TOWARDS A THEORY OF SELF-ADMINISTERED QUESTIONNAIRE DESIGN

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Our understanding of self-administered questionnaire design clearly remains in infancy. Although recommendations for design have been offered (e.g., US General Accounting Office, 1993; Dillman, 1978), few systematic efforts have been made to derive principles for designing self-administered questionnaires from relevant psychological or sociological theories.

One notable exception is a paper by Wright and Barnard (1975). They reviewed the behavioral research, particularly on language and comprehension, and presented ten rules for designing forms. In a later paper, Wright and Barnard (1978) write that the problems of completing self-administered questionnaires fall into two classes: problems with the language used and problems arising from the way information is arranged spatially. This statement suggests that the spatial arrangement of information is not "language." However, it is more precise to label both as graphic language and to further subdivide them into "verbal" versus "non-verbal" language. One reason for suggesting that the term "graphic non-verbal language" be used is that it is more encompassing. Not only does it intimate that respondents extract meanings and cues from the spatial arrangement of information, but it includes other important visual phenomena, such as color and brightness.

Our understanding of verbal language as used in surveys has blossomed in the last few decades (e.g., Jobe et al., 1993; Martin, 1993; Schwarz and Hippler, 1991; Jobe et al., 1990; Lessler, 1989; Converse and Presser, 1986; Belson, W., 1981). Although much of this work involves interviewer-administered questionnaires (that is, verbal language presented aurally), some

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of it is applicable to mail questionnaire design (that is, verbal language presented visually). Schwarz et al. (1991) summarize the major distinctions between these two channels of presentation and conclude that most question wording effects are likely to be relatively independent of the channel of presentation. On the other hand, Schwarz et al. conclude that the channel of presentation is likely to moderate question order, context, and memory effects. The researchers suggest that the following differences in the two presentation channels are responsible for these effects: (1) varying amounts of control over the temporal order in which information is presented (which they term "sequential versus simultaneous presentation"), (2) time pressure, (3) non-verbal interviewer-respondent interaction, (4) interviewer explanations, (5) perception of interviewer characteristics, (6) perceived confidentiality, (7) external distractions, and (8) the differential self-selection of respondents.

Although much research has been directed at understanding the verbal aspects of surveys, in comparison only a limited body of research addresses the non-verbal issues specific to self-administered questionnaires (e.g., Dillman et al., 1993; DeMaio and Bates, 1992; DeMaio et al., 1987; Rothwell, 1985). A recent effort by us (Jenkins and Dillman, 1993) resulted in the stating of 20 design principles, all of which emphasize the visual presentation of information. Although the principles themselves are more comprehensive than those by Wright and Barnard, neither paper attempts to consolidate and organize the information into a working model of self-administered questionnaire design. More importantly, none of the research incorporates the concepts and theories of relevant visual disciplines, such as pattern recognition and the Gestalt Grouping Laws.

Our purpose in this paper is to contribute to the development of a theory of questionnaire design for mail/self administered questionnaires. We define and discuss relationships among concepts important to such a theory. These concepts are utilized to propose a working model along with several principles for guiding the questionnaire design process, thus extending our previous work. Finally, we present results from an initial test of U.S. Census questionnaires that adhered to these design principles.

1. RESPONDING TO SELF-ADMINISTERED QUESTIONNAIRES: A CONCEPTUALIZATION

In Tourangeau's model (1984), as well as other models of the survey interview process, the first step is specified as comprehending the question. Depending on the model, different steps follow, but generally, retrieval of the relevant facts, judgment, and finally, response are given.

Although comprehending the question is the first step in an interviewer-administered survey, the task is different in a self-administered survey. In a self-administered survey, respondents must first perceive the information before they can comprehend it. Once respondents perceive the information, they must comprehend the layout (the visual aspect) of the information as well as the wording (the verbal aspect). Furthermore, respondents must comprehend much more than just the wording of the survey questions and response categories. In a self-administered survey, respondents are often given introductory material and instructions. Also, they must comprehend directions that are meant to guide them through the questionnaire.

In an interviewer-administered questionnaire, the interviewer plays a critical role in the perceptual process. In contrast, the entire onus of perception is on the respondent in a self-administered format. Although we have learned that errors arise as a result of this process (Jenkins and Ciochetto, 1993; Jenkins et al., 1992), we have not developed procedures for controlling these errors. Clearly we need to understand the perceptual process well enough to exert control over it.

