

Cognitive interviewing: verbal data in the design and pretesting of questionnaires

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Purpose. The purpose of this paper is to discuss problems that occur in questionnaire responses and how cognitive interviewing can be used to identify problematic questions prior to using the questionnaire in the field.

Background. Questionnaire design involves developing wording that is clear, unambiguous and permits respondents successfully to answer the question that is asked. However, a number of problems in relation to respondents' understanding and successfully completing questionnaires have been identified. Cognitive interviewing, an amalgamation of cognitive psychology and survey methodology, has been developed to identify problematic questions that may elicit response error. The overall aim is to use cognitive theory to understand how respondents perceive and interpret questions and to identify potential problems that may arise in prospective survey questionnaires. **Methods.** A literature review is used to examine the process of questionnaire design and how cognitive interviewing can be used to reduce sampling error and increase questionnaire response rates.

Findings. Cognitive interviewing involves interviewers asking survey respondents to think out loud as they go through a survey questionnaire and tell them everything they are thinking. This allows understanding of the questionnaire from the respondents' perspective rather than that of the researchers. Cognitive interviews have been used in a number of areas in health care research to pretest and validate questionnaires and to ensure high response rates. Interviewing has been found to be highly effective in developing questionnaires for age specific groups (children and adolescents) and in ascertaining respondents' understanding in health surveys prior to distribution. However, cognitive interviews have been criticized for being overly subjective and artificial.

Conclusion: Cognitive interviews are a positive addition to current methods of pretesting questionnaires prior to distribution to the sample. They are most valuable in pretesting questions that are complex, where questions are sensitive and intrusive and for specific groups for whom questionnaire completion may pose particular difficulties.

Keywords: cognitive psychology, cognitive interviewing, questionnaire design, question wording, survey research, questionnaire pretesting

Introduction

Nonresponse or noncompletion of questionnaires is a major problem in survey research, leading to the collection of

incomplete data, and this may affect the generalizability of the findings. Questionnaire completion may fail for a number of reasons, including participant nonresponse, irrelevance of questions or questionnaires to respondents, inability of

What is already known about this topic

- Non-response or non-completion of questionnaires is a major problem in survey research leading to the collection of incomplete data.
- Likely problems with questionnaire response need to be identified prior to the distribution of questionnaires to the chosen sample.
- Cognitive interviewing, an amalgamation of cognitive psychology and survey research methodology, is a method that can be used to reduce non-completion and non-response of survey questions and questionnaires.

What this paper adds

- Cognitive interviewing was found to allow researchers to understand survey questionnaires from the respondents' perspectives rather than that of the researcher's.
- Cognitive interviews are of most worth when used in association with other reliability and validity measures.
- Researchers should consider cognitive interviewing when developing survey questionnaires to investigate new or poorly described health concepts, for researching and translating questionnaires for culturally diverse groups and when developing questionnaires for samples where questionnaire completion may pose particular problems.

respondents to complete questions involving memory, the use of intrusive or sensitive questions about income or health history, or complex questionnaire design issues including length and skip-patterns (Tourangeau 1984, Conrad & Blair 1996, Dillman 2000). A number of methods have been identified in the literature to pretest questionnaires prior to their distribution, the aim being to ensure high response rates from a sample of the target population. These include focus groups, content validity, alternate forms comparison, pilot studies and, recently, cognitive interviewing (Goldenberg 1996, Dillman 2000). Cognitive interviewing, which has been developed using theories of cognitive psychology, can be used as a part of a multistage approach to questionnaire design. It is particularly useful when there is uncertainty on how respondents will answer questionnaires or doubt about their understanding of the wording of questions.

In this paper, I will first discuss problems that may occur in questionnaire response and the application of cognitive interviewing as a qualitative approach to the pretesting of questionnaires. This will be followed by reviewing the literature on the use of cognitive interviews in health care

research. Finally, the literature on evaluation of cognitive interviewing as a method of pretesting questionnaires will be examined.

Problems with questionnaire design

Questionnaire design involves developing wording that is clear, unambiguous and permits respondents successfully to answer the question asked (Conrad *et al.* 1999, Dillman 2000). However, a number of problems in relation to understanding and successfully completing questionnaires have been identified.

