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Some Cognitive Aspects of Surveys

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This paper considers the effects on survey responses of the cognitive processes respondents must undertake to comprehend questions, to recall events or opinions from memory, to make judgments about such memories or about the interviewer's intent, and to formulate answers to the questions.

After a brief history of the collaboration between cognitive scientists and survey researchers in Section 1, Section 2 presents some examples of actual survey questions, and discusses the cognitive problems that face respondents. Section 3 gives some flavor of what cognitive psychologists have learned about comprehension, judgment, and recall, and sketches some experiments that attempt to apply these findings to a survey context. The concluding section discusses the relevance of these issues to surveys, sketches some modes of collaboration between survey researchers and cognitive psychologists, and discusses the design of experiments to test the efficacy of innovations in surveys.

Two sorts of examples appear in this paper. One kind comes from large scale sample surveys (frequently agricultural surveys), carefully designed in the statistical sense of sample design and analysis. These present evidence that cognitive issues arise in the asking and answering of survey questions. The other kind of example comes from laboratory or other small scale studies, where the primary design issues faced by the investigators concern developing experimental manipulations that will powerfully operationalize concepts in cognitive psychology. These present evidence about the cognitive processes respondents use and offer clues that can be applied to survey design. Those of us working at the intersection of cognitive psychology and survey research hope that, in time, these clues can be made to coalesce to form a more scientific foundation for the art of asking questions.

1. Some History

One would expect a long history of collaboration between cognitive psychologists and survey statisticians because comprehension, recall, and judgment are processes of interest to both disciplines. Yet, this collaboration is in fact recent. Of course, there have been many studies of question-asking in cognitive psychology and many studies of the effects of different questions in survey research. But the first formal cooperation between cognitive psychologists and survey researchers was in a two-day workshop in 1980 organized by Albert Biderman of the Bureau of Social Science Research and funded by the Bureau

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of Justice Statistics and the Bureau of the Census. This workshop focused on the National Crime Survey. The resulting consensus was that survey researchers and cognitive psychologists had much to learn from each other. Indeed, this was the beginning of "a two-way street." That is, not only could the insights of cognitive psychologists improve survey methodology, but surveys could present research opportunities for cognitive psychologists as well. A good deal of cognitive psychology research is done in academic settings with homogeneous populations and small samples. The use of surveys as an extension of cognitive research laboratories would allow findings to be generalized to more realistic contexts and more heterogeneous populations.

A natural follow-up of this 1980 workshop was the 1983 Advanced Research Seminar on Cognitive Aspects of Survey Methodology, (CASM), organized by the Committee on National Statistics of the National Research Council, and funded by the National Science Foundation. This seminar was much smaller than the 1980 workshop. Cognitive psychologists, survey researchers, statisticians, and agency representatives spent a week learning to talk to each other. The focus of the seminar was on surveys of health, and in particular, on the U.S. National Health Interview Survey. A project at the National Center for Health Statistics to explore the feasibility of setting up a laboratory for designing questionnaires came out of the CASM seminar, as did many other projects, many of which are ongoing (see Jabine et al. (1984)).

To follow up the CASM seminar, the Social Science Research Council organized a Committee on Cognition and Survey Research that promotes the cooperation between cognitive psychologists and survey researchers. This cooperation is still in its early stages and has raised more questions than it has answered. (See, e.g. Fienberg et al. (1985a, 1985b, 1985c); Lessler and Sirken (1985); Loftus et al. (1985)).

Let us turn now to examine the kinds of survey questions we have been asking respondents and consider the cognitive puzzles we have been setting them.

2. Examples of Survey Questions

In the 1977–78 National Food Consumption Survey, the U.S. Department of Agriculture (USDA) asked respondents the following question:

> Now I have some questions about the meals household members ate. We will be talking about all the meals from a week ago today after the morning meal to today including the morning meal. Let's begin with you. How many morning, noon, and evening meals did you have from your household food supplies, including any meals you may have carried from the household supplies to eat away from home?

Before reading further the reader is urged to try to answer that question and to take note of the thought processes involved in answering.

In what order did you recall? Did you start with the first thing you ate at the beginning of the week and carry through until now? Or did you think about your most recent meal today and work backwards from that to the first thing you ate in the week? What did you think the question meant by a meal? Did you have to be sitting at the table or did a stand-up sandwich count? Did you include between-meal snacks? When does a snack become a meal? Did you think of the company you were in at mealtimes or other times and thus decide if you were at home or not? Did you actually think about this week and trace your paths in some way through the week or did you judge what you do on a typical week? A late breakfast on the weekends, perhaps; skipping lunch, perhaps; dining out, perhaps?