When respondents are asked to complete a self-administered questionnaire, they are being asked to perform a task that from their perspective may be different from the task we wish them to perform. From the respondent's perspective, the task may be similar to asking them to view a picture, in which they are free to start anywhere and to make their own decisions as to which parts of the picture to examine in what order.

However, from our perspective, this viewing method is detrimental, for it gives us very little control over the perceptual process. From our perspective, it would be best if respondents started at a specified place, read prescribed words (in order to comprehend the question or stimulus) in the order in which we intend, provide answers to each stimulus, and move sequentially through the questionnaire. In general, we do not want respondents to mark answers without having fully read and understood the questions and accompanying instructions, nor do we want them to pick and choose which questions get answered and in what order.

In order to have control over the above process, it seems important that we have some understanding of graphic language, for this is the channel through which communications are taking place. In the following discussion, we begin by categorizing questionnaires in terms of the graphic language they use. After this, we go on to discuss cognition, especially as it applies to visual perception, and motivation, for these are the actual processes we wish to influence.

1.1 Graphic Language

Graphically speaking, questionnaires are complex. In a tutorial paper, Twyman (1979) provides a classification matrix for graphic language. Along the horizontal axis, graphic language is divided into seven methods of configuration, or ways in which information can be configured on a page: (1) pure linear, (2) linear interrupted, (3) list, (4) linear branching, (5) matrix, (6) non-linear directed viewing, and (7) non-linear most options open. The vertical axis is made up of four modes of symbolization, that is, ways in which the information may be symbolized: (1) verbal/numerical, (2) pictorial and verbal/numerical, (3) pictorial, and (4) schematic. This schema gives rise to a matrix comprised of 28 graphic language categories. Text, for instance, uses a linear-interrupted method of configuration and a verbal/numerical mode of symbolization, whereas a picture would fall into the pictorial, non-linear, most-options-open method of configuration and the pictorial symbolization category.

Questionnaires do not perfectly conform to any one category. Often they utilize more than one configuration, such as linear interrupted (for the questions themselves), list (for the answer options) and matrix (for answer tables). To further complicate matters, questionnaires tend to use several modes of symbolization--verbal (for the questions and answers) and schematic (for the answer boxes and symbolic directions). Unfortunately, most of the graphic language literature is applicable to only a few of the graphic language categories: to a large extent, text and pictures (e.g., Waller, 1987 and 1985; Hartley, 1985; Spencer, 1968; Tinker, 1965; Buswell, 1935) and to a much lesser extent, graphs (e.g., Tufte, 1990 and 1983).

1.2 Cognition and Visual Perception

Cognition refers to all the processes by which sensory input is transformed, reduced, elaborated, stored, recovered, and used. Perception involves using previous knowledge to gather and

interpret the stimuli registered by the senses (Matlin, 1994; Glass and Holyoak, 1986; Neisser, 1967). Pattern recognition is a particular perceptual process that involves identifying a complex arrangement of sensory stimuli. Obviously, to make sense of the information presented on a questionnaire, respondents must be able to see patterns.

Pattern recognition is accomplished through two sub-processes: bottom-up and top-down processing. In bottom-up processing, pattern recognition begins with the arrival of stimulus. In contrast, top-down processing emphasizes the role of context and expectations in identifying a pattern. In this case, our knowledge about how the world is organized helps us to identify patterns.

If in Figure 1, you see a "c" on the left and a "d" on the right, you have just engaged in pattern recognition and most likely you have used bottom-up processing. However, the task is not as clear in Figure 2. This is an example of where by using top-down processing, that is, by placing well-founded expectations on the middle letter, you can quickly decipher the sentence.

As respondents begin to fill out a questionnaire, they apply both bottom-up and top-down processing, only no doubt the top-down processing at this point comes from other more common experiences, such as reading or looking at objects. Most respondents are not experienced at filling out questionnaires, and it seems quite clear that we should keep this in mind when we design questionnaires.

One would expect, however, that the act of filling out the questionnaire would influence the top-down processing so that as respondents move along, they will begin to associate particular visual information with particular requests. This argues for a consistent application of visual information.

The world extends 360 degrees around us. However, our field of vision spans about 210 degrees, and is sharp only within 2 degrees (Kahneman, 1973). When people are presented with simultaneous tasks, like the need to perceive a 210-degree field, they must focus their attention on one task at a time. In stationary visual perception, this corresponds to choosing a place to look first, then moving to a second place, and so on. This approach requires a detailed analysis of a field, which we carry out so effortlessly and automatically that we are not even aware of being engaged in this step-wise process. In contrast, preattentive processing involves the automatic registration of features at a global or holistic level (Neisser, 1967). It

occurs when individuals survey an entire visual field, instantaneously recognizing the features enough to grossly make sense of the scene.

