

## SAMPLE DESIGN AND QUESTIONNAIRE DESIGN RESEARCH AT THE NATIONAL CENTER FOR HEALTH STATISTICS

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### Introduction

One of the principal objectives of the National Center for Health Statistics (NCHS) is to excel in providing public health decision makers with quality, timely, and relevant information at minimum cost and respondent burden. In carrying out this mission, NCHS has a long tradition of supporting a vigorous survey methods research program that develops and applies innovative technologies. This paper describes two recent innovative survey design technologies initiated and promoted by NCHS - the integrated sample design and the questionnaire design laboratory.

### Integrated Sample Design

"When multiple surveys of the same population are conducted simultaneously, it is often more advantageous to integrate their sample designs by linking them to a common sampling frame, then to design each survey independently." This is the paradigm of a sample design research project described by Sirken and Greenberg (1983) about a decade ago. The project's aim is to investigate the effects of integrating the sample designs of the Center's independently designed surveys, and to implement the design changes as appropriate.

NCHS conducts three families of national sample surveys: three vital record linked surveys, three population surveys, and six health establishment surveys. This makes a total of twelve surveys as listed in Figure 1. Until the mid 1980's, all NCHS surveys were independently designed. During the 1980's, several theoretical and field research studies investigated the cost and error effects of integrating the sample designs of the population surveys (Waksberg & Northrup, 1985; Mathiowetz, et al., 1987) and establishment surveys (Cox et al., 1987) compared to designing

each of them independently. On the basis of the findings of those studies, the sample designs of two population surveys, the National Health Interview Survey (NHIS) and the National Survey of Family Growth (NSFG) cycle 4, were integrated with the designs of two establishment surveys, the National Hospital Discharge Survey (NHDS) and the National Ambulatory Medical Care Survey (NAMCS).

Before describing how the sample designs of these four surveys are now integrated it is instructive to keep in mind how they were formerly independently designed.

The NHIS and NSFG designs were based on stratified multi-stage samples of households that were selected from listed area segments or from decennial population census listings.

The NHDS and NAMCS designs were based on subsamples of patient encounters that were selected from the files of stratified samples of medical providers.

A noteworthy difference between the sample designs of the population surveys and the establishment surveys when independently designed is that the samples of the population surveys (i.e., NSFG and NHIS) are clustered in primary sampling areas (psu's) and the samples of the establishment surveys (i.e., NHDS and NAMCS), are not clustered in this manner.

These four NCHS surveys were integrated by having NHIS, which is a continuing survey and by far the largest NCHS population survey, serve as the sampling frame for the three other surveys. The sample designs of NSFG, NHDS, and NAMCS were linked to NHIS in the following manner:

NSFG sample persons were selected from the files of previously enumerated persons in NHIS.

NHDS and NAMCS sample establishments were selected within a subset of NHIS psu's.

In other words, NSFG enumerated persons that had been previously enumerated in NHIS, and NHDS and NAMCS clustered their hospital and physician samples respectively within NHIS psu's. The net effect of sample design integration has been that four NCHS surveys are now being conducted in the same subset of NHIS' primary sampling units.

The integrated survey design plan was initiated while redesigning the NHIS sample after the 1980 decennial population census. Two innovative changes were made then in the NHIS sample redesign to accommodate design integration.

The NHIS sample selection process was decoupled from the 1980 decennial population listings. Otherwise, census confidentiality restrictions (Title 13) would have prohibited releasing the NHIS sample identifiers to the private contractors that conducted NSFG.

The 200 NHIS psu's were subdivided into four psu panels, each panel representative of the national population. Constructing psu panels, made NHIS a more flexible sampling frame for accommodating the design requirements of the Center's other surveys which seem to be best served by using only two of the four NHIS psu panels.

Both innovations are being carried forward in the 1990 post-censal NHIS redesign.

