, resulting in individualized interviews and adaptive conjoint measurement (Sikkel, 1996).

The power of advanced computers and advanced programming will make it possible to use "background" knowledge in interviews in far more sophisticated ways then at present. Interviewers in the field will have access to "expert systems" with instructions, automatic coding facilities, etc. Another valuable potential, especially for business surveys, is "dependent" interviewing. Using information from earlier surveys, figures are checked and specific questions about changes and reasons for changes are formulated. When the potential of computer-assisted data collection is fully developed, it will evolve from merely a useful technology into an unique new method of data collection. However, this evolution will only be successful if developers of new survey systems keep the human *user* in mind.

Successful human-machine interaction will be the key to success or failure in computer-assisted interviewing. Ergonomic interfaces should be designed and evaluated using usability testing (Dumas and Redish, 1994). In addition, more attention should be paid to social norms and how these influence the usefulness of computer-assisted surveys. A prime test case will be the Internet survey, a buzz word in the late nineties; whether or not it will prove to be a "hype" or the data-collection method of the future is still unclear. Much depends on a thorough knowledge of the way people use the Net and the customs, social codes and "nettiquette" that will develop. Issues of security, respondent burden and reaction to unsolicited mail will be of great importance. Key aspects of successful Internet surveys will be "respondent-centered", not "technology-centered" (Witt, 1997; De Leeuw, 1997a).

At the same time, survey researchers should also become more "client-oriented". Advances in information technology and sophisticated statistics make users of survey data dependent upon interpreters to tell them what the results actually mean. Knowledge of survey methodology will not be enough; one should be able to translate raw data into relevant information, using advanced statistics.

NOTES

(1) An earlier version of this paper was presented at the 14th World Congress of Sociology, Montreal, July 1998. We thank Willem Heiser, Olga Janssen, Klaas ten Hoeve, and Jonathan Verweij for sharing their historical knowledge. Special thanks are due to Frans de Mast, whose help with the history of censuses, surveys, and Statistics Netherlands was extremely valuable. His work was a great inspiration. The views expressed in this paper are those of the authors and do not necessarily reflect the policies of Statistics Netherlands.

(2) In alphabetical order. Contact address: Dr. Edith D. de Leeuw, MethodikA, Plantage Doklaan 40, NL-1018 CN Amsterdam, Netherlands; tel/fax 31 20 6223438; email edithL@xs4aLL.nL

(3) Sussmilch was a chaplain in the armies of Frederick The Great of Prussia. He was an admirer of Graunt and published, in 1741, *Divine Order in the Changes of the Human Race Shown by Its Birth, Death, and Propagation*. Sussmilch was severely attacked by a young British clergyman and mathematician, Malthus, 50 years later for his "naive generalizations about the differences between city and

country" and the unsystematic collection of facts including "the failure to include years of epidemic in his figures" (Boorstin, 1985: 671). Malthus published this criticism in *An Essay on the Principle of Population* in 1798. It is a mixture of quantitative social science and moral philosophy, and had a very practical goal: to reform the Poor Laws of Britain. At the same time, it had an immense influence on science and economy in the 19th century. Malthus influenced such diverse thinkers as Marx, Keynes and Darwin (Boorstin, 1985: 474).

(4) Then, as now, the citizens of Britain are the least suicidal of Europe. Then, as now, Europeans of every nations were more suicidal in summer than in winter (Hacking, 1990: 75).

(5) The general public knows Quetelet not for his mathematics, but for the "Quetelet-index" which indicates whether the weight falls within the "normal" range. The Quetelet index is the weight in kilograms divided by the square of the length in meters. If the resulting figure is between 20 and 25, one is considered to be "normal".

(6) This study, done in cooperation with Burnett-Hurst, was published in 1915.

(7) Booth and his co-workers produced very precisely colored maps of London. Each of the eight colors represented a social-economic class, ranging from "very poor and a danger to society" to "can afford servants" (De Mast, 1997). Using modern technology, this same method is now used in market research and marketing. Based on the postcode, geo-demographic coding schemes give detailed information on inhabitants of cities. As a result, colored maps of cities, with different colors for each social-economic status, can be viewed on a computer monitor!

(8) At the congress of the International Statistical Institute in 1895, Georg von Mayer put it this way: "il faut rester ferme et dire: pas de calcul là où l'observation peut être faite" [we should be firm and keep saying, no mathematics where observations can be done] (De Mast, 1997).