Both preattentive processing and attention are necessary for visual perception and both suggest that we must pay attention to how visual information is presented at both the macro and micro level on a questionnaire. Respondents should be able to glance at a questionnaire and as a result of preattentive processing be able to quickly understand where to start, and generally where they are expected to go. And then the path should continue to be unambiguous as respondents begin to attend to the details of the questionnaire.

Brandt (1945) discovered that humans have preferred positions in eye movements (see Figure 3). He constructed a card with squares that were symmetrically located about a locus. The results of his study reveal that if a field is divided into four quadrants of equal visual interest, subjects' eyes will naturally fall in the upper left-hand quadrant, closer to the center of the page than the extreme left-hand corner. The least preferred space was the lower right-hand quadrant. Brandt also discovered that successive movement of the eyes following the initial fixation is toward the left and upward. He suggests that the left side preference is most likely due to our habits of reading a printed page from left to right and to the fact that most people are left-brain dominant. As questionnaire designers, we are in a position to take advantage of these tendencies.

Most of what we look at, however, is not of equal visual interest. In this case, we know that people will focus on areas which are physically informative, like high contrast areas, or on areas of ecological significance (Kahneman, 1973). Figure 4, for instance, depicts the typical eye movement trail of someone looking at a face in which the eyes and the mouth have attracted a great deal of attention.

How we look at pictures is important, but it is not all we need to know to design questionnaires. Since we predominately use linear interrupted text to communicate, we also need to understand how we read. Lima (1993) and Rayner (1993) note that contrary to what we might think, we do not read text smoothly. Rather, our eyes fixate about every eight to nine letter spaces, corresponding to the 2-degree visual angle mentioned earlier. This is known as the foveal region. Generally, our eyes are fixated about 90 percent of the time. The remainder of the time, our eyes move very rapidly between fixations in what are known as saccades.

There is evidence to suggest that the region to the right of the region on which our eyes are fixated, the parafoveal region, plays an important role in our ability to recognize words during reading. Previewing the initial letters of the next word helps us to recognize that word more quickly (Lima, 1993). We will explain this in greater detail later, but suffice it to say for now that in effect we deprive readers of the information to the right of a fixated word when conceptually connected information is presented at separate locations on a questionnaire.

The eyes and their movements are the mechanism by which we take in our surroundings. What the eyes take in, however, are visual elements. Visual elements are first described in terms of brightness and color, then shape, and finally location. When information from all three levels are encoded, perceptual representation occurs (Glass and Holyoak, 1986). Figure 5, for instance, depicts a relatively simple line drawing that is based primarily upon the visual element of shape. The building blocks in Figure 6 have different contrasts. The problem with these building blocks is that they are impeding our ability to make out this picture clearly. Their perimeters are contributing too many lines or visual detail.

Bringing together the visual elements leads to an important visual outcome--that is, we are able to distinguish between figure and ground. The recognition of a figure against a background depends on contrast, especially contrast between brightness (or color) and shapes (see Figure 7).

According to Gestalt psychologists, a number of perceptual principles guide our understanding and interpretation of figures (Wallschlaeger and Busic-Snyder, 1992; Castner and Eastman, 1984; Zusne, 1970). The Law of Pragnanz states that figures with simplicity, regularity, and symmetry, such as squares, will be more easily perceived and remembered than irregularly shaped polygons. This law is depicted in Figure 8. The Law of Proximity states that when similar figures are located in close proximity to each other, we tend to see them as belonging to the same group. Do the dashes in Figure 9 appear to be horizontal or vertical lines? What if you turn the figure sideways? Figure 10 is a good example of the grouping laws in operation. The first example depicts two lines of different shapes. That is because according to the Law of Similarity, we tend to see similar shapes as belonging together. Finally, if you see a white triangle in Figure 11, you are acting according to the Law of Closure.

These laws provide further evidence for paying close attention to how we display information on a page, for respondents will extract meaning from how the information is

shaped, shaded, and grouped. The real challenge for us in all this is to learn how to visually communicate our intentions.

1.3 Motivation

Neisser (1967) points out that although cognitive psychology is concerned with all human activity rather than some fraction of it, the concern is from a particular point of view. He asserts that other viewpoints are equally legitimate and necessary, such as dynamic psychology: "Instead of asking how a man's actions and experiences result from what he saw, remembered, or believed, the dynamic psychologist asks how they follow from the subject's goals, needs, or instincts..."

