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Achieving Usability in Establishment Surveys Through the Application of Visual Design Principles

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The purpose of this article is to develop theoretical connections between principles for visual design and principles of cognitive and emotional usability, as a basis for developing rules of construction for improving questionnaire layout and design. The usability principles draw from cognitive psychology research and have been applied previously to the use of physical objects in one's environment. The visual principles rely on gestalt psychology concepts that have been previously applied to questionnaire design. Based upon the resultant theoretical framework, twelve rules for questionnaire construction are developed and applied to revising the Agricultural Resource Management Survey of farm operators conducted annually by the United States Department of Agriculture.

Key words: Questionnaire; mail survey; survey response; gestalt psychology.

1. Introduction

A recent analysis of establishment survey development and testing methods used in 43 statistical organizations from around the world concluded with the recommendation that a shift is needed from, "error correction to error prevention through improved instrument design" (Willimack, Lyberg, Martin, Japec, and Whitridge, 2004). Better questionnaire design for these surveys of businesses, most of which rely on the completion of paper forms, presents a major challenge to designers of establishment surveys. Such questionnaires tend to pose complicated questions, which are difficult for respondents to understand and complete. They also tend to require respondents to generate data on organizational expenditures and characteristics that are often difficult to produce and report (Cox and Chinnappa 1995; Willimack and Nichols 2002).

Paper questionnaires are entirely visual, with the reading and answering of questions being controlled by the respondent. Thus, improvement of the visual design and layout of

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questionnaires has been proposed as one important avenue for enhancing the ability of recipients to comprehend and respond accurately to establishment surveys (Dillman 2000). These procedures rely on the application of concepts from gestalt psychology for designing question layouts that follow natural reading and comprehension processeses used by people to make sense of visual information (Jenkins and Dillman 1997). Although experimental research has shown that different visual layouts of questions influence whether people respond correctly to instructions (Redline, Dillman, Dajani, and Scaggs 2003), and different visual presentations of specific questions often produce quite different answers (Christian and Dillman 2004), these tests have been limited to individual-person questionnaires.

Other sets of ideas that appear relevant to reducing error in establishment surveys are usability concepts based upon cognitive psychology, as developed by Norman (1988; 2004). These concepts are focused on how people cognitively and emotionally respond to everyday objects in their environment, and the aspects of those objects that make them easier or more difficult to understand and use. These concepts have not, to our knowledge, been previously applied to the design of survey questionnaires.

Our purpose is to propose linkages among concepts drawn from theories of visual design, cognitive design and emotional design in order to develop construction rules for the design of establishment surveys that will make such surveys easier for respondents to complete. We apply the resultant framework to the redesign of the Agricultural Resource Management (ARMS) questionnaire used by the United States Department of Agriculture to survey a large sample of the nation's farm operations each year. Redesign of this instrument following the principles developed here is aimed at improving the quality (accuracy and completeness) of respondent answers, reducing item nonresponse and improving mail-back response rates.

2. Theoretical Background

The framework for design that we develop here connects concepts drawn from three distinct literatures, as illustrated in Figure 1. We consider design requirements from the perspective of usability to establish the context in which visual design must be applied. The first body of work to be discussed is the application of cognitive psychology to making all manner of products more usable by those who experience them (Norman 1988). The second area of work to be summarized broadens usability considerations to how people respond emotionally to objects in their environment. It concerns how peoples' cognitive interactions with those objects are predispositioned by automatic or instinctive reactions that affect the cognitive demands required for their effective use (Norman 2004). The third

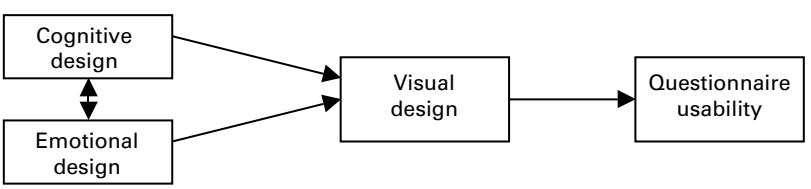


Fig. 1. Linkages between three sets of concepts that constitute the redesign framework of this article

body of research brings into consideration the specific demands of questionnaires on respondents when one must rely entirely upon the visual channel of communication for accomplishing usability objectives. It describes how the meaning of questions is communicated through multiple languages (symbols, numbers and graphics, as well as words) the understanding of which is heavily influenced by concepts drawn from gestalt psychology (Jenkins and Dillman 1997). For this aspect, we rely primarily upon research on how people construct meaning from visual displays (e.g., Wallschlaeger and Busic-Snyder 1992; Palmer 1999; Hoffman 1998).

2.1. Cognitive principles for improving usability

In his book, *The Design of Everyday Things* (1988), Norman proposed seven general principles which, if followed, are expected to make products more understandable to potential users and therefore easier to use correctly. The nature of these principles and an example of their potential application to questionnaire design are summarized here.

2.1.1. Use knowledge in the head and knowledge in the world

When users are able to internalize the knowledge required for using a product, then performance can be faster and more efficient (Norman 1988). This is accomplished by making a good connection between knowledge in the head, i.e., a general understanding of the way in which an object is supposed to work, and information embedded in the object itself, for example, specific instructions for accomplishing the steps of operation. This suggests that questionnaire designers must give careful consideration to what the respondent can be depended upon to know and apply to filling out a questionnaire and what additional information needs to be provided on the questionnaire itself, as well as how they connect with one another.

2.1.2. Simplify the structure of tasks

There are limits to how much a person can hold in memory at one time, with the usual limit in short term memory being 4–5 separate items (Norman 1988). The limitations associated with long-term memory are such that information is better and more easily acquired if it is integrated into a mental conceptual model that the user has acquired and has thus become knowledge in the head. The presentation of instructions for responding to questionnaires must therefore take these cognitive limitations, and how the respondent is likely to view the nature of the questionnaire completion task, into account.

2.1.3. Make things visible

This design task is to make visible to respondents what needs to be done *and* the effects of their actions. For questionnaires, this suggests that the visual layout needs to make clear the order in which tasks are to be done and where responses are to be provided. Upon completion, it should also be easy for the respondent to see at a glance what has been done, and whether anything remains incomplete. Making things visible for questionnaires is especially important, because of either one-time use of the questionnaire, or multiple uses that are widely separated in time (e.g., annual or biennial completion). Thus, for business questionnaires, the task of making things visible seems different than the task of making

things visible for daily use (e.g., a word processing program) in which multiple steps learned through regular use might be needed for providing that visibility.

2.1.4. Get the mappings right

Mapping refers to the relationship between controls on objects, their movements, and the consequences. Natural relationships are used to develop mappings that are easy to understand and follow, for example, designing a steering wheel on a car so that one turns it to the right when one wants the car to turn right. On questionnaires placing all of the needed elements–the query, any needed instructions, answer choices, and spaces to mark answers–in close proximity to one another and in the same sequence, is to provide a natural mapping.

2.1.5. Exploit the power of constraints

Limiting the number of options that the user has available for use helps clarify to users what can and cannot be done at each stage of operation. For example, providing answer spaces on questionnaires that cannot be confused with nonanswer spaces, and sizing those answer spaces for the type of answers expected, are examples of using the power of constraints to elicit desired response behaviors.

2.1.6. Design for error

Errors are likely to occur when using most objects. Thus, it is important that procedures for recovering from those errors be made clear to the respondent. Special instructions on questionnaires specifying that only certain respondents should answer particular questions or a direction to make sure that percentages add to 100, are examples of designing for error.

2.1.7. When all else fails, standardize

Usually, it is not possible to utilize natural mappings for all instructions that one might need for operating certain objects, nor is it always possible to relate operation of some objects to a conceptual model already possessed by the respondent. When faced with such a problem, it is important to make requests for actions in the same way. For example, although it is arbitrary whether one drives on the right or left side of the road, different countries standardize the expectation so that it is the same for all streets, roads, and highways in that country. For questionnaires, this implies the need for consistency in whether questions are numbered or lettered, and whether answer spaces are to the left or right of answer choices.

2.2. The emotional design context

In a more recent book, *Emotional Design: Why We Love (or Hate) Everyday Things*, Norman (2004) argues that there is more to getting everyday things to be understood and operate correctly than cognitive design. He proposes that peoples' affective states, whether positive or negative, change how they think and behave, and divides those reactions into visceral, behavioral and reflective. Visceral level responses to objects are immediate,

automatic responses to any new sensory input. At this level, questionnaires may register as visually pleasing overall, or not.

Visceral level judgments appear to be genetically driven human tendencies that are broader than individual personalities. For example, Norman (2004, p. 29) lists a number of conditions as having positive affects on people, e.g., soothing sounds and rhythms, harmonious music and sounds, rhythmic beats, symmetrical objects, and rounded (or) smooth) objects. Some of these qualities may be projected to the visual design of questionnaires, perhaps thinking of them as producing soothing, rather than harsh, impressions and being rhythmically constructed; perpendicular corners can be rounded, and shapes made symmetrical.

The visceral level of response is about emotions that occur quickly and generally during the preattentive stage of processing. Evaluation does not occur beyond the level of detail immediately evident from an unfocused glance at the form. Nonetheless, certain aspects of the questionnaire that set the general tone of the questionnaire may be interpreted at this time. Examples may include visual harmony, i.e., the agreement of visual elements such as balance, color, and arrangement. Extending Norman's description of rhythm beyond sound seems appropriate for describing the repetition of visual elements, and consistent use of graphical language. Yet another descriptor of the larger tone may be comfort, i.e., visual elements that have a calming effect, and reflect smoothness and symmetry.

In contrast, the, second, or behavioral level of emotional reaction, which was the primary emphasis of Norman's 1988 book, is described in the new book as *not* being about aesthetics. He states, "Behavioral design is about use. Appearance doesn't really matter. . .performance does. . .This is the aspect of design that practitioners in the usability community focus upon." (Norman 2004, p. 70). At the behavioral level of emotional response, the understandability of instructions, good organization of information, clear and visible connections between all steps, and good navigation sequences become important. They are also responsible for generating the positive or negative reactions that will influence whether a questionnaire is completed, and whether accurate answers are provided. The seven usability principles outlined earlier seem important for achieving positive responses at the behavioral level.

The connection between the visceral and behavioral levels of response and the rationale for needing to be concerned about the aesthetics of layout and design, as well as the specificity of construction features is summarized as follows:

> . . .when people are anxious, they are more focused (and) the designer must pay special attention to ensure that all the information required to do the task is continually at hand, readily visible, with clear and unambiguous feedback about the operations that the device is performing. Designers can get away with more if the product is fun and enjoyable." (Norman 2004, p. 70.)