NSFG-cycle 4 is a good example of the benefits of integrated survey design. Design integration reduced data collection costs by about 25 percent (over \$1,000,000) and reduced the sampling errors of minority population statistics even more substantially. The savings were realized because design integration avoided the substantial screening costs that would have been required to oversample Black females had NSFG been independently designed. Also, it should be noted, design

integration greatly enhanced NSFG analytic potential by adding NHIS micro-data to the NSFG data base.

### **Questionnaire Design Laboratory**

From the perspective of survey respondents, answering survey questions may be viewed as problem solving exercises in which they perform a series of mental tasks. These tasks include comprehension - understanding the question, recall - retrieving information from memory, estimation - editing incompletely known or recalled information, and decision making - deciding whether or not to answer the questions and to answer them truthfully. It is proposed that "the quality of survey responses depends on the difficulty of the cognitive tasks posed by the survey questions and how well these burdens are tolerated by survey respondents." This proposition is the psychological paradigm that supports the Center's cognition and survey measurement research program - a program that was initiated about eight years ago to improve the design of survey questionnaires.

Until about 1984, the survey response process was viewed from the survey taker's perspective - a viewpoint that largely ignored the respondents' cognitive role (Jabine et al., 1984). Survey response was viewed as a two stage stimulus/response process with the quality of response depending only on questionnaire design options and other design features of surveys. Response error effects of survey and questionnaire design options were investigated almost exclusively in field tests that replicated the main survey conditions as closely as possible, and hence provided limited opportunities to investigate the cognitive aspects of survey response. That is, the field tests provided little opportunity to investigate how the performance of the mental tasks implied by the survey questions affected the quality of the responses.

In 1984, Lessler and Sirken (1985) conducted a project that demonstrated the utility and practicality of investigating the cognitive aspects of answering survey questions in a laboratory setting as a method of improving survey questionnaire designs. Soon thereafter, NCHS established the National

Laboratory for Collaborative Research in Cognition and Survey Measurement. The Laboratory supports two questionnaire design programs (Sirken, et al., 1988). Its testing program develops and tests NCHS survey questionnaires prior to field testing. Its collaborative research program conducts laboratory experiments to test cognitive theories of response errors. Let me briefly describe and illustrate the work of these two programs.

### **Questionnaire Design Testing Program**

The goal of the testing program is to design survey questionnaires that are as free as possible of cognitively flawed questions. What are cognitively flawed questions? They are questions that elicit poor quality responses because they impose mental tasks that challenge or exceed the cognitive capacities of respondents.

The National Laboratory uses intensive interviewing techniques to conduct cognitive interviews (Royston, 1989). These techniques examine the thought processes of laboratory subjects as they answer survey questions. They look for evidence that the subjects are having difficulties in performing any of the mental tasks of answering questions including those of comprehension, estimation and decision-making. In this manner cognitive interviews identify cognitively flawed questions, and determine how and why they are flawed so that they can be appropriately revised. The "concurrent think-aloud interview" is the most frequently used intensive interviewing technique. It encourages subjects to verbalize their thought processes as they answer survey questions.

Cognitive interviews are conducted with volunteer laboratory subjects who are remunerated for their efforts. The subjects are selectively recruited to include those that would most likely be cognitively burdened by the survey questions and least able to cope with the burdens. For example, disabled persons were targeted for recruitment in testing the questions of a disability survey questionnaire. Testing is usually carried out in interviewing waves of 5 to 10 subjects. When questions with cognitive overloads are detected, the reasons for the overloads are examined and the

flawed questions are revised accordingly. The revised questions are then retested iteratively until acceptable questions are designed. In this manner, QDRL has rehabilitated literally hundreds of flawed questions that would not have been detected by traditional field testing procedures and hence would have been asked in our national household surveys.

The following is a favorite example of a cognitively flawed question that was detected and rehabilitated in the National Laboratory.

"During the past 12 months have you been bothered by pain in your abdomen?"