The motivational aspect of responding to questionnaires concerns whether respondents desire to read the questions and to formulate and express appropriate answers. In a larger sense, motivational considerations influence whether respondents even begin the process of filling out the questionnaire, and whether it gets returned to the researcher. Consequently, we need to understand what motivates respondents to answer surveys, and how questionnaires can be designed to positively influence this process.

Dillman (1978) has argued from a social exchange perspective (also see Goyder, 1988) that people are more likely to complete a mail questionnaire if they expect that the costs to them of completing it are less than the expected rewards to themselves or groups with which they identify. This perspective leads to recommendations to reduce perceived costs by making the questionnaire appear quick and easy to complete and to avoid information that may embarrass the questionnaire recipient (e.g., a question that is hard to understand) or subordinate them to the survey sponsor. Among the recommendations for increasing rewards are including explanations of the study's usefulness to the respondent or groups with which the respondent is likely to identify, including questions that are likely to be salient or of interest to the recipient, and laying out the questionnaire in a format that is easy and encourages the respondent to get a sense of progress from being able to proceed quickly through its pages. Visual aspects of questionnaire construction are accorded substantial significance under this perspective for improving response to mail surveys.

Cialdini (1988) has argued more generally that people decide whether to perform a requested task on the basis of the inherent

attractiveness of that task and other social or psychological influences, including

- reciprocation (the tendency to favor requests from those who have previously given something to you),
- commitment and consistency (the tendency to behave in a similar way in situations that resemble one another),
- social proof (the tendency to behave in ways similar to those like us),
- liking (the tendency to comply with requests from attractive others),
- authority (the tendency to comply with requests given by those in positions of power), and
- scarcity (the tendency for rare opportunities to be more highly valued).

Groves and others (1992) provide examples of how each of these can be utilized to encourage survey participation. Although most of the examples refer to interviewer behavior or the implementation process, some can be applied to questionnaire design. For example, the fact that people tend to comply with requests from attractive others suggests that respondents may be more likely to answer an attractive questionnaire than an unattractive one.

Finally, the literature on opinion change (Petty and Capioppo, 1986) suggests that when a topic is of high personal relevance, subjects will change their opinion based on an in-depth review of a message. However, when the topic is not important to the subject, they will rely on a heuristic review, such as the credibility of the source. This literature suggests that if a questionnaire is not really important to a respondent, then we probably are not going to persuade them to complete it by presenting them with an in-depth, highly logical, persuasive discussion of why they should complete it. Instead, we should rely on other means.

2. PRINCIPLES FOR DESIGNING SELF-ADMINISTERED QUESTIONNAIRES

Utilizing concepts from the preceding section having to do with cognition and visual perception as well as motivation, it is our ultimate goal to develop a series of theoretically based

principles that can be empirically tested, as part of the effort to develop an overall theory of good questionnaire design. In this section, we provide examples of such principles and illustrate their application to selected self-administered questionnaires, the task to which we now turn.

To accomplish this goal, it is useful to introduce a heuristic device which we have found beneficial for guiding our design efforts, that is, the distinction between navigational guides and information organization. In essence, decisions about navigational guides are aimed at motivating and guiding the respondent through a questionnaire in a particular way in the absence of an interviewer who would otherwise perform that task. Decisions about information organization concern what a respondent would hear if he/she were being interviewed.

2.1 Designing Navigational Guides

To some degree, navigational features of self-administered questionnaires have been discussed previously. For instance, in 1978, Dillman provided practical advice on how to construct a questionnaire so as to guide respondents through it. More recently, DeMaio and Bates (1992) carried out an experiment during the 1990 U.S. Census, known as the Alternative Questionnaire Experiment, which was largely about how to structure a questionnaire to get respondents through it.

The visual perception literature provides conceptual underpinnings for such design efforts. It suggests that respondents should be able to glance at a questionnaire and as a result of preattentive processing be able to quickly understand where to start, and generally where they are expected to go. Additionally, the path should continue to be unambiguous as respondents begin to attend to the details of the questionnaire. The following principles are meant to accomplish these goals.

Principle 1: Use the visual elements of brightness, color, shape, and location in a consistent manner to define the desired navigational path for respondents to follow when answering the questionnaire.

The questionnaire in Figure 12, utilized for a 1992 pretest of the National Survey of College Graduates (Shettle et al., 1993) successfully manipulates the visual presentation of

information. Because they have different brightnesses and shapes, the questions, answer categories, and other information on the page unambiguously appear as figures in the foreground, whereas the formless shaded area printed in light blue (10 percent of fixed color) appears to extend behind the figures as background.