The perception of usability at the behavioral level is framed by the initial interpretation from the visceral level, making the connection between the visceral and behavioral levels of response an essential consideration. Separate research projects in Japan and Israel provide evidence of the relationship between aesthetics and the perception of usability across cultural divides (Kurosu and Kashimura 1995; Tractinsky 1997). In those studies, subjects were shown a series of potential layouts for ATM screens and asked to rate how

easy they believed they would be to use. Of the many direct usability components tested, none had nearly as high a correlation with perceived ease of use as how pleasing the aesthetics were to the subject.

The essence of designing a good questionnaire is that respondents must *comprehend* and *understand* all the questions and accompanying instructions in a uniform manner, as intended by the designer. Achieving this goal is possible through the combined effect of emotional and cognitive design. Although emotional design has a distinctive meaning, as described by Norman (2004), its effect on respondents is not independent from that of cognitive design. A positive first impression of a survey is born visually, so producing the right visual tone should guide the form towards increased usability by the respondent. In the two studies of ATM screen layouts previously discussed, the aesthetics were a more powerful influence on perceived usability than any of the actual changes to usability components, such as error correction strategy, cognitive efficiency or operational efficiency (Kurosu and Kashimura 1995; Tractinsky 1997). A good first impression visually should reciprocally evoke more positive emotions towards the use of the questionnaire, inducing respondents to work more efficiently, provide answers faster and overlook imperfections in the design. When usability of a product is initially perceived poorly, research has shown that users are much more likely to express dissatisfaction after four months of use (Hitz and Johnson 1990).

The third response level identified by Norman (2004) is reflective level thinking. It concerns the intellectually developed meanings of products. It is described as occurring in the contemplative part of the brain, and is the basis for top-down responses based upon thought and reflection. Its role with regard to questionnaire completion may be with regard to how a respondent reacts to future requests to complete the same or similar questionnaires. In this article, our focus is on questionnaire design as it relates primarily to the visceral and behavioral levels of emotional response.

2.3. General principles of visual design

Many products, ranging from door openers to coffee makers and computers, allow interaction with the user via multiple channels of communication, from touch to sound. Visual design of such products is only one component of the design and often these products may be most appreciated from a distance. Touch, feel, and interaction may be critical to behavioral assessments of products such as these (Norman 2004). Designs that fail visually may catch-up with touch, feel, vibration, smell or sound. However, a somewhat different situation exists with respect to paper self-administered questionnaires. Although they can be touched and the pages turned, they rely mostly on the visual channel of communication with respondents. The way researchers communicate with respondents through this channel influences how individuals respond to the questionnaire.

Four visual languages, verbal, symbolic, numeric and graphical, are available for conveying the researchers' meaning (Redline and Dillman 2002). These languages can independently or jointly influence respondent behavior. Verbal language that refers to use of words is usually thought of as the primary means of communicating with questionnaire respondents. A body of research in survey methodology has shown the influence of the chosen words on respondent behavior (e.g., Schuman and Presser 1981; Sudman and

Bradburn 1974). Researcher expectations are also communicated through both symbolic language that relies on such symbols as arrows and boxes and numeric language, which uses numbers to give a sense of order and connectivity (Redline and Dillman 2002).

In addition, graphic language can independently convey expectations to respondents (Rothwell 1985; Smith 1993). Graphic language is about presentation, the way that the individual pieces of information are organized and presented. Specific changes in size, location, brightness, color, shape, spatial arrangement of numbers and symbols, figure/ground and other graphical features have been shown to influence the order in which all visual information is read, which information is associated with other information, and whether it is read at all (Jenkins and Dillman 1997; Christian and Dillman 2004). Graphic language influences the broad perception and interpretation of a survey because our vision and brains work together to understand the whole of what we are looking at by organizing visual scenes according to certain principles.

With an infinite number of possible interpretations of any scene, we rely on our visual intelligence to organize it into elements that we understand and recognize. This visual intelligence (Hoffman 1998) uses properties of a visual scene to trigger certain ways of grouping the pieces, prioritizing focus, sensing movement, and making it understandable. The rules and laws of perceptual organization determine how certain properties of a visual scene relate to its interpretation. Hoffman provides 20 specific rules of visual intelligence that we will reference specifically as needed, and the gestalt laws that explain basic patterns of visual perception will be our base.

Gestalt psychologists studied how the relationships between objects in a visual scene work to guide perception and interpretation (Palmer 1999). They found that our vision system detects edges, regions, groups, objects, and patterns in an optical image according to patterns of perceptual grouping. From the first glance, our visual system works to turn the many words, boxes, shaded regions, answer spaces, and other distinct bits of visual language on a page into visual elements that we recognize and understand. That simplification process works generally according to the gestalt laws.

The Law of Pragnanz tells us that the visual system will detect the simplest possible figures from the scene being observed, which tend to be those that are easiest to interpret and remember (Wallschlaeger and Busic-Snyder 1992; Palmer 1999). This means that the information on the page will be efficiently organized into the most basic elements that can be derived from the layout. The detailed pieces of visual language are perceived only after the broad visual layout is seen. Since our visceral reactions occur quickly, care should be taken to make sure that the basic shapes and arrangements are viscerally pleasing. For instance, an unfocused glance at a page should show bigger regions that are simple, symmetrical, warmly colored, or in some other way structured so that a positive visceral response is generated.

The Law of Common Region explains that people interpret smaller items within the larger regions as belonging together (Palmer 1999). Thus, the visual information held within broader, simpler visual elements will be associated together by respondents. This is why we assume that all of the information that is in a header or displayed against an area of colored background is linked to the other information in that space. Distinct steps in completing the survey can be separated for easier understanding and use by placing them within separate larger elements, helping at the behavioral level. At the same time, poorly

planned regions can lead to confusion and a poor behavioral level response if the regional separation is not in agreement with other ways of separating the information.

The Law of Proximity explains that the visual pieces closest to each other will be seen as belonging together as part of a larger visual element (Palmer 1999). This means that people will interpret numbers, boxes, symbols, letters, or other items that are closest to each other as being connected. By connecting certain items visually, the order of scanning and completing the form can be affected. Placing pieces of information that are not part of the same step too close together can cause confusion. This could make a poorly designed survey more difficult on the behavioral level or leave a bad emotional association at the reflective level.

The Law of Similarity states that items with similar color, shape, orientation, and size will be seen as belonging together (Palmer 1999). The visual pieces of a page will be organized according to their basic graphic properties, so people will interpret the information within the pieces as somehow similar as well. Visual design that uses similarity to create visual connections between steps that match and reinforce the intended survey process will make a questionnaire easier to use. On the other hand, inconsistency here can cause frustration (poor emotional design) and make the interpretation process more difficult (poor cognitive design).

The Law of Continuity says that smooth continuation between items will lead to them being seen as a single continuous element (Palmer 1999). If pieces of visual communication seem to run together, our eyes will see them as part of a single continuous element. This can be used to make completing a survey easier, as different graphic tools can create a path of perceived continuation through the page of questions. This can be a tool for emotional design by providing visual rhythm, and it can be a tool for cognitive design by offering a map through the process. However, bits of visual communication that unintentionally are perceived as exhibiting continuity can lead to questionnaires being completed in the wrong order or directions being misunderstood.

Although the negative consequences of poor visual layout have often been noted on questionnaires (e.g., Rothwell 1985; Smith 1993; Wright and Barnard 1978), relatively little research has been done that builds explicitly from gestalt psychology considerations of how visual information is perceived and processed. However, recent experimentation suggests that the quality of data for individual person questionnaires can be improved through careful attention to their visual qualities in a manner consistent with the gestalt principles developed through previous research. For example, Redline, Dillman, Dajani, and Scraggs (2003), have shown that the combined use of larger and brighter branching instructions, use of an arrow (a symbol) to direct respondents from each answer to the next appropriate question, and qualifying instructions at the front of the next question (e.g., "If Yes to question 10") decreased commission and omission error rates for the U.S. Decennial Census Long Form by 35% and 20%, respectively. This could come from the clear, bright visual layout (emotional design), the increased ease of use (cognitive design), or some combination. In addition Christian and Dillman (2004) found that answers to survey questions could be changed for a variety of questions by making graphic and symbolic changes. These include linear vs nonlinear display of answer categories, larger vs smaller spaces for open-ended questions, equal vs differential spacing between answer categories, and the use of arrows to direct respondents to subordinated questions.

We hope to achieve through the collective application of these ideas a questionnaire design that is not only cognitively easy to access and process, but also has a pleasing appearance that produces positive emotional reactions. A large part of this comes from avoiding contradictions between how the principles of visual perception organize the page, and how the verbal, symbolic and numeric languages intend to do so. By avoiding confusion between visual signals we aim to make the questionnaire easier to comprehend and more pleasurable to use. Accomplishment of consistency in visual design should, as suggested by Norman (2004), make it possible for more of the respondent's mental effort to be focused on understanding the substance of questions and providing thoughtful answers. Some of the design features introduced are justified by their cognitive qualities, others by their role in creating an initial positive impression at the visceral stage of processing, and some for a combination of cognitive and emotional design. Ultimately, we want to create the most usable questionnaire for respondents that is most likely to bring about a positive emotional reaction and also result in the most accurate answers.