These are complicated questions. Yet they reflect issues relevant to how people answer

survey questions and they are also issues that can be addressed by cognitive psychology. Note that in the National Food Consumption Survey, the questions listed above specified the day on which counting was to begin, thus making the respondent's recall task somewhat easier. Later questions asked about meals bought away from home or eaten as guests. Many of the techniques one would naturally use to recall one's meals were actually suggested by the interview procedure. The same questionnaire also asked for several specific kinds of foods, as illustrated by the following questions about meats.

> In the past 7 days did your household use any beef, pork, veal, or lamb? If the household respondent answers "yes," the next question is "Did you use any beef steak?" If the answer is "yes," then the respondent is asked "What type of beef steak did you use?" "In what form was the beef steak when you first brought it into the kitchen during the last 7 days, was it home frozen, commercially frozen, home canned, commercially canned, fresh (raw), breaded, already cooked, or other?" Then "Was that with or without a bone?" and "In the past 7 days *altogether* how many pounds and ounces did you use?" "Did you buy the beef steak, home produce it, or receive it as a gift or payment?" and so on.

Respondents are again aided in the task of recall, but at the cost of a tedious questioning procedure.

Let us look at a few more questions from USDA surveys. The purpose of displaying these questions is not to criticize the surveys but to point out that such questions require respondents to use the cognitive processes of comprehension, recall, and judgment and any survey can profit by taking into account how people carry out these processes.

Consider the Weekly Weather and Crop Report. Among other things, it asks respondents to supply percentages in a table (similar to Table 1) for each crop according to its degree of maturation.

In this survey, respondents are also asked to judge the conditions of vegetable crops on a scale that ranges from poor, through fair and good, to excellent. Respondents are asked to estimate the percentage of crops harvested for several sorts of crops and to evaluate fruit set compared to average on a scale of: below average, average, and above average. (Note that two judgments are required for this last question – what is average and how this year compares to average.) In the Farm Cost and Return Survey, judgment is also needed to make estimates. For example, the respondent was asked:

> "For all land and buildings owned (include dwellings on the farm), list the number of acres and the market value on January 1, 1986."

One would expect that a farmer would know the number of acres (see Fleischer et al. (1958)), but a farmer might have considerable

Table 1. Reporting form from the USDA Weekly Weather and Crop Report

Weekly Weather and Crop Report				
Fruit by stages	Green tip or earlier %	Half-inch green to pink %	Full bloom %	Petal fall %
Apples				
Peaches				
Pears				

trouble estimating the January 1, 1986 market value. Unless the farm changed hands just then, the farmer would have to use some heuristic to find an approximate figure. The Interviewers' Manual says to use the best estimate, whereas the cognitive psychologist asks how the farmer goes about making that estimate.

> Another question on the Farm Cost and Return Survey asks: "How many hours did you, the operator, work on this farm in 1985?"

How does one figure that out? Does one simply take a 40-hour week, multiply it by 52, subtract 2 weeks for vacation, and come up with a number? Does one think about how many hours one works in a typical week and multiply that by 52? Does one calculate figures for different seasons separately? Again, we do not understand exactly how such estimates are made, but we do know that there are cognitive processes going on as respondents make those estimates.

In the Agricultural Labor Survey, respondents are asked: "List the self-employed workers, operators, partner or partners, and the total hours worked on this or any other farming or managing operation during the week of April 6 – 12." (The survey is carried out during the following week.) This, unlike the previous question, deals with a reference week. If we assume that a self-employed worker does not punch a time clock and does not tell anyone else the hours that he or she works, then some kind of judgment has to be used to make the estimate. The same survey asks respondents to fill in a chart similar to the one shown in Table 2 (a good definition is given for the work code). For workers who work at an hourly wage, answering this question is probably a simple record look-up task for the farm operator. Such an operator has to keep records of total hours worked for payroll purposes. But what happens when the same question is asked for workers who work at a piece rate (people whose wages are based on unit production by the box, by the crate, by the bushel, by the acre, etc.)? Now total hours worked is not something that is naturally a part of the operator's records and the operator will have to make some kind of judgment or calculation to arrive at the hours worked.

Surely, being a respondent can be a significant cognitive chore. Let us next see some of what cognitive psychologists know about how people go about carrying out such cognitive tasks.

3. The Cognitive Issues

In this section the three areas of cognition, comprehension, recall, and judgment, are discussed separately. One must bear in mind, however, that these areas overlap. For example, as already seen in the questions, judgment can aid or mislead recall.