An important attribute of this questionnaire is that the question numbers are prominently displayed. They stand out because they are located on the left-hand side of the reading columns, a highly visible area, and because they are set apart somewhat from the questions.

Another important attribute is that the beginning of the questionnaire is clearly marked "A1." This questionnaire does not place information before the "A1" that is likely to confuse respondents about where to begin.

Also, this questionnaire format uses contrast to its advantage. To begin with, both the question numbers and the questions are in bold type to help them stand out and define the navigational path for respondents to follow. And then there is the really effective contrast between the shaded background and the other information on the page, especially the white answer spaces.

Not only that, but the white answer boxes are equally sized simple shapes that are vertically aligned, all of which is in keeping with the Gestalt grouping laws (the Laws of Similarity and Proximity). As a result, the elements of shape, brightness, and location are giving rise to a well-defined regular pattern on the questionnaire that is immediately evident at the pre-attentive level and that can be used to guide respondents through the form at the attentive level.

Based on both the Gestalt Grouping Laws and the graphic language literature, one can make an argument for listing closed-ended answer categories vertically and scaling categories horizontally. As demonstrated in Figure 12, grouping closed-ended categories vertically--a form of typographical cuing--should give respondents the correct impression that the categories are distinct entities, whereas grouping them horizontally may give the false impression that they are continuous, much the same way a sentence is a continuous thought that runs across the page horizontally. By the same token, grouping scaling answer categories vertically may give respondents the wrong impression that the categories are unassociated, when in fact they are continuous.

Recent evidence supporting this possible underlying construct comes from an experiment by Gaskell et. al (1994). They demonstrate that the choice of response alternatives can influence responses to questions about the frequency of vaguely defined target events. In addition, they showed that the size of the observed shifts depended upon the presence of priming questions and the orientation of the response scales. They concluded that either a horizontal orientation of the response scale or priming questions (or both) may increase the effect of the response alternatives. They speculate that the horizontal presentation of the scale may make the question more distinctive. Perhaps, as suggested above, the horizontal orientation of the scale provides different, and in fact more accurate, information to the respondent--that the response options actually lie along a continuum.

Generally, questionnaires are printed in one color, that is, black print on white paper. The questionnaire presented in Figure 12 has two colors: black print on a light blue field printed on white paper. A number of researchers have speculated that certain colored paper (green, yellow, pink) would appeal to respondents more than others. For the most part, this has not proven true (Phipps et al., 1991; Crittenden et al., 1985). One exception is a metanalysis by Fox et al. (1988) in which green rather than white questionnaires were found to have significantly increased mail response rates. Until more evidence is forthcoming, however, we tentatively think that visual elements (such as a uniformly colored background) which do not serve to guide respondents through the form will have little effect on respondents.

Another good feature of the Survey of College Graduates questionnaire is that the key- and sourcecodes needed for processing are a deeper shade (100 %) of the blue background color. Theoretically, the subtle contrast between the codes and the background should help to make these codes less visible to the respondent, while still being easily read by processing personnel. In addition, because the source codes are off to the far left of the page, outside the foveal and parafoveal view of the respondent, they are even more likely to be ignored. However, this may not be the ideal spot for the sourcecodes. According to the eye-movement literature, information is most likely to be ignored if it is placed in the lower right-hand corner of the viewing space. In the case of A1, this would be to the far right of the "No" response and just left of the dividing line in the middle of the page.

Another minor visual imperfection in this questionnaire is the use of dotted lines beneath the write-in answer spaces.

Since the Law of Closure states that respondents will only connect these lines anyway, why not just make them solid from the start? However, one reason they can be made solid without visually cluttering this questionnaire is because this questionnaire uses lines sparingly. Recall, too much detail impedes our ability to interpret visual data. Lines are mainly used to delineate the colored areas from the white areas; they are NOT used to delineate one question from another, which leads to unnecessary visual clutter. Other than the line running down the middle, the space is open with a strong and consistent separation between figure (what we want respondents to see) and background (what we do not want them to see).

The questionnaire in Figure 13, utilized in the 1993 U.S. Census of Agriculture, violates many of the same principles that Figure 12 exemplifies. It conflictingly invites a respondent's eye to different areas of the questionnaire for different reasons. Rather than working in unison to achieve a desired outcome, information is competing for the respondent's eye. At the very least, there appear to be three different competing areas:

- The upper-left hand quadrant, which according to the eye-movement literature, is the eye's preferred position for looking at information when all of the information on the page is of equal interest.