3. Rules for Revision

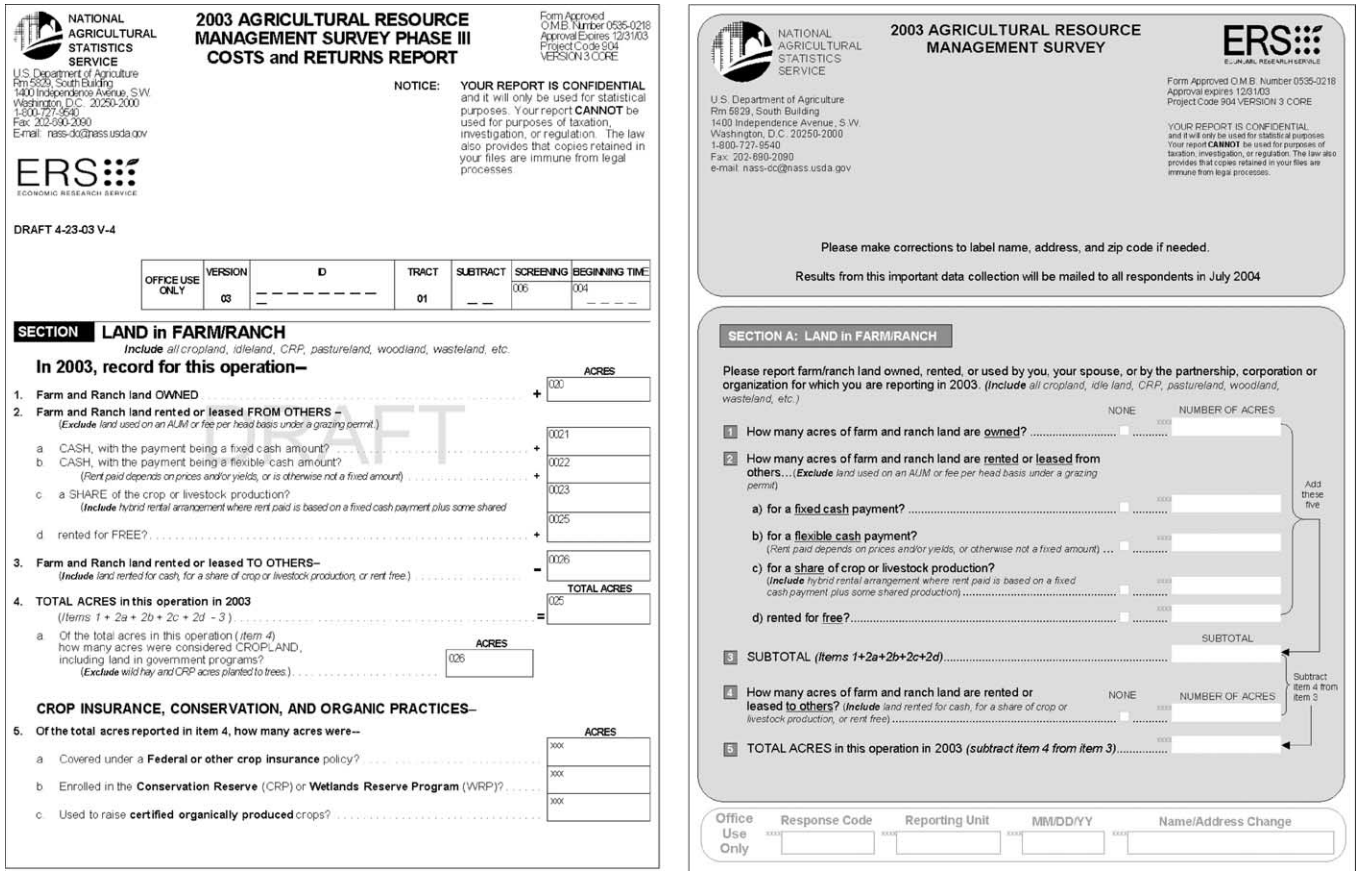
We think of the changes introduced here as *rules for revision* because of the limited amount of freedom we have for choosing many aspects of the visual displays. Our actions are directed and constrained by the principles and rules of how the human visual system automatically and effortlessly deciphers visual information. In general, people are not aware of existing rules of visual perception or their role in constructing what they see. These rules are implicit in their workings and cannot be ignored. We take advantage of the gestalt laws to develop rules for revision that get respondents to construct certain images from the visual clues we provide to them.

Each of the rules for revision relies on more than one principle of visual organization. The combined effect of these principles made the formulation and implementation of our rules possible.

The rules for revision may be understood as being at two levels. Some of them are more general and were adopted for use throughout the entire questionnaire to affect every questionnaire item. These rules might be applied not only to ARMS but also to a variety of other questionnaires. In addition, each page of ARMS involved specific design efforts in order to make that page work more effectively, some of which were unique to a particular page. These rules are ARMS specific and might not be generalized. We begin with issues affecting every page and move to more specific rules needed for particular questions. On the ARMS questionnaire, we shall demonstrate that adoption of particular procedures to solve one concern may limit one's options for other decisions.

3.1. Rule 1: provide a figure/ground composition that highlights answer spaces

Answer spaces were inconsistently displayed in the original questionnaire (left side of Figure 2). Our revision (right side of Figure 2) adopts the convention of white spaces for all answers on a light green background field that contrasts sufficiently with the white to make the box boundaries quite evident, thus eliminating the need for black-line borders. All questions were posed in black letters against the green background. This format is adopted for several reasons. One goal is to make the answer spaces more prominent.



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NOTICE: **YOUR REPORT IS CONFIDENTIAL** and it will only be used for statistical purposes. Your report **CANNOT** be used for purposes of taxation, investigation, or regulation. The law also provides that copies retained in your files are immune from legal processes.

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	03	_ _ _ _ _ _ _ _ _	01	_ _	006	004 _ _ _ _

SECTION LAND in FARM/RANCH

Include all cropland, idleland, CRP, pastureland, woodland, wasteland, etc.

In 2003, record for this operation–

		ACRES
1.	**Farm and Ranch land OWNED** +	020
2.	**Farm and Ranch land rented or leased FROM OTHERS –** (***Exclude*** *land used on an AUM or fee per head basis under a grazing permit.*)	
a	CASH, with the payment being a fixed cash amount? +	0021
b	CASH, with the payment being a flexible cash amount? (*Rent paid depends on prices and/or yields, or is otherwise not a fixed amount*) +	0022
c	a SHARE of the crop or livestock production? (***Include*** *hybrid rental arrangement where rent paid is based on a fixed cash payment plus some shared*	0023
d	rented for FREE? +	0025
3.	**Farm and Ranch land rented or leased TO OTHERS–** (***Include*** *land rented for cash, for a share of crop or livestock production, or rent free.*) –	0026
		TOTAL ACRES
4.	**TOTAL ACRES in this operation in 2003** (*Items 1 + 2a + 2b + 2c + 2d - 3*) =	025
a	Of the total acres in this operation (*item 4*) how many acres were considered CROPLAND, including land in government programs? (***Exclude*** *wild hay and CRP acres planted to trees.*)	ACRES 026

CROP INSURANCE, CONSERVATION, AND ORGANIC PRACTICES–

		ACRES
5.	**Of the total acres reported in item 4, how many acres were--**	
a	Covered under a **Federal or other crop insurance** policy?	xxx
b	Enrolled in the **Conservation Reserve** (CRP) or **Wetlands Reserve Program** (WRP)?	xxx
c	Used to raise **certified organically produced** crops?	xxx

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2003 AGRICULTURAL RESOURCE MANAGEMENT SURVEY

ERS ECONOMIC RESEARCH SERVICE

Form Approved O.M.B. Number 0535-0218
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YOUR REPORT IS CONFIDENTIAL and it will only be used for statistical purposes. Your report **CANNOT** be used for purposes of taxation, investigation, or regulation. The law also provides that copies retained in your files are immune from legal processes.

Please make corrections to label name, address, and zip code if needed.

Results from this important data collection will be mailed to all respondents in July 2004

SECTION A: LAND in FARM/RANCH

Please report farm/ranch land owned, rented, or used by you, your spouse, or by the partnership, corporation or organization for which you are reporting in 2003. (***Include*** *all cropland, idle land, CRP, pastureland, woodland, wasteland, etc.*)

		NONE	NUMBER OF ACRES
1	How many acres of farm and ranch land are owned?		
2	How many acres of farm and ranch land are rented or leased from others... (***Exclude*** *land used on an AUM or fee per head basis under a grazing permit*)		
	a) for a fixed cash payment?		
	b) for a flexible cash payment? (*Rent paid depends on prices and/or yields, or otherwise not a fixed amount*)		
	c) for a share of crop or livestock production? (***Include*** *hybrid rental arrangement where rent paid is based on a fixed cash payment plus some shared production*)		
	d) rented for free?		
3	SUBTOTAL (*Items 1+2a+2b+2c+2d*)		SUBTOTAL
4	How many acres of farm and ranch land are rented or leased to others? (***Include*** *land rented for cash, for a share of crop or livestock production, or rent free*)	NONE	NUMBER OF ACRES
5	TOTAL ACRES in this operation in 2003 (*subtract item 4 from item 3*)		

Add these five

Subtract item 4 from item 3

Office Use Only	Response Code	Reporting Unit	MM/DD/YY	Name/Address Change
	xxxx	xxxx	xxxx	xxxx

Fig. 2. Page 1 of original and revised ARMS questionnaires

Visually, the eye tends to lift them above the page so they are seen as figures against the green background. A reason for the tendency is that, according to Hoffman (1998), the eye tends to associate convex angles with figures and concave shapes with backgrounds. The tendency to see figures is accentuated by aligning the white answer spaces vertically to a greater extent than was done in the original questionnaire (e.g., Question 4a in the old form). Gestalt psychology also suggests that when regions of contrasting colors (in this case green and white) are viewed together, the smaller region is perceived as figure, and therefore is the one of immediate interest to respondents (Palmer 1999).

Thus, the natural tendency of the human visual system to pay attention and attend to those regions that are perceived as figures gave us a cause for introducing a new figure/ground composition that enhance visibility and prominence of answer spaces. By promoting the white answer spaces, usability is improved through Norman's principle of making visible what is needed (1988).

On the old questionnaire, the eye did not identify the answer spaces as figures. Thus, more cognitive effort was required for deciphering where the responses should go. By eliminating the shared black borders of the old questionnaire's answer boxes in favor of the boxes drawn through contrast with the green ground, the new response spaces are more easily associated with the appropriate question. Each space is now seen clearly as a single figure with distinct borders attached to a particular question by connecting dots, an application of the law of Proximity.

The addition of prominent white answer spaces for all answers against a contrasting background is also an attempt to exploit the power of constraints towards increased usability (Norman 1988) in support of the answering process. The contrast around the box helps target the eye and encourages people to keep their answers within the prescribed answer spaces. This physical constraint is empowered by relying on the human visual system preference to attend those regions that are perceived as figures (Palmer 1999). Although the present questionnaire was not planned for optical imaging, the format adopted here helps to "improve" handwriting for when the optical reading of answers is desired (Dillman 2000).

The similarity of shape, color, and size for all answer spaces as well as the symmetrical alignment establishes their visual grouping, an application of the law of similarity. Respondents receive an additional visual clue from these features about a common purpose of all answer spaces.

From an emotional design perspective, the figure/ground format chosen for the redesign seems justified. The initial and immediate reaction that occurs at the preattentive, visceral level may dispose respondents to answering questions even before any of the specific features of visual design have a chance of making a difference. Further, new figure/ground composition provides a simple visual delineation of space according to function that should make the answering process require less cognitive effort. Thus, addition of a brightly hued green background for the entire questionnaire may produce the impression of visual harmony and rhythm, which gives an initial first impression that is positive and can be carried on through the whole questionnaire.

3.2. Rule 2: delineate separate regions to identify thematic sections

The separation of sections with a small white area between green spaces (e.g., Figures 2 and 3), enhanced by a black contour around each of them, helps to identify sections, and changes of topics between sections. These are relevant to the respondent in two ways. The first way is to get a preview of what the questionnaire is about; the second is because the diversity of farming operations throughout the United States is such that some sections are not likely to be relevant to all respondents. Visual identification of these sections is based upon the gestalt psychology common region principle that those elements located within the region established by a contour are perceived together (Palmer 1999). It begins to establish the expectation that information within each bounded section is thematically related.

The natural tendency of the human visual system to pay attention and attend to those regions that are perceived as figures gave us an additional cause for introducing a visual separation between thematic sections. Black contour, green color and soft convex angles make respondents perceive the sections as figures on white background of the rest of the page, and of immediate interest. Separation of the sections promotes achieving the Norman Principle of Mapping.