(9) This again has it roots in community reform at the end of the 19th century. At Columbia University, a new statistical laboratory was started for social statistics. The English mathematician, William Ogburn, was one of its first directors. Pupils of Ogburn were, among others, Burgess, one of the founders of the "Chicago School", and Stouffer, head of the Department of the US Army Information and Education Branch and author, in 1949, of *The American Soldier*.

(10) This was one of the first conferences in a series of international conferences on survey methodology, sponsored by the Survey Research Method (SRM) section of the American Statistical Association (ASA). These conferences and the resulting monographs, which were published by Wiley, contributed much to the improvement of survey methodology.

(11) Italics added by the authors.

REFERENCES

Atteslander, P., and Kneubuhler, H.-U. (1975) *Verzerrungen im Interview: Zu einer Fehlertheorie der Befragung*. Opladen: Westdeutscher Verlag.

Babbie, E.R. (1973) *Survey Research Methods*, Belmont: Wadsworth.

Belson, W.A. (1981) *The Design and Understanding of Survey Questions*. Aldershot: Gower.

Biemer, P.P., Groves, R.M., Lyberg, L.E., Mathiowetz, N.A., and Sudman, S. (1991). *Measurement Errors in Surveys*. New York: Wiley.

Billiet, J., and Loosveldt, G. (1988) "Improvement of the Quality of Responses to Factual Survey Questions by Interviewer Training". *Public Opinion Quarterly* 52, 190-211.

Boorstin, Daniel J. (1985). *The Discoverers: A History of Man's Search to Know his World and Himself*. New York: Random House.

Bowley, A.L. (1906) "Presidential Address to the Economic Section of the British Association for the Advancement of Science". *Journal of the Royal Statistical Society*. 69, 540-558.

Bowley, A.L. (1926) "Measurement of the Precision Attained in Sampling". *Bulletin of the International Statistical Institute*, 22.

Bowley, A.L., and Burnett-Hurst, A.R. (1915) *Livelihood and Poverty: A Study in the Economic Conditions of Working-Class Households*. London: Bell.

Brenner, M. (1978) "Interviewing: The Social Phenomenology of a Research Instrument". In: M. Brenner, P. Marsh and M. Brenner (eds.) *The Social Contexts of Method*. London: Croom Helm, pp. 122-139.

Brenner, M. (1982) "Response Effects of Role-Restricted Characteristics of the Interviewer". In: Dijkstra and Van der Zouwen (1982), pp. 131-165.

Bulmer, M. (1979). *Censuses, Surveys and Privacy*. London: Macmillan.

Campanelli, P. (1997). "Testing Survey Questions, Special Issue on Cognitive Interviewing". *Bulletin de Méthodologie Sociologique (BMS)*, 55, June 1997.

Cannell, C.F., Lawson, S.A., and Hausser, D.L. (1975) *A Technique for Evaluating Interviewer Performance: A Manual for Coding and Analyzing Interviewer Behavior from Tape Recordings of Household Interviews*. Ann Arbor, MI: Survey Research Center of the Institute for Social Research, University of Michigan.

Converse, J.M. (1986) *Survey Research in the United States: Roots and Emergence 1890-1960*. Berkeley: University of California Press.

Deming, W.E. (1944) "On Errors in Surveys". *American Sociological Review*, 9, 359-369.

Deming, W.E. (1982) *Quality, Productivity, and Competitive Position*. Cambridge, MA: M.I.T.

Dijkstra, W., and Van der Zouwen, J. (1988) "Types of Inadequate Interviewer Behavior in Survey Interviews". In: W.E. Saris and I.N. Gallhofer (eds.) *Sociometric Research, Vol. 1: Data Collection and Scaling*. London: Macmillan, pp. 24-35.

Dijkstra, W., and Van der Zouwen, J. (eds.) (1982) *Response Behavior in the Survey Interview*. London: Academic Press.

Dillman, D.A. (1978) *Mail and Telephone Surveys: The Total Design Method*. New York: Wiley.

Dumas, J.S., and Redish, J.C. (1994) *A Practical Guide to Usability Testing*. Norwood: Ablex Publishing Corporation.

Forsyth, B.H., and Lessler, J.T. (1991) "Cognitive Laboratory Methods: A Taxonomy". In: Paul P. Biemer, Robert M. Groves, Lars E. Lyberg, Nancy A. Mathiowetz and Seymour Sudman (1991) *Measurement Errors in Surveys*. New York: Wiley.

Fowler, F.J.Jr. (1991) "Reducing Interviewer-Related Error Through Interviewer Training, Supervision, and Other Means". In: Paul P. Biemer, Robert M. Groves, Lars E. Lyberg, Nancy A. Mathiowetz and Seymour Sudman (1991) *Measurement Errors in Surveys*. New York: Wiley.