- The high contrast areas, which according to the eye-movement literature attracts our attention. The boldest information on this questionnaire is: the "Census Use Only" boxes, which are of the least relevance to respondents, the reverse contrast "Section 1" heading, and the answer box on the right-hand side of the page associated with number 4.

- A third competing area is the question 1 beneath the Section 1 heading. Cognitive research with both the Service Based Enumeration Questionnaire (Gerber and Wellens, 1994) and the Public School Questionnaire (Jenkins et al., 1992) demonstrates that the first question often attracts respondents' eyes.

If respondents decide to begin with question 1, they are likely to miss many important instructions, including those in the upper left-hand quadrant about estimates and time extensions, the confidentiality statement in the upper right-hand corner, the instruction to "report land owned, rented, or used by you, your spouse, or by the partnership, corporation, or organization for

which you are reporting," and the instruction about what to do if the acres the respondent operated changed during the year.

We need to avoid giving respondents the erroneous impression that information is not important. The best way to do this is to make certain that all of the visual cues are "saying" the same thing, like "Start here" or "Read this." Otherwise respondents are reasonably confused about which messages to follow and in what order they should follow them.

We know from psychological experiments with subjects in which brain activity is monitored through the use of PET scans that confusion results in greater brain activity, presumably because subjects need to engage in greater cognitive processing to solve a problem. This suggests that we should not only be interested in outcomes. It is in our best interests to become sensitive to and concerned with minimizing processing times as well.

Principle 2: When established format conventions are changed in the midst of a questionnaire use prominent visual guides to redirect respondents.

Ideally, the visual elements should be used consistently, as emphasized in Principle 1, but occasionally, it may be necessary to violate this principle. In those cases, special care needs to be taken to redirect respondents' attention. For example, the questionnaire shown in Figure 14 from a 1994 survey of new Washington residents (Dillman et al., 1995) uses a common question format. This format involves prominently identifying questions with "Q-x" designations, writing the questions in dark ink, and then listing categories below the questions, vertically. This format, however, would consume a great amount of space if used for questions that repeat themselves for each of many items, as in question 8. In addition, this page has the added complexity of including certain questions (3,4, and 7) that do not apply to some respondents.

In general, top-down processing lends efficiency to our ability to interpret visual stimuli. It enables us to more quickly perceive our visual world with less effort by placing what are usually well-founded expectations upon it from past experiences. However, a break-down in this system may occur when the visual world deviates from our expectations, and a change is made in the way each visual element is used.

Figure 14 illustrates this problem. In questions 1 through 7 respondents are supposed to answer to the left of the answer categories (stubs) usually, by circling a number. In question 8, a change was made to circling a word (rather than a number) placed to the right of stubs that are listed similar to answer choices in previous questions, for example, "A. For me to accept a new job". When used in a pilot study, this questionnaire resulted in several people either circling the letters (or starting to answer and then erasing) to the left of the stubs, rather than making the desired switch to circling actual answers on the right.

One way to correct this problem is to place numbers to the left of the stubs and ask respondents to "circle the answers which apply." Although this solution might seem simple, there is evidence that doing so encourages a primacy effect, that is, biases towards the selection of answers from early in the listing. Asking respondents to respond either "yes" or "no" to each stub may avoid this bias.

Figure 15 demonstrates another solution. In this revision of question 8, attention is directed away from the left-hand side of the answer categories by removing the letters (which a few respondents treated like numbers) and placing an area of dense information on the right to attract the respondent's attention. That is done by the dark "hat" over the answer choices and by shading behind the answer choices. This page was further revised by using lines to visually demarcate "screened" questions from those to be answered by everyone, and aligning the demarcated spaces vertically.

2.2 Achieving Good Information Organization

Many authors have written extensively about principles for achieving desirable information organization in survey questions, many of which apply equally to both self-administered and interview surveys (Sudman and Bradburn, 1982; Dillman, 1978; Wright and Barnard, 1975). Examples of such principles are: Ask questions in the affirmative using short sentences, avoid the use of double negatives, and be sure that all answer choices are mutually exclusive. However, space constraints in self-administered questionnaires may result in additional information organization problems. It is these types of concerns that are emphasized in the principles which follow:

Principle 3: Place directions where they are to be used and where they can be seen.

Consider the following information which is representative of that which sometimes appears on a separate page at the beginning of a questionnaire.