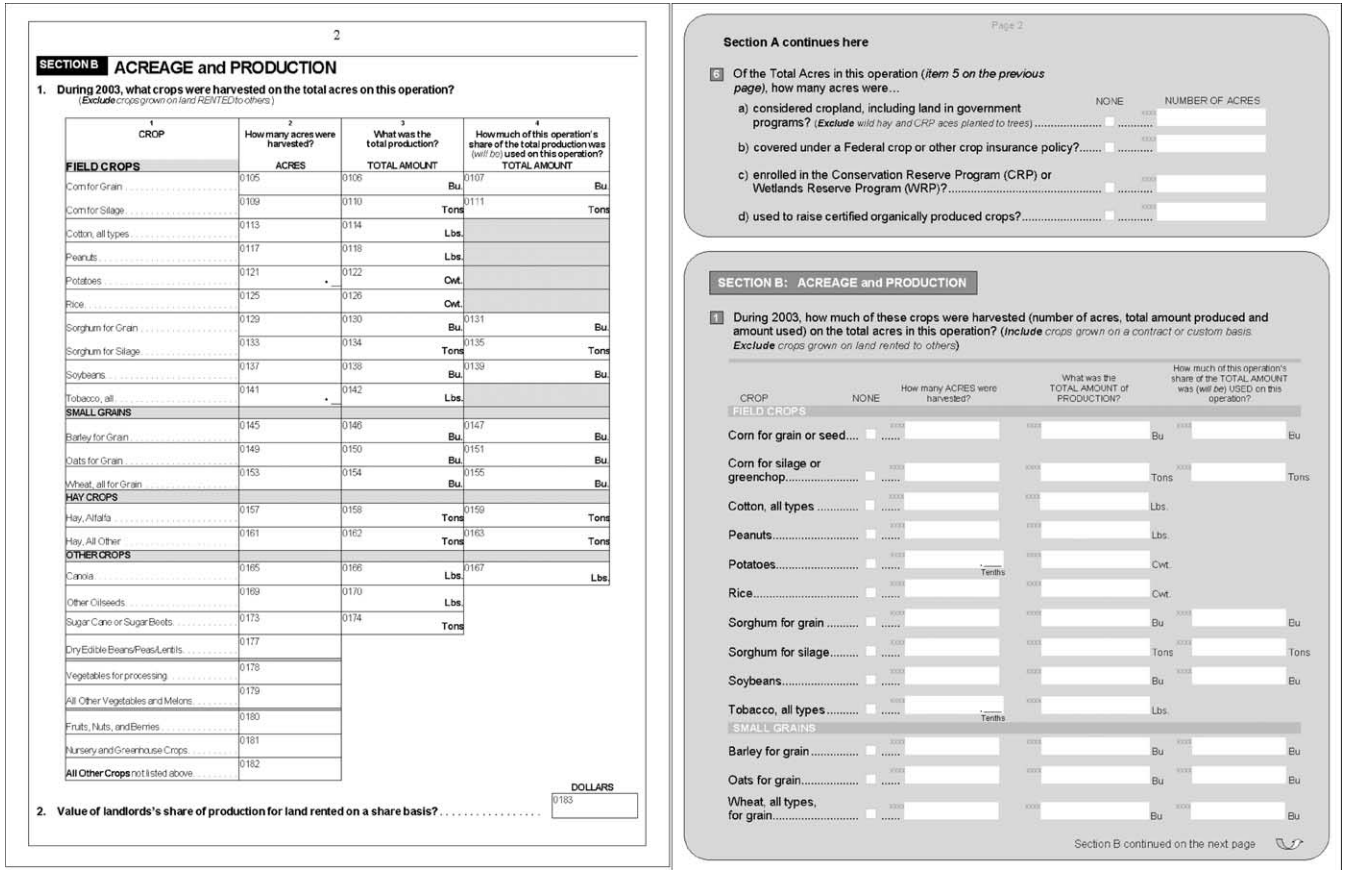
Although the spaces in the old questionnaire were separated by lines, the functions of those separations were less apparent. Because the section separation line was shared between two sections, it was not entirely clear whether the reverse block section letter and title was to be associated with the space above or below (see Figure 3). The separations accomplished here represented a continuation of the efforts made through the figure/ground changes mentioned above, to make relevant information visible and provide a clear mapping of what was expected from the respondent.

The separation of spaces serves an additional function on the first page (Figure 2). It helps to clarify where the respondent is to start answering questions. The top space also contains the address label (not shown) and provides agency contact information.

At the visceral level of emotional response, the clear separation of regions allows topical identification to be made more quickly than seems likely to happen on the old questionnaire. The corners of the sectional borders in the revised questionnaire are curved, which should also increase positive emotional response at the visceral level. According to Norman (2004) and Hoffman (1998), most people are inclined to experience more positive affective reaction towards softer edges and shapes. Thus, the method of delineating sections is aimed at achieving visual rhythm and comfort.

For the set of questions 1–5, on page 1 of the revised questionnaire (Figure 2), there is an implicit box on the left two thirds of the page. The contrasting white answer spaces form an implied vertical rectangle to the right. These implied shapes take advantage of familiar shapes (square and rectangle) to bridge respondents from an initial look to the content of the questions. Achieving uniformity in the text length of questions, which contrasts significantly with the old questionnaire, was aimed towards getting this quick shape recognition.

Also on page 1, the individual question and answer layouts have been changed following the Law of Similarity (similar objects seen as a group) in a way that facilitates visual comfort. At first glance, the new format appears as a vertical white rectangle of answer spaces, and to its left as a square of black text. This gives the initial interpretation



2

SECTION B **ACREAGE and PRODUCTION**

1. During 2003, what crops were harvested on the total acres on this operation?
(***Exclude*** *crops grown on land RENTED to others.*)

1 CROP	2 How many acres were harvested? ACRES	3 What was the total production? TOTAL AMOUNT	4 How much of this operation's share of the total production was (*will be*) used on this operation? TOTAL AMOUNT
FIELD CROPS			
Corn for Grain	0105	0106 Bu.	0107 Bu.
Corn for Silage	0109	0110 Tons	0111 Tons
Cotton, all types	0113	0114 Lbs.	
Peanuts	0117	0118 Lbs.	
Potatoes	0121 .	0122 Cwt.	
Rice	0125	0126 Cwt.	
Sorghum for Grain	0129	0130 Bu.	0131 Bu.
Sorghum for Silage	0133	0134 Tons	0135 Tons
Soybeans	0137	0138 Bu.	0139 Bu.
Tobacco, all	0141 .	0142 Lbs.	
SMALL GRAINS			
Barley for Grain	0145	0146 Bu.	0147 Bu.
Oats for Grain	0149	0150 Bu.	0151 Bu.
Wheat, all for Grain	0153	0154 Bu.	0155 Bu.
HAY CROPS			
Hay, Alfalfa	0157	0158 Tons	0159 Tons
Hay, All Other	0161	0162 Tons	0163 Tons
OTHER CROPS			
Canola	0165	0166 Lbs.	0167 Lbs.
Other Oilseeds	0169	0170 Lbs.	
Sugar Cane or Sugar Beets	0173	0174 Tons	
Dry Edible Beans/Peas/Lentils	0177		
Vegetables for processing	0178		
All Other Vegetables and Melons	0179		
Fruits, Nuts, and Berries	0180		
Nursery and Greenhouse Crops	0181		
All Other Crops not listed above	0182		

2. Value of landlords's share of production for land rented on a share basis? ..... DOLLARS 0183

Page 2

Section A continues here

6 Of the Total Acres in this operation (*item 5 on the previous page*), how many acres were...

	NONE	NUMBER OF ACRES
a) considered cropland, including land in government programs? (***Exclude*** *wild hay and CRP acres planted to trees*)	☐	xxxx
b) covered under a Federal crop or other crop insurance policy?	☐	xxxx
c) enrolled in the Conservation Reserve Program (CRP) or Wetlands Reserve Program (WRP)?	☐	xxxx
d) used to raise certified organically produced crops?	☐	xxxx

SECTION B: ACREAGE and PRODUCTION

1 During 2003, how much of these crops were harvested (number of acres, total amount produced and amount used) on the total acres in this operation? (***Include*** *crops grown on a contract or custom basis.* ***Exclude*** *crops grown on land rented to others*)

CROP	NONE	How many ACRES were harvested?	What was the TOTAL AMOUNT of PRODUCTION?	How much of this operation's share of the TOTAL AMOUNT was (*will be*) USED on this operation?
FIELD CROPS				
Corn for grain or seed	☐	xxxx	xxxx Bu	xxxx Bu
Corn for silage or greenchop	☐	xxxx	xxxx Tons	xxxx Tons
Cotton, all types	☐	xxxx	xxxx Lbs.	
Peanuts	☐	xxxx	xxxx Lbs.	
Potatoes	☐	xxxx .___ Tenths	xxxx Cwt.	
Rice	☐	xxxx	xxxx Cwt.	
Sorghum for grain	☐	xxxx	xxxx Bu	xxxx Bu
Sorghum for silage	☐	xxxx	xxxx Tons	xxxx Tons
Soybeans	☐	xxxx	xxxx Bu	xxxx Bu
Tobacco, all types	☐	xxxx .___ Tenths	xxxx Lbs.	
SMALL GRAINS				
Barley for grain	☐	xxxx	xxxx Bu	xxxx Bu
Oats for grain	☐	xxxx	xxxx Bu	xxxx Bu
Wheat, all types, for grain	☐	xxxx	xxxx Bu	xxxx Bu

Section B continued on the next page

Fig. 3. Page 2 of original and revised ARMS questionnaires

of only one answer space and one question space. Thus, it takes advantage of familiar shapes (Law of Pragnanz: simpler familiar shapes are easier to process and recall) to bridge respondents from an initial look at what is required to access the content of the questions. In contrast to the original questionnaire, a uniform text length for the questions has facilitated the creation of this effect. As a page that now consists of only a few separate and distinct geometric spaces, the revised survey may appear to respondents as easier to absorb and conquer.

Few pages of a questionnaire are more important than the initial page, which has a disproportional role in determining whether a questionnaire will be started immediately, or laid aside and perhaps forgotten. The visual changes made here in order to help people "enter" the page are substantial.

3.3. Rule 3: make agency-only information less visible to respondents

The general idea of this rule is to diminish the visual prominence of the office-use only information which is not relevant to respondents. ARMS contains three different kinds of agency information that add to the visual complexity of the questionnaire. Displacement, transformation, and removal of some agency-only information have been made to make unneeded information "invisible" for respondents.