Green, B.F. (1954) "Attitude Measurement". In *Handbook of Social Psychology, Vol I*. Cambridge, MA: Addison-Wesley.

Groves, R.M. (1989) *Survey Errors and Survey Costs*. New York: Wiley.

Groves, R.M., Biemer, P.P., Lyberg, L.E., Massey, J.T., Nicholls, W.L.II and Waksberg, J. (eds) (1988) *Telephone Survey Methodology*. New York: Wiley

Groves, R.M., and Couper, M.P. (1998) *Nonresponse in Household Interview Surveys*. New York: Wiley.

Hacking, I. (1990) *The Taming of Chance*. Cambridge: Cambridge University Press.

't Hart, H. (1972) "Interviewmoeheid en twijfels over het enquete-onderzoek". *Sociologische Gids*, 19 (4), 249-257.

De Heer, W. (1996) "International Response Trends: Development and Results of an International Survey". Paper presented at the 4th International Social Science Methodology Conference, July 1996, Essex, GB. Forthcoming, *Journal of Official Statistics*, 1999.

De Heer, W. (1999) International Response Trends: Results of an International Survey, *Journal of Official Statistics*, 15, 129-142.

Heiser, W. (1996) "De probabilisering van het wereldbeeld". Lezing uitgesproken op het Symposium ter gelegenheid van het 25-jarige hoogleraarschap van Ivo Molenaar, Groningen, 4 October 1996.

Houtkoop-Steenstra, H. (1996) "Probing Behavior of Interviewers in the Standardized Semi-Open Research Interview". *Quality and Quantity*, 30, 205-230.

Hox, J.J. (1997) "Er is nieuws onder de zon; Nieuwe oplosisngen voor oude problemen". Rede uitgesproken bij de aanvaarding van het ambt van hoogleraar "methoden en technickn van sociaal-wetenschappelijk onderzoek" aan de Universiteit Utrecht, 1 May 1997.

Hox, J.J., De Leeuw, E.D., and Kreft, I.G.G. (1991) "The Effect of Interviewer and Respondent Characteristics on the Quality of Survey Data: A Multilevel Model". In: Paul P. Biemer, Robert M. Groves,

Lars E. Lyberg, Nancy A. Mathiowetz and Seymour Sudman (1991) *Measurement Errors in Surveys*. New York: Wiley.

Hyman, H.H. (1954) *Interviewing in Social Research*. Chicago: Chicago University Press.

De Jong-Gierveld, J., and Van der Zouwen, J. (1986) *De Vragenlijst in het sociaal onderzoek*. Deventer: Van Loghum Slaterus.

Kahn, R.L., and Cannell, C.F. (1957) *The Dynamics of Interviewing: Theory, Techniques, and Cases*. New York: Wiley.

Kenessey, Z.E. (1997) *Adolphe Quetelet as Internationalist. Annual Report on International Statistics, Vol. 4-1997*. The Hague-Voorburg: International Statistical Institute.

Kish, L. (1965) *Survey Sampling*, New York: Wiley.

Lyberg, Lars, Biemer, Paul, Collins, Martin, de Leeuw, Edith, Dippo, Cathryn, Schwarz, Norbert, and Trewin, Dennis (1997) *Survey Measurement and Process Quality*. New York: Wiley.

De Leeuw, E.D. (1992) *Data Quality in Mail, Telephone, and Face to Face Surveys*. Amsterdam: TT-publikaties.

De Leeuw, E.D. (1997a) "Comment on Witt: Best Practices in Interviewing via Internet". *Sawtooth Software Conference Proceedings*, Sequim: Sawtooth.

De Leeuw, E.D. (1997b) "Nonrespons: Wat weten we en wat kunnen we eraan doen". In: A.E. Bronner *et al.* (red) *Recente ontwikkelingen in het marktonderzoek. Jaarboek 1997 van de Nederlandse Vereniging voor Marktonderzoek en Informatiemanagement*. Haarlem: De Vrieseborch.

De Leeuw, E.D., Nicholls, W.L.II (1996) "Technological Innovations in Data Collection: Acceptance, Data Quality and Costs". *Sociological Research Online*, 1, 4 <http://www.socresonline.org.uk/socresonline/1/4/leeuw.html>.

De Leeuw, E.D., and Hox, J.J. (1988) "Response Stimulating Factors in Mail Surveys". *Journal of Official Statistics*, 4, 241-249.