> To get comparable data, we will be asking you to refer to the week of April 15, 1993, when answering most questions.
>
> Unless otherwise directed, mark one box for each question.
>
> When answering questions that require marking a box, please use an 'x.'
>
> To answer questions which require an occupational code see pages 12 and 13 of the questionnaire.
>
> When finished please return this questionnaire to the address shown above.

Such information is often provided at the start of questionnaires in an well-intentioned effort to avoid repetition and "simplify" the questionnaire, but the result is exactly the opposite. The information is given at a point where none of it can as yet be used, and on many different topics. Cognitive research with the Public School Questionnaire shows that in general respondents either never read the beginning information or they read it and forgot it by the time they needed it (Jenkins et al., 1992). Memory studies have shown that information tends to be remembered in "chunks." Each item of information is likely to be remembered best, and subsequently used, if it appears as part of the question where it applies. For example, the reference date might be introduced in this way at the first question where it is to be used.

> "Were you working for pay (or profit) during the week of April 15, 1993?"

Then the date can be repeated at points where it is needed. Similarly each of the other directions can be imparted at the point where they are first used.

Principle 4: Present information in a manner that does not require respondents to connect information from separate locations in order to comprehend it.

The 1992 U.S. Census of Agriculture included this question, followed by a listing of 12 crops:

> "Were any of the following CROPS harvested from "THIS PLACE"

in 1992?"

As shown in Figure 16, the column headings to the right specify "acres harvested," "quantity harvested," and "acres irrigated." One problem with this format is that the question stem does not correspond with what respondents are being asked to provide. The question requires a "yes" or "no" response, whereas the answer categories suggest that respondents are really being asked to report numerical data. Only by making the effort to perceive and then integrate each separate part can the meaning of the question be deciphered.

Based on what we know about reading and memory, presenting conceptually-connected-but-physically-disconnected information should be problematic for the following reasons. First, it should require a greater effort on the part of respondents to perceive the information that is out of both the respondent's foveal and parafoveal view. Confirmation of this comes from cognitive research with both the Public School Questionnaire and the Census of Construction Industries questionnaire in which respondents were likely to overlook information that was not presented in a natural reading format. More importantly, this was likely to lead to the misreporting of information (Jenkins et al., 1992; DeMaio and Jenkins, 1991).

Second, a separate presentation of conceptually related information should lead to an increase in processing times because respondents will not have had the advantage of having previewed the information in the parafoveal view.

Finally, a separate presentation will require respondents to store the separate pieces of information in short-term memory long enough to integrate them. Theoretically, one would expect this to burden short-term memory more than if the pieces are already consolidated. Therefore, one way to simplify the respondent's task is to ask a comprehensive question, which both visually and logically consolidates the information for the respondent. For instance, the agricultural question would become:

> "For each of the following crops, how many acres and bushels (or other measures of yield) were harvested from "THIS PLACE" in 1992? In addition, please indicate how many of the acres for each crop were irrigated.

Principle 5: Ask people to answer only one question at a time.

The above question, however, also illustrates the problem of asking more than one question at a time, which so often appear on mail questionnaires in an attempt to save space. Because acres and yield are likely to be closely interconnected in the respondent's mind, and acres irrigated connects to total acres, the respondent may be able to provide the desired information, but not without effort. Such a question might be restructured into a temporal sequence, as follows:

> For each of the following crops, please write down how many acres of each was harvested from "THIS PLACE" in 1992.
>
> Next, indicate the quantity of each crop that was harvested.
>
> Finally, please write down how many of the acres, if any, were irrigated.

An even more complicated multiple-part question taken from another questionnaire where it was used to save space is the following:

> "How many of your employees work full-time with health insurance benefits, how many are full-time without health insurance benefits, and what is the average length of time each type of employee has worked for this firm?"

The respondent is being asked to think of four questions at once. This question can be divided into its constituent parts somewhat more easily than the previous one:

1. How many of your full-time employees receive health insurance benefits and how many do not?

2. Of those who receive health insurance, what is the average length of time they have worked for this firm?

3. Of those who do not receive health insurance, what is the average length of time they have worked for this firm?

2.3 A Combined Application of Information Organization and Navigational Guide Principles

Principles of the nature discussed here have been experimentally tested on survey questionnaires to some degree. Insight into the results that might be achieved from adhering to

these principles can be inferred from some experiments conducted by the U.S. Bureau of the Census.

The Decennial Census Questionnaire shown in Figure 17 was changed from the matrix format shown there to one in which respondents were given an individual space in which to respond, as shown in Figure 18. The matrix questionnaire clearly violates our model of organizing information and navigating respondents through a form properly. In order to comprehend the questions and answers, respondents need to connect row stubs, column headings, and their intersecting information, all of which are located at separate places on the questionnaire.