The first piece of agency-only information, which is not relevant to the respondent, appears in the middle of the first page of the questionnaire (Figure 2). It visually stands out against the empty space around it. Bold print used for this information is likely to attract respondent attention. For that reason and because of its dominant location (Brandt 1945; Kahneman 1973), it is likely to be one of the first parts of the questionnaire seen by the respondent. Further, it may provide confusion, i.e., the respondent not knowing what to do as he or she decides how to begin answering the questionnaire.

In the revised questionnaire, two significant visual changes are made to the agency-only section on this page to improve respondent usability. First, the agency-use information is relocated to the bottom of the page. Research has shown that respondent eyes are less likely to see information in that location (Brandt 1945; Kahneman 1973). In addition, the black on green with white answer box figure/ground format is not used here; it is replaced by gray print that contrasts less against a white background. Thus, agency-only information became visually a part of the background and is less likely to be seen by respondents. Green sections, to the contrary, represent figures and attract immediate attention. The common region principle also suggests that everything that is outside of the green region is not of interest to respondents. Thus, the contour line around the green region of each thematic section becomes a "visual border" between relevant and irrelevant information.

The lighter print for agency-only information also emphasizes the subordinate character of this part of the page and is less likely to be seen by the respondent. When respondents start to respond they are likely to ascertain that their task is to provide answers in the white spaces on the green format. As attentive processing begins, they are likely to stay within the areas of green background fields (Jenkins and Dillman 1997). Agency personnel can be instructed on where the agency-only information is and how it is to be used, while in

essence making it invisible to the respondent as a result of the combination of location change and figure/ground contrast.

The second piece of agency-only information in the old questionnaire was unexplained key codes placed into the answer boxes used by respondents. Visual information that respondents are not expected to use adds to the visual complexity of the questionnaire that the respondent must learn to disregard. Use of the prominent key codes was motivated by cost savings during processing when each answer must be entered in a numbered location by data entry personnel.

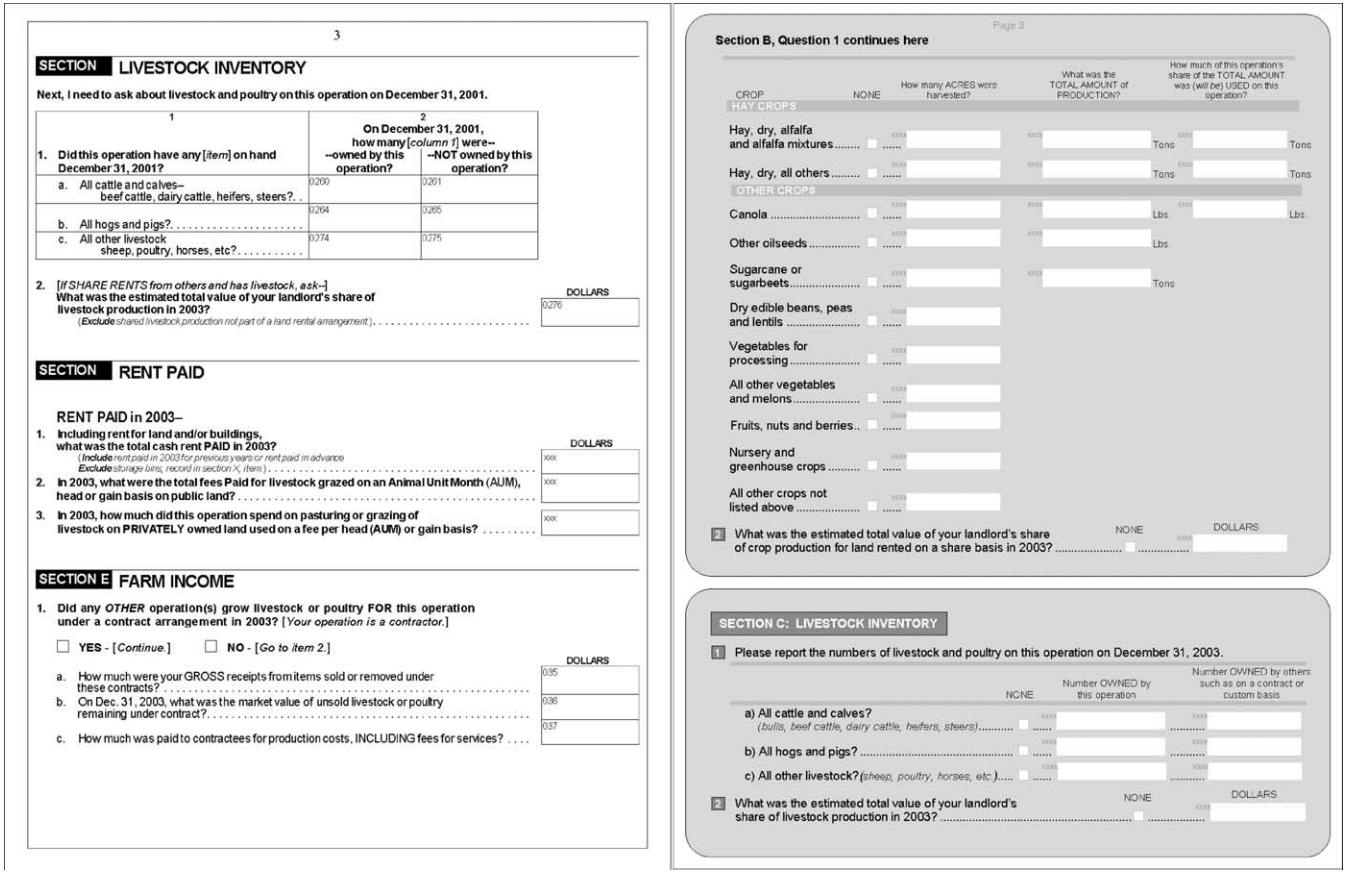
Two steps were taken to make these key codes less visible to the respondent, yet maintain their visibility to data entry operators during processing. First, they were moved outside of the answer spaces. This relocation, according to the common region principle, would separate these two pieces of information, key codes are not grouped visually with respondent answers because they are now a part of a background and not the figure. Second, they were printed in a gray font, which on the final printed questionnaire remained quite visible if one needed to find a key code, but would be less visible to respondents for whom all relevant visual information was printed in a black font. In addition, they were printed in a superscript position (as done in the old questionnaire) to lessen the seeming importance to respondents. The result of these steps was to make these codes relatively invisible to respondents. These steps are consistent with Norman's principle of making visible what is needed and invisible that which is not (1988).

Finally, the third piece of the agency-only information was unexplained office codes placed into one of the columns of the tables, e.g., Question 2 in Section E (Figure 5). It was not expected that the respondent would provide anything in that column. Its location in the same table as a request for the unit code discussed above made this especially problematic for some respondents. The simple solution was to eliminate the column and unexplained request. By making agency-only information invisible for respondents but reachable by agency personnel, we implemented Norman's cognitive principle of "make visible what is needed" with an aim of improvement in usability.

From the standpoint of emotional design, the benefit of making agency-only information less visible is that it added to overall visual comfort. The relocation of the key codes from inside to outside of the answer spaces and moving the office-use box to the bottom of the page might enhance the positive emotional reaction by adding to overall visual simplicity. Clean, symmetric, and simple shapes of answer spaces make information needed by the respondent easier to see and process. The agency-only box on page 4 of the questionnaire now possesses softer edges, which are soothing and rhythmically consistent with other visual elements. Further, the new figure is now symmetrically aligned within the page. Previously, this subsection was a sharp figure set emphatically out of line with other visual elements, making it particularly noticeable to respondents.

3.4. Rule 4: use reverse print to support preattentive processing and definition of navigational path

It is difficult for the eye to toggle between reverse and positive print (Redline and Dillman 2002). Therefore, reverse print should be avoided as a means of emphasizing words or



3

SECTION **LIVESTOCK INVENTORY**

Next, I need to ask about livestock and poultry on this operation on December 31, 2001.

1. Did this operation have any [*item*] on hand December 31, 2001?	2 On December 31, 2001, how many [*column 1*] were-- --owned by this operation?	--NOT owned by this operation?
a. All cattle and calves-- beef cattle, dairy cattle, heifers, steers?	0260	0261
b. All hogs and pigs?	0264	0265
c. All other livestock sheep, poultry, horses, etc?	0274	0275

2. [*If SHARE RENTS from others and has livestock, ask--*] **What was the estimated total value of your landlord's share of livestock production in 2003?** (*Exclude shared livestock production not part of a land rental arrangement.*) — DOLLARS 0276

SECTION **RENT PAID**

RENT PAID in 2003–

1. **Including rent for land and/or buildings, what was the total cash rent PAID in 2003?** (*Include rent paid in 2003 for previous years or rent paid in advance. Exclude storage bins, record in section X, item.*) — DOLLARS xxx
2. **In 2003, what were the total fees Paid for livestock grazed on an Animal Unit Month (AUM), head or gain basis on public land?** — xxx
3. **In 2003, how much did this operation spend on pasturing or grazing of livestock on PRIVATELY owned land used on a fee per head (AUM) or gain basis?** — xxx

SECTION E **FARM INCOME**

1. **Did any *OTHER* operation(s) grow livestock or poultry FOR this operation under a contract arrangement in 2003?** [*Your operation is a contractor.*]

☐ **YES** - [*Continue.*] ☐ **NO** - [*Go to item 2.*]

DOLLARS

a. How much were your GROSS receipts from items sold or removed under these contracts? 035

b. On Dec. 31, 2003, what was the market value of unsold livestock or poultry remaining under contract? 036

c. How much was paid to contractees for production costs, INCLUDING fees for services? 037

Page 3

Section B, Question 1 continues here

CROP	NONE	How many ACRES were harvested?	What was the TOTAL AMOUNT of PRODUCTION?	How much of this operation's share of the TOTAL AMOUNT was (*will be*) USED on this operation?
HAY CROPS				
Hay, dry, alfalfa and alfalfa mixtures	☐	xxxx	xxxx Tons	xxxx Tons
Hay, dry, all others	☐	xxxx	xxxx Tons	xxxx Tons
OTHER CROPS				
Canola	☐	xxxx	xxxx Lbs.	xxxx Lbs.
Other oilseeds	☐	xxxx	xxxx Lbs.	
Sugarcane or sugarbeets	☐	xxxx	xxxx Tons	
Dry edible beans, peas and lentils	☐	xxxx		
Vegetables for processing	☐	xxxx		
All other vegetables and melons	☐	xxxx		
Fruits, nuts and berries	☐	xxxx		
Nursery and greenhouse crops	☐	xxxx		
All other crops not listed above	☐	xxxx		

2 What was the estimated total value of your landlord's share of crop production for land rented on a share basis in 2003? — NONE ☐ — DOLLARS xxxx

SECTION C: LIVESTOCK INVENTORY

1 Please report the numbers of livestock and poultry on this operation on December 31, 2003.

	NONE	Number OWNED by this operation	Number OWNED by others such as on a contract or custom basis
a) All cattle and calves? (*bulls, beef cattle, dairy cattle, heifers, steers*)	☐	xxxx	xxxx
b) All hogs and pigs?	☐	xxxx	xxxx
c) All other livestock? (*sheep, poultry, horses, etc.*)	☐	xxxx	xxxx

2 What was the estimated total value of your landlord's share of livestock production in 2003? — NONE ☐ — DOLLARS xxxx

Fig. 4. Page 3 of original and revised ARMS questionnaires

phrases in sentences; such a use is likely to lead to the reverse printed information being passed over. However, another quality of reverse print is that it is bright and attracts the eye. Reverse print is reserved in the ARMS questionnaire for designating section letters and names, as well as the numbered items within each section. The reason for the first use is to facilitate preattentive processing. Its quality of being easily located makes reverse print ideal for helping respondents peruse the questionnaire to see which sections apply to their farm.