These problems generally include respondents' difficulty with interpretation and comprehension of questions, retrieval of answers (the mental processes that respondents use to arrive at the information needed) and judgement and social desirability in relation to how much information the respondent is comfortable in disclosing (Tourangeau 1984, Jobe & Mingay 1989, Schechter *et al.* 1994, Conrad & Blair 1996, Goldbloom *et al.* 1999, Pasick *et al.* 2001). These problems may result in respondents not following an instruction, missing a skip pattern (asking respondents to move to another question if the current question does not apply to them), providing obvious incorrect answers and failing to answer questions.

Conrad and Blair (1996) have developed a classification of possible response problems that may occur with questionnaire completion, and this has five categories: lexical problems, inclusion/exclusion problems, temporal problems, logical problems and computational problems.

Lexical problems are associated with respondents' understanding of the meaning and use of words and the context in which they are used on the questionnaire. Words that are familiar to one group may not be to another or they may have a different meaning. For example, Conrad and Blair (1996) demonstrate the use of the term 'spatial abilities' on a questionnaire. A question may be posed to a patient: 'Since your stroke to what degree have your spatial abilities been affected?' The term 'spatial abilities' may well be understood by health care professionals but may cause a patient difficulties in understanding its meaning. The context of the question may also create lexical problems. For example, when developing a questionnaire to survey mobility amongst patients, a respondent may be asked about the number of 'rooms' in their home. This may lead to a lexical misunderstanding of what constitutes a 'room'. For example, does it include hallways, bathrooms or landings? Other words that may lead to lexical misunderstanding include 'income' (gross or net?), 'regularly' (Do you regularly check your blood sugars?) and 'fast' (speed or the withholding of food?).

Lexical problems tend to occur because of the researcher overestimating the understanding and vocabulary of respondents, especially in questionnaires that involve nursing/medical terminology (Dillman 2000).

The second problem class identified is inclusion/exclusion problems that deal with determination of the scope of the question. This mainly relates to categories in a question (Conrad & Blair 1996). For example, if a respondent is asked a question about 'nurses', they may interpret this as public health nurses, hospital nurses or home helps whom they view as providing 'nursing' care, when the question intended 'nurses' to include Registered Nurses working in a hospital setting. This can lead to problems with respondents supplying multiple or incorrect responses when only one specific response is required.

Temporal problems in questionnaires relate to time, both in relation to time periods and time spent on activities. Examples of temporal problems include the phrase 'in the last year', which can have a number of meanings including the 'last calendar year' or 'the last 12 months', or when response options such as 'all of the time' and 'some of the time' are offered. This may leave respondents confused about selecting an appropriate option when in fact a precise option may be more suitable (Conrad & Blair 1996, Drennan 2001).

Logical problems are associated with respondent difficulties in relation to words that connect concepts such as 'and' or 'other than', and the use of presuppositions in questions. Connecting words may lead to respondents attempting to answer more than one question at a time. Presuppositions relate to the relevance of the question to the respondent and whether they can answer the question or not. Nonresponse may occur because the respondent is simply unable to supply information requested on the questionnaire (Conrad & Blair 1996, Dillman 2000).

Finally, computational problems include those that do not fall into any other category. Examples include long-term memory recall, questions with complicated structure and those involving mental calculation. Dillman (2000) gives an example when asking, 'How many books you have read for leisure in the past year?' Respondents may be unable to identify a precise number and this may result in high nonresponse to that item. Time referent questions are an example of those that require mental calculation. Asking respondents to calculate how many times they received a visit from a health visitor or public health nurse over a 3-year period may be impossible, again resulting in nonresponse error.

Problems with questionnaire response are multifactorial and need to be identified prior to the distribution of questionnaires to the sample. To identify the variety of problems that may occur, cognitive interviews can be used as part of a multistage approach to pretesting. They also allow

the response process to questionnaires to be viewed from the perspective of the respondent rather than the researcher, with the primary goal of reducing question nonresponse (Blair & Presser 1993, Goldenberg 1996).

Cognitive interviewing

Cognitive interviewing (also known as verbal protocols and think-aloud interviewing) is an amalgamation of cognitive psychology and survey methodology in the identification of questions that may elicit response error. The overall aim is to use cognitive theory to understand how respondents perceive and interpret questions, and to identify potential problems that may arise in prospective survey questionnaires (Gerber & Wellens 1996). The process involves analysis of respondents' verbal reports during the pretesting phase of questionnaires prior to distribution and use in the main data collection stage (Conrad *et al.* 1999, Dillman 2000).