3.1. Comprehension

The central question in comprehension is whether the respondent and the interviewer ascribe the same meaning to the words and concepts they use. One can look at this issue in a kind of local sense or in a kind of broader sense of "meaning." Local meanings are often

Table 2. From USDA Agricultural Labor Survey

Type of worker	Work code	Number of workers	Total hours worked	Total gross wages

handled by definitions, and many surveys are careful to define terms so that the interviewer and respondent communicate with the same language (meanings). But research by Kalton and Schuman (1980), for example, shows that sometimes these carefully thought out definitions are ignored by respondents. Vogel, for example, (1974) found that when trying to get an inventory of cattle with a large national survey, a question that asked the respondent to list "heifer, steer, and bull calves, weighting less than 500 pounds" gave 10% lower estimates than a question phrased "calves: heifer, steer, and bull calves weighting less than 500 pounds." The difference seems to be that the second form forces respondents to focus on a larger category of calves and therefore counts unweaned calves as well as weaned ones (contrary to a farmer's usual thinking practice that conceptualizes an unweaned calf as a single unit with its mother). So even when definitions are used, it is hard to be sure that local meanings are the same thing across respondents or between respondent and interviewer.

Question wording can make an enormous difference – perhaps because wording gives respondents some idea of what the interviewer really wants to know. A good example was offered by Herbert Clark, a member of the SSRC committee, and his collaborators (Clark et al. (1983)). Subjects were presented with a photo showing President Ronald Reagan (whose name and appearance are known to almost all Americans) and the then Budget Director David Stockman (who was not as well-known as President Reagan) together. Half the respondents were asked question 1: "You know who this man is, don't you?" The other half were asked question 2: "Do you have any idea at all who this man is?" The subjects were free to answer whatever they chose – the responses of 15 people to each question are shown in Table 3. To question 1 subjects had a strong tendency to answer about the more familiar figure, President Reagan. However, the question: "Do you have any idea at all who this man is?" inspired some people to respond about Stockman and many others to be confused about which person was meant. Question 1 seems to assume that the subject will know who the man is, and that assumption seems to lead the respondent to think the interviewer is asking about Reagan. Question 2 seems to doubt whether the subject knows who the man pictured is, and that leads the respondent to believe the interviewer means Stockman, or to be unclear who is meant.

When we move away from local meanings and consider broad meanings, we may consider what cognitive psychologists call schemas, which are simply organized cognitive structures. Knowledge does not seem to be stored as isolated facts, but rather as related constructs. We know that the context surrounding a question and its wording influence which schema the respondent might choose when trying to answer the question.

Choosing a schema again probably helps the respondent decide what the interviewer really wants to know. A classic example concerns attitudes towards the poor. One could

Table 3. Responses to questions 1 and 2 by 15 respondents each

	Question 1	Question 2
Identifies Reagan	12	0
Asks for more information	0	11
Identifies Stockman	0	3
Identifies both	0	1

Source: Clark et al. 1983.

precede the attitude questions with several others that would evoke in the respondent a schema of welfare recipients as the old, the truly needy, those who deserve help. On the other hand, one could ask introductory questions that evoke a schema associated with "welfare cheats and chiselers."

Another classic example concerns question wording. What is called the "forbid/allow" mystery has a long history in survey research. In reference to several different objects, the question has been asked for years in two different ways: "Do you think the United States should forbid ...?" and "Do you think the United States should allow ...?" Let us consider public speeches against democracy as an example. Those who say "yes," the United States should forbid, should, in a grammatical sense, be saying the same as those who would say "no" the United States should not allow. Thus one would naively expect the same percentages of respondents to say "yes" to the forbid question as say "no" to the allow question. But Table 4 shows that over the years in large scale national surveys there is a constant difference of over 20 percentage points between those who say "no" it should not be allowed versus "yes" it should be forbidden. Fewer people are willing to forbid than are willing to not allow. "Forbidding" may evoke a schema related to totalitarianism that is hard to endorse, but "not allowing" is gentler and perhaps easier to endorse. These effects are studied in the book by Schuman and Presser (1981).