Because the reverse print is unlikely to be read when respondents are in an attentive processing mode, i.e., concentrating on understanding queries and providing answers, a related criterion for its use is not to put information that must be read into the reverse print headings.

Another significant part of the rule on reverse print was adopted for this questionnaire, and a change from the old one is to put both the section letter and title entirely into the reverse print (lower example) rather than leaving it divided and somewhat harder to read, as was the case in the old questionnaire (upper example). This change facilitates visual grouping where the revision is much easier to comprehend as an entire unit than is the first one shown here.

The continued use within each section of reverse print to identify questions is to help define clearly the dominant navigational path of the questionnaire. This theme was continued in branching questions by using similar reverse print boxes to specify the next question respondents who branched were supposed to answer. Thus, the laws of Similarity (similar figures will be seen as a group) as well as Pragnanz (figures with simplicity, regularity and symmetry are easier to perceive and remember) are being invoked to facilitate the connection between the instruction to branch and the desired destination of the branch.

The choice to use reverse print in these different but connected ways illustrates some of the conflicts involved in using a visual signal as powerful as reverse print (Palmer 1999). While its use for headings to facilitate preattentive processing or searching to locate particular sections of the questionnaire seemed justified by visual theory, its use in a string of information otherwise printed in positive print (the branching instruction) did not. In effect, we made the question numbers within the branching instructions slightly more difficult to read. However, it seemed justified because of the offsetting desire to connect visually the section headings with question numbers, in order to provide a better "mapping" of the navigational path.

The emotional benefit of the new section headings and question numbers stems from the consistent use of simple visual elements. This consistency encourages respondents to perceive the pages as simpler and more organized. The pattern also has greater salience because of now occupying a distinct space in the upper left-hand corner of every section and along the left margin, a feature that contributes to a sense of visual comfort and rhythm that we are attempting to develop.

3.5. Rule 5: use wording that enables sections and questions to stand alone

How questions are worded can have a profound effect on the visual processing of questionnaire pages. People normally read from top to bottom of a page. If words are not provided in the sequence that facilitates comprehension, the respondent is likely to have to reread information and otherwise deviate from the usual navigational path in order to complete questions accurately. Poorly located information expressed in phrases that are incomplete makes it more difficult for respondents to take advantage of other features of good visual design.

The beginning of Section A on page 1 (Figure 2) is an example of information being provided in a way that is likely to require rereading to get the sense of what a question is asking. Between the Section A designation and the first question are three lines, each in a different size font, further accentuated by variations in brightness and the use of capitals. Visual competition of the information creates additional burden to respondents rather than working together in helping them and providing the clear navigational and meaningful path.

LAND in FARM/RANCH
Include all cropland, idle land, CRP, pastureland, woodland, wasteland, etc.
In 2003, record for this operation-

This particular combination of words does not tell what the question is that this information is to be used for when answering, and it will most likely need to be read again after the respondent figures out what question is being asked. Next, the number "1" designates what is likely to be seen as the first question (see Figure 2) and it is followed by another incomplete phrase: "Farm and Ranch land OWNED." Only when one gets to the answer box (see Figure 2) is it specified that the respondent is being asked to provide the number of acres.

In the redesign, an initial instruction is provided for the section to explain what is wanted and it is expressed in a complete sentence. The first question that follows this statement is also posed as a complete sentence, with the number of acres being incorporated into the question. Respondents to the rewritten sequence of information are less likely to need to reread the information, and respondent burden will therefore be decreased. Throughout the revised questionnaire, cryptic phrases have been replaced with complete sentences in an effort to make both the sections and questions self-standing and easier to comprehend with less effort.

However, this rule does not extend to subquestions identified by a letter and parentheses mark, e.g., "a)." In these cases, the letters are sufficiently indented under the question number (about three spaces) to visually convey that the incomplete query is "grouped" under the complete query associated with the reverse print item number.

The changes in instructional information may also have an emotional benefit. The previous header and instructions appeared cluttered and unorganized because of varying sizes, boldness and alignment. The adoption of complete sentences in a unified format uses the gestalt law of Similarity to present each section question as a single figure. The subjective borders that become apparent where the complete sentences wrap to the next line strengthen this visual construction. The resulting continuity between the instruction and question text areas adds to the visual rhythm and comfort we are attempting to create through the introduction of simplicity.

3.6. Rule 6: establish consistency in use of all symbols and graphical arrangements across questions

This rule refers to the consistent use of such graphical features as boldness, font size, capitalization, italics, underlining, and branching arrows to convey unambiguous and clear meaning. The rationale for this rule comes from the gestalt law of Similarity and gestalt law of Pragnanz. The first states that similar elements are perceived as belonging together, carrying the same meaning, and serving the same purpose, and the second states that figures with simplicity, regularity and symmetry are easier to perceive and remember. Thus, consistent use of all graphics and symbols serves a function of visual grouping of required tasks and thereby making it easier for respondents to make sense of what is being asked.

In the old questionnaire, boldness was used for many different purposes, thus leaving the purpose of its use unclear. For example, in Figure 2, it was used for titles, special instructions, questions, words within subordinate queries, and answer space labels. The effect is to pull the eye away from reading all of the information on the page in appropriate sequence to focusing only on the bold information. The lack of clear purpose is accentuated on the old questionnaire by using capital letters in bold for multiple purposes, e.g., the heading prior to Question 5 and the "office-use only" information, the answer category labels, and certain words within already bolded phrases. In the redesign, an attempt was made to limit boldness to one purpose, i.e., **Include** and **Exclude** instructions, which the sponsors deemed critical for respondent understanding.

Underlining was adopted as a convention for emphasizing words in sentences. This use of lines was further limited to one word or phrase per question, with the most likely candidate for underlining being information that changed the question significantly from the preceding one, e.g., "owned" to "rented." (Dillman 2000, p. 204). The use of capitals was reserved for questions that involved operations with previously provided information, e.g., SUBTOTAL.

Italics, in combination with a slightly smaller font was selected for providing instructions. One reason for using this less visible (compared to large and bold) signal is that the instructions only apply to some people. In addition, the location of instructions immediately following the query to which they apply already places them in a location that fosters their use. Writing instructions in a larger and bolder font would tend to draw the eye past the question, rather than to the query that provides reason for reading or not reading the additional instructions.

Another vivid example of the inconsistent use of symbols and graphical arrangements is page 3 of the old questionnaire (Figure 4). Questions in the first section are boxed but questions in the latter two sections on this page are not boxed. Section C begins with an unnumbered question outside the box, whereas Section D begins with all capitals wording that is unnumbered, "RENT PAID in 2003," and the third section begins with a numbered question.

Whereas all questions are bolded in Section D, three complete sentence queries are not bolded in Section E (although a closer look shows the reason to be that they had letters in front of them rather than a number). Question 2 (in Section C) has a qualifying statement in brackets in front of it as follows: [If SHARE RENTS and has livestock, ask], and an

exclusion direction afterwards. The revision effort changed these items (pages 3 and 4 of the new version) to make the numbering, bolding and other information visually consistent.

The decision to attempt to limit specific visual signals, such as italics and underlining, to only one use is guided by the gestalt laws of Pragnanz and Similarity. It is also guided by our desire to keep people within a prescribed navigational path by eliminating the distraction of inconsistent graphical elements in many places. Consistent use of these signals was aimed in particular at realizing Norman's principle that when things have to be arbitrary, they should be standardized across the system, as well as making visible that which is needed, when it is needed (1988). In addition, the use of different symbolism for different tasks is consistent with providing good mapping. These visual clarifications also tend to simplify the structure of the response task; there is less to figure out at each stage of response.

This rule is, in essence, several simple rules with the collective aim of enabling respondents to detect more quickly than they would otherwise the intent of variations in the normal expression of words and phrases throughout the questionnaire. However, their combined effect on the overall questionnaire is large.

A visceral response associated with visual rhythm is a goal of the redesign. The existence of many different graphical arrangements for varied purposes at multiple locations in the old questionnaire promoted an interpretation of inconsistency in construction. Changes in text use occurred so frequently that each use appeared as a separate figure. With a unified approach to the use of graphics, each text area can now be processed preattentively as similar in construction to the others in which variations of text have a standard meaning. This gives the questionnaire a sense of visual rhythm that was lacking when emphasized words and phrases competed constantly for attention.

3.7. Rule 7: build in mechanisms for correcting errors

This general rule refers to the introduction of the symbolic and graphical elements for helping respondents to avoid errors by providing special process instructions where errors are likely to occur. There are several places where respondents might make errors. One such place is page 1 (Figure 2) of the old questionnaire, which requires the respondent to add-up five categories describing the number of acres of land owned, rented, and leased to others and subtract land rented to others to report total acres in the farming operation. The old method placed plus and minus symbols in front of answer boxes for the early questions to be referred to when answering the seventh query on the page. In their location ahead of the instructions, the symbols (+ or -) had no meaning until the appropriate subtraction and addition questions were read.

The intent of this process is consistent with Norman's principle of designing for error. The procedure used for the revised questionnaire involved designating a special graphical feature and construction to process actions. The request was indicated with capital letters (e.g., SUBTOTAL), followed by which items were to be added.

In addition, lines with arrows were added to the right of the answer boxes to show which categories should be added and subtracted. The tendency of the visual system to group elements with "common fate" encourages respondents to perceive answer boxes connected by lines and arrows as grouped together. Addition of lines and arrows to the

right of the answer boxes should not attract attention of respondents, but rather provide additional visual navigation for those who might need it. In the normal questionnaire answering process, respondents who provide answers go immediately to the next numbered question, and usually have no reason to look to the right of the answer boxes. In addition, perception research has shown that the area to the right and bottom of pages is least likely to attract the eye because of our cultural tendency to start at the upper left when we read (Kahneman 1973). Thus, the addition of lines on the right side of the answer space tend to be less visible to the respondent than would be the case if they were located between the query and the answer box. The final component of this redesign was the use of arrow heads (a powerful symbol) directed towards the "SUBTOTAL" answer space showing from where the number to be inserted was derived.