De Leeuw, E.D., Hox, J., and Snijkers, G. (1995) "The Effect of Computer-Assisted Interviewing on Data Quality: A Review". *Journal of the Market Research Society*, 37, 325-344.

Lessler, J.T., and Kalsbeek, J.T. (1992) *Nonsampling Error in Surveys*. New York: Wiley.

Maas, C.F., and de Heer, W.F. (1995) "Response Developments and Fieldwork Strategy". *Bulletin de Méthodologie Sociologique*, 48, 36-51.

De Mast, F. (1997) "Over Statistieken, Surveys en het CBS: Een Basispakket van Begrippen, Feiten en Namen". Intern CBS rapport.

Moser, C.A. (1958) *Survey Methods in Social Investigation*. London: Heinemann.

Nicholls, W.L.II (1988) "Computer-Assisted Telephone Interviewing: A General Introduction". In R.M. Groves *et al.* (eds) *Telephone Survey Methodology*, New York: Wiley.

Nicholls, W.L.II (1996) "Chronology of CASIC Events", Intern Paper, US Bureau of the Census.

Nixon, J.W. (1960) *A History of the International Statistical Association*. The Hague: International Statistical Institute.

O'Muircheartaigh, C. (1997) "Measurement Error in Surveys: A Historical Perspective". In: Lars Lyberg *et al.* (eds) *Survey Measurement and Process Quality*. New York: Wiley.

Payne, S.L. (1951) *The Art of Asking Questions*. Princeton: Princeton University Press.

Phillips, D.L. (1971) *Knowledge from What? Theories and Methods in Social Research*. Chicago: Rand McNally.

Phillips, D.L. (1973) *Abandoning Method: Sociological Studies in Methodology*. San Francisco: Jossey-Bass.

Plat, J. (1996) *A History of Sociological Research Methods in America: 1920-1969*. Cambridge: Cambridge University Press.

Presser, S. (1984) "The Use of Survey Data in Basic Research in the Social Sciences". In: C.F. Turner and E. Martin (eds.) *Surveying Subjective Phenomena*. New York: Russell Sage Foundation.

Rossi, Peter H., Wright, James D., and Anderson, Andy B. (1983) "Sample Surveys: History, Current Practice and Future Prospects". In: Peter H. Rossi, James D. Wright and Andy B. Anderson (eds) *Handbook of Survey Research*, New York: Academic Press.

Saris, W.E. (1991) *Computer-Assisted Interviewing*. Newbury Park: Sage.

Schaeffer, N.C. (1991) "Conversation with a Purpose- or Conversation? Interaction in the Standardized Interview". In: Paul P. Biemer, Robert M. Groves, Lars E. Lyberg, Nancy A. Mathiowetz, and Seymour Sudman. *Measurement Errors in Surveys*. New York: Wiley.

Schwarz, N., Sudman, S.(1996) *Answering Questions: Methodology for Determining Cognitive and Communicative Processes in Survey Research*. San Francisco: Jossey-Bass.

Sikkel, D. (1996) "The Individualized Interview". Paper presented at the INTERCASIC'96 Conference in San Antonio, Texas.

Simonetta, L.G. (1997) "Blocking Telephone Calls". AAPORNET/WAPORNET, June 1997.

Stigler, S.M. (1986), *History of Statistics*. Cambridge, MA: Harvard University Press.

Sudman, S., and Bradburn, N.M. (1974) *Response Effects in Surveys*. Chicago: Aldine.

Sudman, S., Bradburn, N.M., and Schwarz, N. (1996) *Thinking about Answers: The Application of Cognitive Processes to Survey Methodology*. San Francisco: Jossey-Bass.

Sykes, W., and Collins, M. (1992) "Anatomy of the Survey Interview". *Journal of Official Statistics*, 8, 277-291.

Turner, C.F., and Martin, E. (1984) *Surveying Subjective Phenomena*. New York: Russell Sage Foundation.

Van Hattum, M., and de Leeuw, E. (1996) "A Disk by Mail Survey of Teachers and Pupils in Dutch Primary Schools: Logistics and Data Quality". Paper presented at the INTERCASIC'96 Conference in San Antonio, Texas; MLS-publikatie n. 56, Universiteit van Amsterdam. Forthcoming, *Journal of Official Statistics* (1999: 3).

Willis, G.B., Royston, P., and Bercini, D. (1991) "The Use of Verbal Report Methods in the Development and Testing of Survey Questionnaires". *Applied Cognitive Psychology*, 5, 251-267.

Witt, K.J. (1997) "Best Practices in Interviewing via the Internet". *Sawtooth Software Conference Proceedings*, Sequim: Sawtooth.