3.2. *Judgment*

The "attitude" examples above addressed comprehension, but judgment is involved as well. The respondent may well be asking: "What does the interviewer want to know and therefore how should I judge this?" Estimates of factual material are also influenced by these kinds of judgments about what the interviewer wants to find out. Consider the following two examples. In a laboratory experiment, Harris (1973) asked some subjects "How tall was the basketball player?" and asked others, "How short was the basketball player?" The average of the heights given in response to the first question was 79 inches, to the second, 69 inches. The estimates differ by 10 inches. One can speculate that this happens because basketball players tend to be tall and "How tall was the basketball player?" is the common formulation for this question. "How short was the basketball player?" seems to signal that the basketball player was particularly short. The results are consistent with that interpretation. In another laboratory example (Loftus (1975)), subjects who were asked, "Do you get headaches occasionally, and if so, how many times per week?" had, on average, 0.7 headaches per week, while those asked "Do you get headaches frequently, and if so, how many times per week?" had, on average, 2.2 headaches per week. We know that wording effects occur in some surveys, but not in others. Cognitive psychologists have a natural role in the development of a theory that ex-

Table 4. Response to "Do you think the United States should forbid/allow public speeches against democracy?"

	1940	1974	Feb. 1976	Spring 1976
Forbid (% Yes)	54	28	20	21
Allow (% No)	75	44	45	48

Source: Schuman and Presser (1981).

plains the occurrence as well as the nonoccurrence of these effects.

Let us focus further on judgments and the circumstances in which respondents should feel confident about their judgments. Common sense suggests that respondents should be more sure about judgments about the past than about judgments about the future, and more sure about judgments about themselves than judgments about others. Recent research by Ross (1984) asked people to estimate: the number of checks written, the amount of money spent in restaurants, the amount of time spent watching TV, and the number of long distance telephone calls made over a 30-day period (either the past 30 days or the upcoming 30 days and either for themselves or for their roommates). Subjects were also asked to give a 50% "confidence interval," a number below which they would expect only a 25% chance of being wrong, and the number above which they would expect a 25% chance of being wrong. The results appear in Table 5.

Table 5. Relative widths of 50% confidence intervals for judgments

	Past	Future
Self (25 subjects)	100	131
Roommate (25 subjects)	111	124

Source: Ross (1984).

If we take the estimates of the past for oneself as a standard, there is very little difference between the length of the confidence interval for these judgments that we think people should be most certain of and the confidence intervals that are generated for one's roommate's actions rather than one's own actions and little difference between estimates of accuracy for the past and for the future.

While the results follow our common sense expectations, the differences are smaller than expected. The difference that one would expect to be the largest in the table (between oneself for the past and others for the future) is not the largest at all. So there are mysteries about how people make judgments and calculate their confidence about judgments that survey researchers hope to get some help from cognitive psychologists in unraveling.

3.3. *Recall*

We know from cognitive psychology that human memory does not store items as a computer file or a book does. Remembering is a constructive process. When one retrieves from one's memory, what one retrieves is influenced by later events, by question forms, and so forth. But let us focus on questions that are often asked in surveys, questions that ask us not so much to describe an event as to tell the number of events of a particular kind that happened during a time period (usually called the reference period). We know that there are two processes going on when respondents are asked to recall things that happened during a reference period and these two processes tend to work in opposite directions. There is forgetting to mention things and there is telescoping. (Telescoping is usually taken to mean that events that happened *before* the reference period are telescoped into happening in the reference period.) Thus, if a respondent is asked if he/she ate certain foods within the last week, he/she may report foods eaten two weeks ago thinking that he/she is reporting food eaten this week. There is a long history of research on these issues (e.g., Sudman and

Bradburn (1973)). There is a trade-off: the longer the reference period, the more likely it is that there will be forgetting; the shorter the reference period, the more likely that there will be telescoping into it. One would think that there is some kind of an optimum reference period that would balance off these two effects and indeed there has been some exploration about the appropriate length of a reference period in order to balance these off. In panel studies, bounded interviews are done to control telescoping. In these, a respondent is told what he or she had reported up till the time of the previous interview and then asked if he or she has anything to report since the previous interview. The effects of telescoping are explored in research by Swinehart and Crespi (1982). They asked subjects to tell them if they had done some of a variety of health-related activities during the last two months. (Let us focus on the health-related activity of cutting down on butter, eggs, meat, and milk.) Swinehart and Crespi asked half the subjects whether they had reduced their consumption of these products during the last two months. The other half was asked if they had cut down within the last six months and *then* if they had cut down within the last two months. When the two-month question was asked alone, 29% answered "yes," when the two-month question followed the six-month question only 18% answered "yes." From these results, we can infer that about 11% of the people asked the two month question telescoped some of their earlier activities into the more recent period.

How can cognitive psychology help survey researchers to understand and avoid problems like telescoping? One suggestion is landmarking. Respondents often spontaneously use personal landmarks when trying to recall an activity or event. "Has this happened since my birthday? Since I took my vacation?" This kind of landmarking increases accuracy of reporting by reducing forward telescoping. The work of Loftus and Marburger (1983) suggests that the introduction of landmarks by interviewers also helps reduce this kind of telescoping. These researchers worked with two kinds of public landmarks, one an unusual one-time event, the eruption of Mount St. Helens (they were working in the vicinity at the University of Washington in Seattle), and the other a regularly recurring public landmark such as New Year's Day. They found that telescoping was controlled by both kinds of landmarks.