An inherent aspect of correcting for errors is to change directions from moving forward to going backwards. This unusual procedure of directing respondents to look backward (or upwards) on the page was the only use of placing information to the right of answer spaces.

Another source of error through the entire questionnaire was a lack of specification about what to do in case a question does not apply to respondents. No provision was made in that questionnaire for the respondent to indicate that a question did not apply other than writing zero, none or perhaps "does not apply to me" in certain boxes. Respondents were left with uncertainty in deciding what to report and how to report it for such questions. The consequence is for respondents to learn that leaving questions blank is an acceptable response behavior. Analysts reported that, when processing data from the old questionnaires, it was difficult to determine whether some items had been intentionally left blank or did not apply to the particular farm operation.

In the revision, a "None" box is added to encourage the habit of answering every question throughout the questionnaire. In all cases (see Figures 2–4), it is located in the same position on the dotted connecting line between the query and the answer space for reporting amounts. This consistency throughout the questionnaire makes it another of the many standardized features introduced into the revision. Use of a square of the size shown here, rather than a larger or smaller box or rectangle, is based on observations that this size of box encourages use of an "x" rather than a check mark; the "x" is a more constrained mark that is likely (because of the background color) to remain inside of the box, thus avoiding interference with other answer spaces when optical imaging is desired (Dillman 2000, Chapter 12).

In addition to making visible a needed response mechanism, this change was aimed at an important aspect of error correction. One of the benefits of the white answer spaces is to make it possible for the respondent to review a questionnaire to be sure appropriate questions were answered, which is consistent with the Norman principle of providing for error corrections. At the review phase, these markings could indicate to the respondent that the question had been read and marked. The white answer spaces on a colored background field make it much easier to identify questions that remain unanswered because the reviewer can concentrate visually on a smaller area of the questionnaire.

"Yes/No" branching instructions in the old questionnaire were designed in a way that made them more likely to be missed by respondents (Section E, Figure 4). The visual display for answer choices in this section was horizontal and widely separated. This format has been shown to place the second answer outside the foveal view (8–10 characters of

space), which is what the eye normally sees when doing attentive processing (Redline and Dillman 2002), and it is therefore more likely to be missed than if placed vertically within the natural navigation flow. In addition, the direction to skip sends a respondent to Item 2, which appears on a different page, further increasing the likelihood that it will be missed. To decrease errors, the branching questions have been rearranged vertically, with arrows being added to direct respondents to the next appropriate question. This branching format is based upon one tested by Redline, Dillman, Dajani, and Scaggs (2003) and found effective for reducing branching errors in a U.S. Decennial Census long form.

Including the symbolic arrows, mathematical symbols, and a "None" box to correct for errors would seem to add some visual burden to the respondents by increasing the overall number of visual elements. While not entirely concordant with the established graphical pattern, the redesign may still provide more visual rhythm than the original. Although addition of the arrows at an unexpected place breaks the visual simplicity, that loss is at least partially offset. We think that this loss of simplicity will be repaid at the attentive level of processing later when the human eye's tendency to construct T-intersections (Hoffman 1998) will help respondents to see the junction of the answer spaces and the arrows and relate to them in a more efficient way. Additionally, the new layout encourages the perception of the branching questions as individual figures that no longer blend into the next question.

Visual consistency of the shape of "None" boxes, vertical symmetry, and aligning with the questions and other answer spaces, do not evoke a negative immediate response at the visceral level. These smaller white answer spaces intertwine with other visual elements and set up completeness rather than disconnection with the overall organization of the page.

3.8. Rule 8: establishing visual connections between pages

Adoption of a separate region format for topics produced a need to provide an appropriate visual connection across pages. The old questionnaire simply continued to the next page when necessary with no special notation other than a page number at the top of each page.

In general, we think it is desirable to avoid continuing sections from one page to the next. However, that is not always possible and is a far better alternative than cramming information together to make it fit on one page, or leaving large blank spaces. When a section had to be continued onto the next page, three steps were made to clarify the continuation. A header was added in positive print, e.g., "Section A continues Here." (Figure 3). This information was not placed in the reverse print box, because doing so would add confusion during preattentive processing in which one was perusing the section topics. In addition, because of being a continuation of the previous section, positive print was more likely to be read during the attentive processing of reporting answers and signal that the same subject was continued onto the next page.

At the bottom of the page, a similar footer was used to indicate the continuation of the section on the next page, and a curved arrow was placed there to suggest going to the top of that page. Adoption of this rule is partly influenced by Norman's knowledge in the head principle. Arrows are traditionally used in the larger U.S. culture to navigate where to go and are understood by virtually all respondents in the same way. An additional verbal

statement, "Go to the next page," that accompanies the arrow, facilitates the overall visual effect of established visual connectivity.

Even in this more specific aspect of construction, designing for usability also means designing for emotional response. The introduction of the footer in the form of the curved arrow is focused on increasing usability because it is located in a place that is less likely to be seen at the preattentive stage of processing, and soothing shapes that repeat the shape of the sections corners, as noted by Hoffman (1998), tend to evoke positive emotional responses (if seen).

3.9. Rule 9: make hidden questions more visible

Section B on page 2 of the old questionnaire (Figure 3) provides an example of a question that is likely not to be answered because of being missed by the respondent, a fact noted from previous use of the questionnaire. The hidden question is Number 2 at the bottom of that page, which has its answer box in the extreme lower right corner. There are two reasons that some respondents will fail to complete it. First, it is visually dominated by the other questions on the page; the lined connections that link all components of this dominant question also make the orphaned question appear very different, thus increasing the likelihood of it not being seen as a question. Second, evidence on how people process information (Brandt 1945; Kahneman 1973) indicates that people are most likely to start in the upper left-hand corner, so the eye often misses information in the lower right portion of the page.

Our effort to solve this problem is based on the gestalt psychology figure/ground organization and Hoffman's research on how people process information. The change to the white box on green background format and rectangular shape made the answer spaces for the hidden question more prominent. In addition, the relocation of this question to near the middle of the page, put it in a location more likely to be seen and attended by respondents.

The visual changes introduced here have been made in support of making the mappings clear. The resulting visual consistency of the questions and aligning of answer spaces set up the visual completeness and clarity of the overall page and thus may also evoke a positive immediate response at the visceral level.

3.10. Rule 10: simplify each matrix by building consistency, regularity and completeness across the many parts

Few question structures are more challenging for respondents to complete than are matrices in which several items of related information are requested for multiple items. The challenge to questionnaire designers is equally great. Instead of stating a simple query followed by any needed instructions or qualifications and an answer space or categories, the query is often broken into a succession of parts that the respondent must connect in the desired manner; and, because so many parts may be asked in increasingly cryptic language to stay within space limits, the connection of parts to form the whole becomes problematic (Wright and Barnard 1978).

Question B1, page 2 (Figure 3) illustrates many of these challenges. It requests three kinds of information for each of many possible crops that might be grown in the farm

operation. The mental challenge is to recall each question as one moves down the matrix. The old version of the questionnaire makes it much more difficult to do that than is necessary. Initially, the question asks what crops were harvested, but when one gets to the columns, it becomes apparent that it is not the question to be answered. This is solved in the revision by stating the question in a more complete form, an application of Rule 5.

The old form has column numbers, with "1" for the first column being the same as the question number. Thus, the same numbers are being used for two different purposes. This use of numbers makes it difficult to achieve the needed connectivity between the overall and specific questions being asked. The numbers are not needed by the respondent, and were removed. Perhaps because of the complexity of the multiple questions, which tax short term memory, the designers of the old survey added summary words at the top of each column in capital letters, with the same wording, "TOTAL AMOUNT" above the last two columns, which asked for different figures. The information has been simplified by removing both the numbers and summary words.

The column numbers and summary words in the old version suggest use of the Norman "design for error" principle (1988). In some instances, this might be helpful to respondents. However, because of all of the other information that the respondent needed to recall (three questions, specific crops, and units for reporting), the addition of summary word meanings results in short term memory being taxed beyond its common limit of 4–5 items. The more information the respondents need to remember simultaneously, the more difficulties they have while completing the form, and the more errors they are likely to make.

The box format with vertical lines between columns makes it difficult to visually move from left to right inasmuch as the eye sees dividing lines not associated with either box. According to the figure/ground organization principle, the answer spaces, as they are designed on this page, are difficult to comprehend despite the lines between the boxes because they are not visually separated from the background and from each other. Dividing lines that have been used to separate the boxes cannot be ascribed to any of the boxes (see Rule 1 on figure/ground aspects of old and new formats). In addition, the most dominant visual parts of the matrix are those that are of least direct importance, the gray shading that indicates a box should not be completed, and the capitalized headings, e.g., **Field Crops,** set against a similar gray background. In addition, the gray backgrounds are being used there for two different purposes.

A major challenge of redesigning this question was to encourage respondents to simultaneously process information horizontally as well as vertically. This was accomplished in several ways. Initially, the common region signaled by the green fields surrounded by contour lines conveys the expectation that all of the answer spaces are related. The addition of a new visual feature, dark green horizontal lines, helps to orient respondents in that direction; these bars were also used for the reverse print (white on green) general category descriptions. The visual strength of the many white boxes that are more separated, by distance, horizontally than vertically (based upon law of proximity) was used to convey the vertical nature of the display, which in turn helps emphasize the connectivity of the vertical line of boxes to the question at the top of each column. The similarity of all boxes (none are gray and the darker green horizontal lines provide only a minor visual interruption to the vertical flow) also helps strengthen the vertical orientation