Cognitive interviewing uses cognitive theory to understand human information processing, which includes attention span, word recognition, action, memory, language processing, problem-solving and reasoning, as well as the exploration of how knowledge is organized in memory and how memory is retrieved in relation to completing questionnaires. An understanding of this information processing will enable researchers gain a deeper understanding of the response process respondents go through when answering questionnaires (Haberlandt 1997). A number of models of response process have suggested that respondents must comprehend a question, perform mental processing in determining whether and how to find the answer, and produce a response that incorporates some element of judgement as to what the respondent wants to reveal and what the question was seeking (Tourangeau 1984, Conrad & Blair 1996, Willis *et al.* 1999).

Process of cognitive interviewing

The fundamental procedure of carrying out cognitive interviews is through semi-structured, in-depth interviews, the purpose of which is to identify overall problems with questionnaires (Conrad & Blair 1996). The process involves an interviewer asking a survey respondent to think out loud as they go through a questionnaire and tell them everything they are thinking, with the interviewer asking probing questions of the respondent to find out their thoughts (Dillman 2000). The interview process is usually carried out in a controlled 'laboratory' setting with subjects who match the characteristics of the proposed sample. However, interviews can also be held in the environment where the proposed survey is to be administered.

There are two main types of interview: concurrent and retrospective. Concurrent involves the respondent giving a verbal account of their thinking. Retrospective involves a response after the respondent answers a draft questionnaire. Problems with prospective questions can be identified through cognitive interviews and then re-worded prior to use in the main survey. Taylor (2000) highlights the fact that while retrospective reporting may be considered of less benefit than concurrent reporting due to its reliance on long-term memory, it can still elicit valid information about the thought processes used by respondents.

Methods used in cognitive interviewing include probing (concurrent and retrospective), observation of the respondent's behaviour (concurrent), and think-aloud/read-aloud as the respondent completes the questionnaire (concurrent) (Schechter *et al.* 1994). These methods may be used in combination during the interview process.

The first method, probing, consists of requesting respondents to paraphrase questions, asking them to define meanings of words used in questions, explain their responses and identify areas of the questionnaire that pose difficulty in understanding, interpretation or completion (Goldenberg 1996, Czaja 1998, Willis *et al.* 1999). The overall aim is to elicit respondents' understanding of a question. For example, the researcher may probe with the following statements: 'Can you repeat the question in your own words?' or 'Do you recall how "long-lasting medical conditions" was defined?' (Schechter *et al.* 1994, Conrad *et al.* 1999, Willis *et al.* 1999). The types of probes reported vary, and include either prescribed pretest or unscripted probes (Conrad *et al.* 1999). Prescribed probes are a selection of probes used in predetermined situations during the interview. For example, they are used when the respondent expresses certain types of verbal behaviour such as hesitation or frequently using 'um' and 'ah' or changing answers. Unscripted probes are used at the discretion of the researcher and spontaneously throughout the course of the interview. They are effective in that they allow the interviewer to explore unexpected responses (Conrad & Blair 1996, Conrad *et al.* 1999, Willis *et al.* 1999).

Secondly, observations of respondents' behaviour during the cognitive interview can be used. Observations that would be of interest include respondents skipping questions, flipping a page back and forth when answering a question, putting answers in the wrong place on the form, or changes in appearance (e.g. frowning, hesitation). Respondents can then be directly questioned on the difficulties they are experiencing with the questionnaire.

Finally, think-aloud protocols allow the researcher to gain insight into the cognitive processes used when completing a questionnaire by encouraging respondents to verbalize their

thoughts. Verbalization is viewed as representation of the respondent's memory, language, comprehension and problem-solving processes and is a central element to the overall interview process (Czaja 1998, Taylor 2000, Schuwirth *et al.* 2001).

Cognitive interviewing in health care research

Cognitive interviewing has been used in a number of areas in health care research, including an investigation of adolescents' perceptions of their life chances (Zuckerberg & Hess 1996), validation of a questionnaire surveying patients with gastro-oesophageal disease (Shaw *et al.* 1998, 2001a, 2001b), measuring the public's knowledge, attitudes and beliefs about asthma and its management (Grant *et al.* 1999), examining the thought processes of GPs and medical students in patient assessment (Schuwirth *et al.* 2001), Medicare recipients' understanding of health plan surveys (Goldstein & Fyock 2001), development of a questionnaire to measure work limitations because of chronic health problems (Lerner *et al.* 2001), development of culturally appropriate health surveys (Pasick *et al.* 2001), and school children's reports of their health (Rebok *et al.* 2001).