Another device that is being studied to improve accuracy of reporting by improving accuracy of recall is order of retrieval. If one is retrieving a number of events from one's memory, what is the natural order of retrieval? What order is more efficient? Does the efficiency vary with the kind of information? In psychology there is a long tradition of laboratory studies using word lists for memorization and recall. The results of these list memorization tests have shown two kinds of effects – recency effects and primacy effects. Recency effects are seen when the last items learned on a list are remembered better and primacy effects are seen when the first items learned on a list are remembered better. Both things happen. Current research shows that subjects generally recall material from lists on a first-in-first-out basis, recalling the earliest words in the list first. When instructions are given to retrieve either in the forward direction (first-in-first-out) or backwards (last-in-last-out), no major differences in efficiency of recall seem to occur.

We can now ask if these findings for list memorization are transferable to the retrieval of autobiographical memories. If they are transferable, do the findings carry over to the field situations in which surveys are conducted? Loftus and her colleagues (Fathi, Schooler, and Loftus (1984)) studied deposits to cafeteria accounts and visits to health care providers and discovered that these actions, at least, tend to be recalled in a forward direction, that

is, the event that occurred earliest in time is recalled first. In another study (Loftus and Fathi (1985)), subjects were asked to recall examination dates and given instructions either to recall in the forward direction or to recall in the backward direction or were given no recall instructions at all. It was found that those recalling in the forward direction erred on the average by two days while those given the backward recall instructions erred on the average by only one day. Most of the free-recall subjects recalled backward. This finding is different from the finding about cafeteria accounts and health care visits where recall tended to be forward. Accuracy was also better in the backward direction for content of the exams. For those who were instructed to recall backward, 62% of the items were recalled correctly but only 46% were recalled correctly by those instructed to recall forward.

What is the difference between the health care visits and deposits to cafeteria accounts on the one hand and examinations on the other? Exams are in some sense independent and therefore the most recent may be easiest to recall, while deposits to cafeteria accounts and especially health care visits are in some sense dependent. For example, "I didn't feel well, so I went to see the doctor, and he referred me to a radiologist, who sent me back to my doctor, and then I had to go back to my doctor for a follow-up visit." That is, perhaps respondents tell themselves stories about these dependent events that facilitate retrieval and increase accuracy.

Are these hints for how surveys can be designed to make recall easier and more accurate? That is the broad question that is being explored in the intersection of cognitive psychology and survey research. In particular, it is being explored in the field test of the National Health Interview Survey where an experimental version of the questionnaire asks people to recall health care visits and randomly asks some to recall in a forward direction and randomly asks others to recall in a backwards fashion and will eventually see which way seems to be more efficient in a field setting. This research will generalize the results coming from the cognitive psychology laboratory, an outcome of the two-way street that will benefit both cognitive psychology and survey research.

4. Conclusion

Some argue that consideration of these cognitive aspects is only relevant for single-purpose, one-time surveys. They argue that since continuing surveys focus on changes over time, the biases induced by respondents' cognitive processes difference out. Besides, experimentation with question wording or anything else in the survey design is pernicious because it confounds the artifactual changes introduced by the experiment with real-world changes.

The first argument fails to take into account that cognitive processes differ – probably not randomly – across individuals (and perhaps across time within individuals). Hence we should not expect that survey measures of change over time will be free of the effects of cognitive processes.

The second argument seems a counsel of despair, eschewing improvement for the sake of (a possibly misleading) stability. Surely when an ongoing survey is changed, a period of overlap should be scheduled in order to provide calibration, but equally surely we should judiciously make needed improvements in surveys.

How can survey researchers and cognitive psychologists collaborate? One model is the cognitive laboratory established at the National Center for Health Statistics (Lessler and Sirken (1985)). Here small-scale pretesting of questionnaires, using such methodology of a cognitive laboratory as think-aloud protocols

and analyses of video-tapes, parallels and supplements the usual field pretesting. Another model takes cognitive psychological findings or principles, applies them to questionnaire design, and performs a formal field experiment to test their generalizability.

It is during the field testing that the experimental design principles of statistics are crucial. Thoughtful use of the survey structure (e.g., interpenetrating networks of samples, using interviewers as blocks) can enhance the power and precision of experiments embedded in surveys (see Fienberg and Tanur (in press)).

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