Furthermore, it is left up to respondents to determine in what order to answer questions, a situation which does not usually occur in interviews. Respondents can answer all of the questions about one person at a time, in which case they will need to work down the columns. Or they can answer the same question for each person, in which case, they will need to work across the rows. In any event, they are given a choice, but provided little guidance for making the choice.

Not only that, but the black squares, which were placed on the questionnaire as optical scanning guides, but are not important to respondents, are the most dominant feature. Then to make matters worse, color (contrast) is not used effectively. As can be seen in Figure 17, the white answer spaces are not easily distinguished from the white background. In this case, respondents must rely on only two visual clues, the shape and location of the answer circles, to identify the answer spaces. In the Survey of College Graduates, respondents were given three elements--shape, location, and contrast--to guide them. Recall, the recognition of a figure against a background, depends on contrast, especially contrast between brightness (or color) and shapes. Recall as well that too much visual detail impedes our ability to interpret visual data. Unfortunately, many lines are used to form the rows and columns of the matrix questionnaire shown in Figure 17.

With the individual space format, shown in Figure 18, respondents no longer need to connect information from separate locations on the questionnaire. Now they need only be concerned with answering one question about one person at a time, and they need not deviate from moving down the page or to the top of the next column in search of the next question and response categories. In other words, this format effectively uses the visual element of location to guide the respondent through the form.

This format also uses contrast more effectively. To begin with, the words "Person 1, Person 2," etc. are the dominant information points. Also, the white answer spaces are easily distinguishable from the blue background and the blue person spaces are easily distinguished from one another. Finally, the individual space format is a much more open format than the matrix format.

The individual space revisions required extending the questionnaire from the one page (10-1/2" x 28") matrix used in the 1990 Decennial census to an eight-page booklet of 8-1/2" x 11" pages. When tested experimentally, the booklet format achieved a completion rate of 66.8 percent versus only 63.4 for the matrix form, a statistically significant improvement of 3.4 percent (Dillman et al., 1993).

These individual-space procedures were also used to revise a much longer Census form, which in the matrix format consisted of 20 pages. In the revised 28-page format, a response improvement of 4.1 percentage points from 51.8 percent to 55.9 percent was achieved (Dillman et al., 1994).

The latter experiment also included a treatment that provided improved navigational guides, but stayed within the matrix format of the 1990 form. Shown in Figure 19, this redesign made better use of the visual element of contrast than the original matrix. This matrix utilized light blue back ground fields, and provided white answer spaces. Also, a 100-percent blue color with reverse printing was used to identify the person columns, making this the most dominant navigational guide on the page. These limited changes, and retention of the matrix format allowed staying within the original length of 20 pages. This treatment achieved an intermediate completion rate of 54.4 percent, 2.6 percentage points higher than the 1990 form, an amount that was in the direction of showing improvement, but within sampling error.

3. CONCLUSION

We view this paper as a beginning. Consider for a moment the large body of research targeting whether or not a "don't know" category should be included as one of the response categories on a questionnaire compared to the dearth of information available for deciding the huge number of decisions that face self-administered questionnaire designers, like should we include an instruction here or not, and if we do, what should

it look like? For the most part, designers have had very little besides convention and "common sense" to guide them because issues relating to the non-verbal aspects of questionnaire design have generally been neglected.

We were convinced, however, that it was not only possible but necessary to develop a set of scientifically derived principles for guiding this process. To better define where errors were occurring in this process and what we needed to do to avoid these errors, we reviewed the cognitive literature, especially as it applies to visual perception, and the motivation literature. Combining the concepts we uncovered, such as pattern recognition and the Gestalt Grouping Laws, with the existing empirical research on self-administered questionnaires enabled us to propose a working model along with principles for design.

The model that emerged is composed of two major decision making components: the first component is aimed at encouraging respondents to follow a prescribed path through the questionnaire, which we call designing navigational guides. The second component refers to the choice of words for formulating questions and answers and the prescribed sequence in which respondents are expected to process them. This we call achieving good information organization. Finally, we presented initial results from a test of a U.S. Census questionnaire that seem to support the model.

We need to continue to work towards developing a set of scientifically derived and experimentally proven principles to guide the construction of self-administered questionnaires. Much remains to be considered and tested. We hope other survey methodologists will expand upon this discussion, and will begin to test these and other principles to determine their potential influence on response rates, processing times, and the accuracy of self-administered responses.

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