Shaw *et al.* (1998, 2001a, 2001b) used cognitive interviewing in association with multitrait scaling analysis (factor analysis, item validity and reliability) to develop a discriminative digestive health status instrument (DHSI). The aim was to develop a questionnaire that would accurately reflect and describe the breadth of symptoms experienced by patients suffering from abdominal pain and heartburn. The process of pretesting the questionnaire consisted of extensive cognitive interviews with patients and primary care physicians about how well they understood the questionnaire and to identify problems that might have arisen with the interpretation of wording. Respondents were also asked to comment on whether the items adequately reflected the breadth of their symptoms.

Similarly Grant *et al.* (1999) developed a valid and easy to use a 32-item survey instrument to collect information on the general public's knowledge, attitudes and beliefs about asthma and its management. Content validity of the instrument was determined through cognitive interviews. To ascertain the level of understanding of items, a convenience sample of 83 individuals was interviewed. The process involved asking them to complete a self-administered instrument in which they were asked to highlight and comment upon unclear or confusing items in the questionnaire. They were also asked to discuss what each item meant to ensure that it was being read as intended. The outcome of the cognitive interview, used in association with other pretests, was the development of a valid and relevant survey instrument.

Cognitive interviewing has also been used with age-specific groups, such as children and adolescents, to ascertain their understanding of the meaning of questions prior to general distribution of a questionnaire, the aim being to ensure the age appropriateness of the questions used (Zuckerberg & Hess 1996, Goldbloom *et al.* 1999).

Children and adolescents may perceive words differently than adults, leading to misunderstandings in respect to questionnaires designed by adults. Zuckerberg and Hess (1996) used cognitive interviewing to investigate the response of adolescents about experiences with parent-child conflict and their exposure to violence. The purpose of the cognitive interviews was to test a number of sensitive questions that might have been difficult to complete and the age-appropriateness of the questions prior to general distribution of the questionnaire. Interviews were carried out with 20 adolescents of various ages using concurrent think-aloud protocols, structured probing and vignettes. Findings indicated that adolescents were able to handle the cognitive process, which included reading and thinking-aloud, and responding to both general and structured probes as they completed the questionnaire. Overall, they were able to provide valuable information to questionnaire designers. The main problems that they experienced were following skip patterns, time reference periods and the definitions and use of words such as 'conflict'.

Recently, cognitive interviewing has been used in the development of culturally appropriate health surveys, reflecting awareness that generic cross-cultural items may be problematic. Pasick *et al.* (2001) argue that the increase in research into the health needs and attitudes in ethnic groups has not been matched by awareness or examination of differences in culture. Problems identified that may arise are the suitability of questions and meaning of translated items to respondents from an different ethnic group.

Pasick *et al.* (2001) examined survey questions used to evaluate strategies to increase breast and cervical cancer screening in different ethnic communities in San Francisco. The aim was to explore the causes of problematic questions in multiethnic surveys and to identify questions that worked well. As in other studies, both quantitative and qualitative techniques, including baseline surveys, focus group, test-retest, alternative forms interviews and cognitive interviews in the form of think-aloud protocols, were used. Cognitive interviewing identified problematic questions as those that involved recall and interpretation, consisted of complex operational concepts, and asked about preventive behaviours and attitudes and beliefs. An example of the difficulties revealed was the meaning of a 'routine health check-up' to Chinese and Vietnamese immigrants. Chinese immigrants reported difficulty in understanding why someone would visit

a doctor when not ill, and Vietnamese respondents did not identify with the concepts of 'routine' and 'check-up'. Questions that worked well were those that had clearly defined concepts (for example, 'mammogram') and those that requested facts in clear and unambiguous language. Pasick *et al.* (2001) concluded that cognitive interviewing could develop deep cultural understanding of the relevance and comprehension of ethnic group health surveys.

Overall, cognitive interviewing has been found to be successful when investigating new or poorly described concepts, developing questionnaires for groups that have particular needs and perceptions, and researching and translating questionnaires for culturally diverse groups. In particular, words or phrases that involve medical terminology that may cause respondents problems can be identified prior to the distribution of questionnaires, leading to a reduction in item response error.