Laboratory subjects initially answered the question readily, either "Yes" or "No". However, it became apparent in cognitive interviews that the subjects were unsure about the location of the abdomen. The problem was resolved by providing subjects with a flash card showing an outline of the torso with the abdominal area shaded in.

### **Questionnaire Design Research Program**

The questionnaire design research program conducts laboratory experiments to test the capacities of people to perform the mental tasks of answering survey questions. It is what Featherman (1991) calls a "mission oriented basic research program." It is mission oriented in the sense that practical concerns about designing better survey questionnaires dictate the choice of topics that are investigated. Nevertheless, it is a basic research program because the experiments are not necessarily intended to yield results that lead to immediate applications for improving questionnaires.

The experiments investigate the capacities of laboratory subjects to perform the kinds of cognitive tasks implied by difficult-to-answer survey questions. They explore how the survey questions should be asked so that they would not exceed the respondents' cognitive capacities. The survey questions tested in these experiments relate to important public health issues for which better quality survey statistics are needed. However, the cognitive tasks posed by survey questions on different health issues often pose very different

kinds of cognitive tasks. Consequently, each laboratory experiment focusses on those specific cognitive tasks that are posed by difficult-to-answer questions on a particular health topic. Some examples are listed below.

estimation strategies in reporting cigarette smoking histories;

cognitive processes in long-term dietary recall;

judgement and recall of pain episodes;

decision factors in responding truthfully to drug-use questions;

autobiographical memory for health care visits.

The basic premise of this research program is that the accumulated findings of the combined experiments will provide a fertile seedbed for making major breakthroughs in designing the next generation of survey questionnaires.

By way of illustration, let me briefly describe an experiment that was conducted by Nathan et al. (1990) on the survey topic of illegal drug-use. The experiment investigated the cognitive factors affecting respondents' decisions to answer sensitive survey questions truthfully. In particular, the experiment investigated the extent to which respondents' decisions to answer truthfully depended on their perceptions of the response disclosure risks and their assessments of the losses in the event of response disclosure.

The experiment, a feasibility study, was designed as follows: Four different survey vignettes were presented to laboratory subjects. The vignettes varied by whether the respondents were portrayed as marijuana or cocaine users and by whether the drug-use questions were administered in a confidential or an anonymous mode. Laboratory subjects served as proxy respondents for the drug user's described in the survey vignettes and provided the following information: (1) likelihood of truthful responses; (2) perception of response disclosure risks and (3) assessment of losses in the event of response disclosure.

## Concluding Remarks

Further development and implementation of the sample design options and questionnaire design technologies described in this paper have high priority at NCHS. Research currently underway, for example, is investigating the design effects of integrating the sample designs of the three remaining independently designed establishment surveys (see figure 1). Also in progress, is work to investigate the feasibility of designing dual frame sample surveys to enhance the quality of subnational health statistics. It involves supplementing the NHIS sample with RDD telephone interviews.

The success of the Center's program for investigating the cognitive aspects of designing survey questionnaires has drawn our attention to the possibility of using similar methods to investigate the cognitive aspects of designing graphs and statistical maps. Preliminary investigations conducted by Beu et al. (1989) have been encouraging.

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Figure 1: Surveys of the National Center for Health Statistics

Population surveys

\*National Health Interview Survey (NHIS)

National Health and Nutrition Examination Survey (NHANES)

\*National Survey of Family Growth (NSFG)

Establishment surveys

National Health Provider Inventory Survey (NHPIS)

\*National Hospital Discharge Survey (NHDS)

National Nursing Home Survey (NNHS)

\*National Ambulatory Medical Care Survey (NAMCS)

National Hospital Ambulatory Medical Care Survey (NHAMCS)

National Home and Hospice Care Survey (NHHCS)

Vital record surveys

National Mortality Follow-back Survey (NMFS)

National Natality Follow-back Survey (NNFS)

National Fetal Death Follow-back Survey (NFDFS)

\*Integrated surveys