Evaluation of cognitive interviewing

The process and analysis of cognitive interviews have been criticized because of their artificiality and subjectiveness. The fact that they are not grounded in theory and variability in the process of interviewing and analysis of data are considerations that need to be taken into account prior to undertaking interviews (Conrad & Blair 1996). Cognitive interviewing has been evaluated in the literature in three main areas: thinking-aloud during an interview, the artificiality of the process, and analysis of the data.

Thinking aloud during an interview

Think-aloud protocols, which are central to the cognitive interview process, have been found to be problematic for a number of reasons. Respondents may not be able to articulate their thought processes as they complete the questionnaire, and there is the probability of individual embarrassment when they do not understand questions posed (Pasick *et al.* 2001). Thinking aloud also may affect respondents' thought processes, leading to an assumption that there are problems with the questionnaire when in fact there are none (Ericsson & Simon 1993, Conrad *et al.* 1999). However, Ericsson and Simon (1993) argue that individuals can perform the task in relation to the questionnaire whether or not they are thinking out loud. Thinking aloud slows down the task of questionnaire completion but does not necessarily change it (Conrad *et al.* 1999).

Artificiality

Cognitive interviewing has been criticized in relation to the false environment and 'cognitive load' it adds to respondents who normally would not think-aloud, be probed or observed

when completing questionnaires (Schechter *et al.* 1994, Dillman 2000). Generally, interviews are completed with a researcher present, regardless of how questionnaires will be answered in the field. The presence of a researcher creates a distraction, resulting in artificiality of the overall process (Schechter *et al.* 1994, Willis *et al.* 1999). There is also the chance of a 'Hawthorne effect', with the respondent reading the questions more thoroughly than if the interviewer was not present. However, retrospective interviewing can reduce the artificiality of concurrent interviews by probing the respondent after they have completed the questionnaire (Willis *et al.* 1999, Dillman 2000). This allows insights to be gained without the undue influence of the researcher during the process of completing the questionnaire. On the other hand, in some situations the researcher remains in the room silently observing the respondent's actions, which can compound the artificiality of the process.

Analysis of interviews

The data collected from the interview are analysed for problems in respondents' verbal reports. These reports are primarily qualitative in nature. However, analysis of interviews has been highlighted as being subjective, and based to some extent on the researcher's own analysis and impressions. The lack of a framework to analyse and interpret the interviews is viewed as the main issue in the validity of the data collected (Conrad *et al.* 1999). Cognitive interviews produce large volumes of narrative data, which in turn lead to problems with ascertaining validity and objectivity (Taylor 2000). Several researchers have attempted to address objectivity through the development of a taxonomy of possible problems based on respondents' response processes (Bolton 1993, Conrad & Blair 1996, Lessler & Forsythe 1996, Conrad *et al.* 1999). These taxonomies are then used to increase objectivity in the analysis of interview data. Taxonomies of problem classification generally come under four headings: understanding, retrieval, judgement and response formatting. Use of such taxonomies is aimed at increasing consistency and objectivity and allows standardization of the process of interview analysis (Conrad & Blair 1996, Conrad *et al.* 1999). However, the overall approach of analysing cognitive interview data remains overtly subjective, and this remains the greatest flaw in an otherwise comprehensive method of questionnaire pretesting.

Conclusion

Questionnaire completion can fail for a number of reasons. However, through the process of cognitive interviewing the process of question completion can be viewed from the

perspective of the respondent rather than the researcher. This allows the researcher to gain insight into problems that may not have been anticipated prior to general distribution of the questionnaire. It also ensures data compatibility in that the majority of respondents will interpret questions in the same way.

On the other hand, the process of interviewing may be time-consuming and subjective, and it is debatable whether all the problems that may arise in a questionnaire can be identified through a relatively small number of cognitive interviews. There also remains the question of the validity of the analysis of data collected through the interview process. There are also the complications of pretesting a questionnaire through cognitive interviews with a sample that may not be representative of the target population.

However, the growing use of cognitive interviews is supportive of their effectiveness in identifying problems with questionnaires prior to distribution. They are valuable in pretesting questions that are complex, questions that are sensitive and for specific groups for whom questionnaire completion may pose particular difficulties. Cognitive interviews are of most worth when used in association with other reliability and validity measures, leading to the development of effective and comprehensive self-report measurement tools. They are overall an extra and effective tool in the process of ensuring validity and usability of a questionnaire prior to distribution. The integration of cognitive theory with survey methodology allows development of an understanding of respondents' responses to questionnaires and questions that other methods may not illuminate.

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