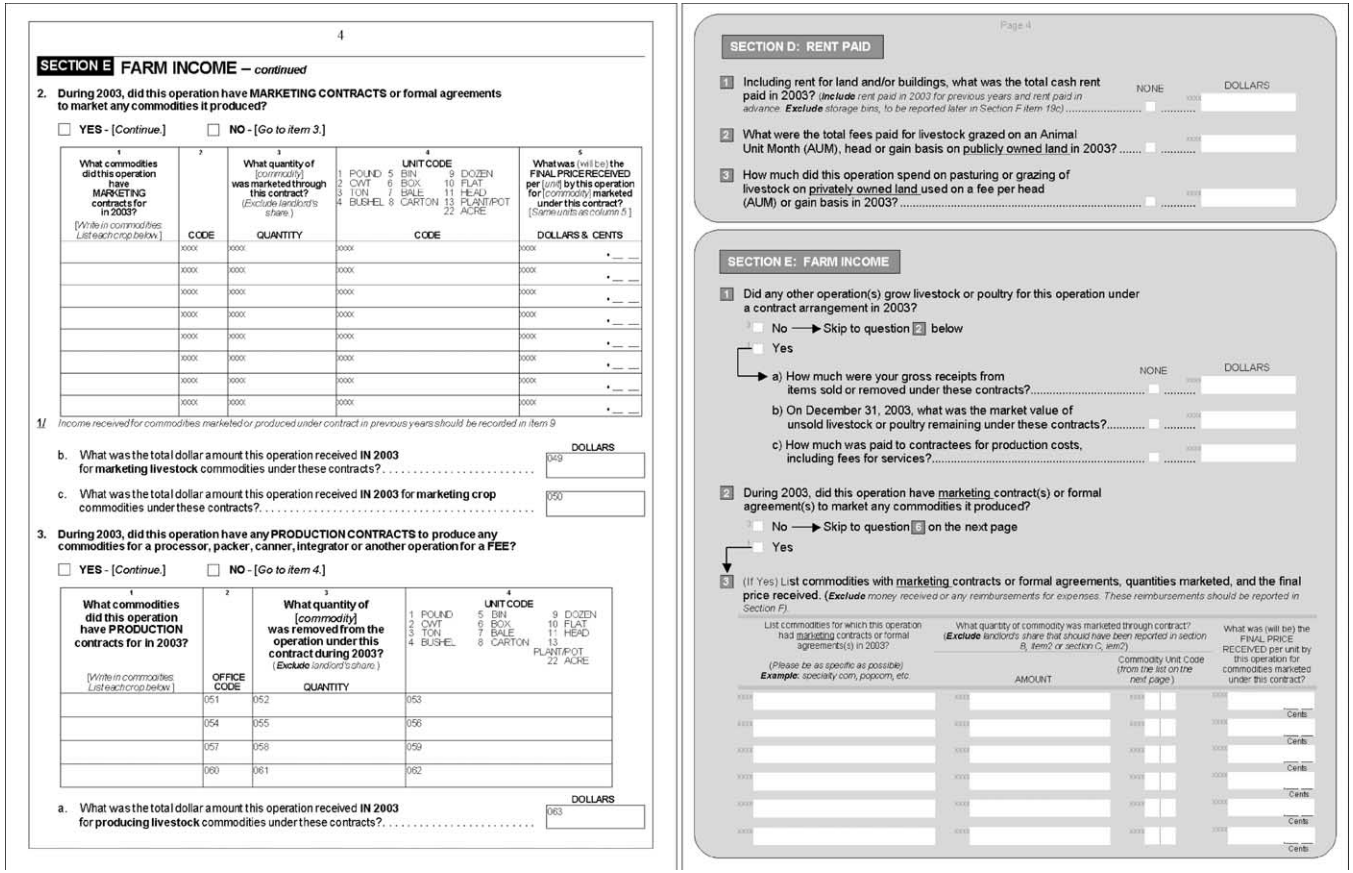
and connection. Simultaneously, the removal of vertical dividing lines between columns and use of dotted leaders to connect specific crops to answer spaces helps give a horizontal orientation to each crop. The unit measures were placed outside the respondent box in the natural position (to the right) of where the number was to be written. Tenths of acres, which applied to only two crops (potatoes and tobacco), were displayed prominently within boxes, because of the break from convention (whole acres) used for all other crops.

Our attempt to improve the visual display of this question was oriented first towards the elimination of considerable unnecessary visual information, second, in rationalizing the question wording sequence, and third, using several techniques to establish simultaneously a vertical and horizontal flow. The expected outcome with regard to Norman's principles is to simplify the task, and get respondents to understand the mapping of a new type of question, the matrix, which is being experienced by the respondent for the first time in this survey, as well as exploiting the power of constraints (Figure 3).

The first question on page 3 of the old questionnaire (Figure 4), the livestock inventory, provides another example of greatly simplifying a matrix question that exhibits many of the same problems as the crop production matrix just discussed. It shows how even short questions may become confusing because of wording that depends upon later phrasing to provide clarity. In this case, the initial query asks about livestock and poultry, the subsequent numbered question (1) asks about unspecified "item" on hand, and a third query (a) finally specifies cattle and calves. In addition, a reference to number on hand December 31, 2001, is specified three times, one of which is an unnecessary additional column heading. Our rework of this question, which now appears at the bottom of the new page 3 in Figure 4, follows a similar approach to our revision of the previous matrix question, using rewording of the parts and elimination of redundant number "1's." It also eliminates the redundant dates, and a query "Did this operation have any (item) on hand December 31, 2001?" that is not consistent with what is being requested, i.e., the number owned and not owned. This revision effort seeks to simplify and get the mappings right, while also extending the standardization that started with asking the matrix question that preceded it.

The application of this rule on consistency, regularity and completeness across parts, started with a focus on words, and finding the appropriate division of labor in what words needed to be located in which part of the multiple step query, and then continued with visual layout changes that would help the respondent connect the parts into a coherent whole. Few questionnaire construction tasks are more difficult to achieve than the application of this rule because of the necessity of relating so many subparts together to form the whole. The division of the initial matrix into distinct spatial figures also works to provide a good first impression through enhanced simplification.

There are nearly as many visceral response benefits to the redesign of this matrix as there are usability enhancements because matrices can be the most visually complicated space on a survey, already inspiring negative emotional judgment. On the most basic level, the visual comfort of the newer version of the survey is amplified through simplification. By replacing the spider web of shared question, header, and answer borders with the new figure/ground composition the design is simpler. The initial matrix is constructed by the eye into a single, uncomfortably misshapen mass of survey query. The law of Proximity has been used to visually connect the answer spaces of each column into three distinct and



4

SECTION E FARM INCOME – *continued*

2. During 2003, did this operation have MARKETING CONTRACTS or formal agreements to market any commodities it produced?

☐ **YES** - [*Continue.*] ☐ **NO** - [*Go to item 3.*]

1 What commodities did this operation have MARKETING contracts for in 2003? [*Write in commodities. List each crop below.*]	2 CODE	3 What quantity of [*commodity*] was marketed through this contract? (*Exclude landlord's share.*) QUANTITY	4 UNIT CODE 1 POUND 5 BIN 9 DOZEN 2 CWT 6 BOX 10 FLAT 3 TON 7 BALE 11 HEAD 4 BUSHEL 8 CARTON 13 PLANT/POT 22 ACRE CODE	5 What was (will be) the FINAL PRICE RECEIVED per [*unit*] by this operation for [*commodity*] marketed under this contract? [*Same units as column 3.*] DOLLARS & CENTS
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __
	xxxx	xxxx	xxxx	xxxx .__ __

1/ *Income received for commodities marketed or produced under contract in previous years should be recorded in item 9.*

DOLLARS

b. What was the total dollar amount this operation received **IN 2003** for **marketing livestock** commodities under these contracts? 049

c. What was the total dollar amount this operation received **IN 2003** for **marketing crop** commodities under these contracts? 050

3. During 2003, did this operation have any PRODUCTION CONTRACTS to produce any commodities for a processor, packer, canner, integrator or another operation for a FEE?

☐ **YES** - [*Continue.*] ☐ **NO** - [*Go to item 4.*]

1 What commodities did this operation have PRODUCTION contracts for in 2003? [*Write in commodities. List each crop below.*]	2 OFFICE CODE	3 What quantity of [*commodity*] was removed from the operation under this contract during 2003? (*Exclude landlord's share.*) QUANTITY	4 UNIT CODE 1 POUND 5 BIN 9 DOZEN 2 CWT 6 BOX 10 FLAT 3 TON 7 BALE 11 HEAD 4 BUSHEL 8 CARTON 13 PLANT/POT 22 ACRE
	051	052	053
	054	055	056
	057	058	059
	060	061	062

DOLLARS

a. What was the total dollar amount this operation received **IN 2003** for **producing livestock** commodities under these contracts? 063

Page 4

SECTION D: RENT PAID

1 Including rent for land and/or buildings, what was the total cash rent paid in 2003? (***Include*** *rent paid in 2003 for previous years and rent paid in advance. **Exclude** storage bins, to be reported later in Section F item 19c)* ..... NONE ☐ DOLLARS xxxx .....

2 What were the total fees paid for livestock grazed on an Animal Unit Month (AUM), head or gain basis on publicly owned land in 2003? ..... NONE ☐ xxxx .....

3 How much did this operation spend on pasturing or grazing of livestock on privately owned land used on a fee per head (AUM) or gain basis in 2003? ..... NONE ☐ xxxx .....

SECTION E: FARM INCOME

1 Did any other operation(s) grow livestock or poultry for this operation under a contract arrangement in 2003?

☐ No → Skip to question 2 below

☐ Yes

a) How much were your gross receipts from items sold or removed under these contracts? ..... NONE ☐ DOLLARS xxxx .....

b) On December 31, 2003, what was the market value of unsold livestock or poultry remaining under these contracts? ..... NONE ☐ xxxx .....

c) How much was paid to contractees for production costs, including fees for services? ..... NONE ☐ xxxx .....

2 During 2003, did this operation have marketing contract(s) or formal agreement(s) to market any commodities it produced?

☐ No → Skip to question 5 on the next page

☐ Yes

3 (If Yes) List commodities with marketing contracts or formal agreements, quantities marketed, and the final price received. (***Exclude*** *money received or any reimbursements for expenses. These reimbursements should be reported in Section F).*

List commodities for which this operation had marketing contracts or formal agreement(s) in 2003? (*Please be as specific as possible*) ***Example:*** *specialty corn, popcorn, etc.*	What quantity of commodity was marketed through contract? (***Exclude*** *landlord's share that should have been reported in section B, item7 or section C, item7*) AMOUNT	Commodity Unit Code (*from the list on the next page*)	What was (will be) the FINAL PRICE RECEIVED per unit by this operation for commodities marketed under this contract?
xxxx	xxxx	xxxx	xxxx .__ __ Cents
xxxx	xxxx	xxxx	xxxx .__ __ Cents
xxxx	xxxx	xxxx	xxxx .__ __ Cents
xxxx	xxxx	xxxx	xxxx .__ __ Cents
xxxx	xxxx	xxxx	xxxx .__ __ Cents
xxxx	xxxx	xxxx	xxxx .__ __ Cents

Fig. 5. Page 4 of original and revised ARMS questionnaires

simple answer areas, reducing the density of required information and making it more manageable. Additionally, the spaces constructed out of the negative space where answers are not required are now the symmetrical, well recognized rectangles.

The division of the previously angular matrix into distinct spatial figures according to function also works to provide a good first impression. The visual rhythm that is maintained from other pages is immediately more pleasing than the previous visual disorganization. In addition to the figure/ground composition changes, the extension of the horizontal header lines across the page replicates the visual pattern of the borders between sections on other pages.

With this matrix taking up the entirety of one page, the use of the horizontal visual elements to break up the page into subsections also adds to the visual harmony by providing balance. Likewise, where before there appeared an indistinguishable mass of potential answer space, the contrast between answer space and background demonstrates a more balanced load of color and function, and that balance is another trigger for positive emotional effect (Norman 2004).

3.11. Rule 11: place codes that the respondent is required to use near where they are to be used

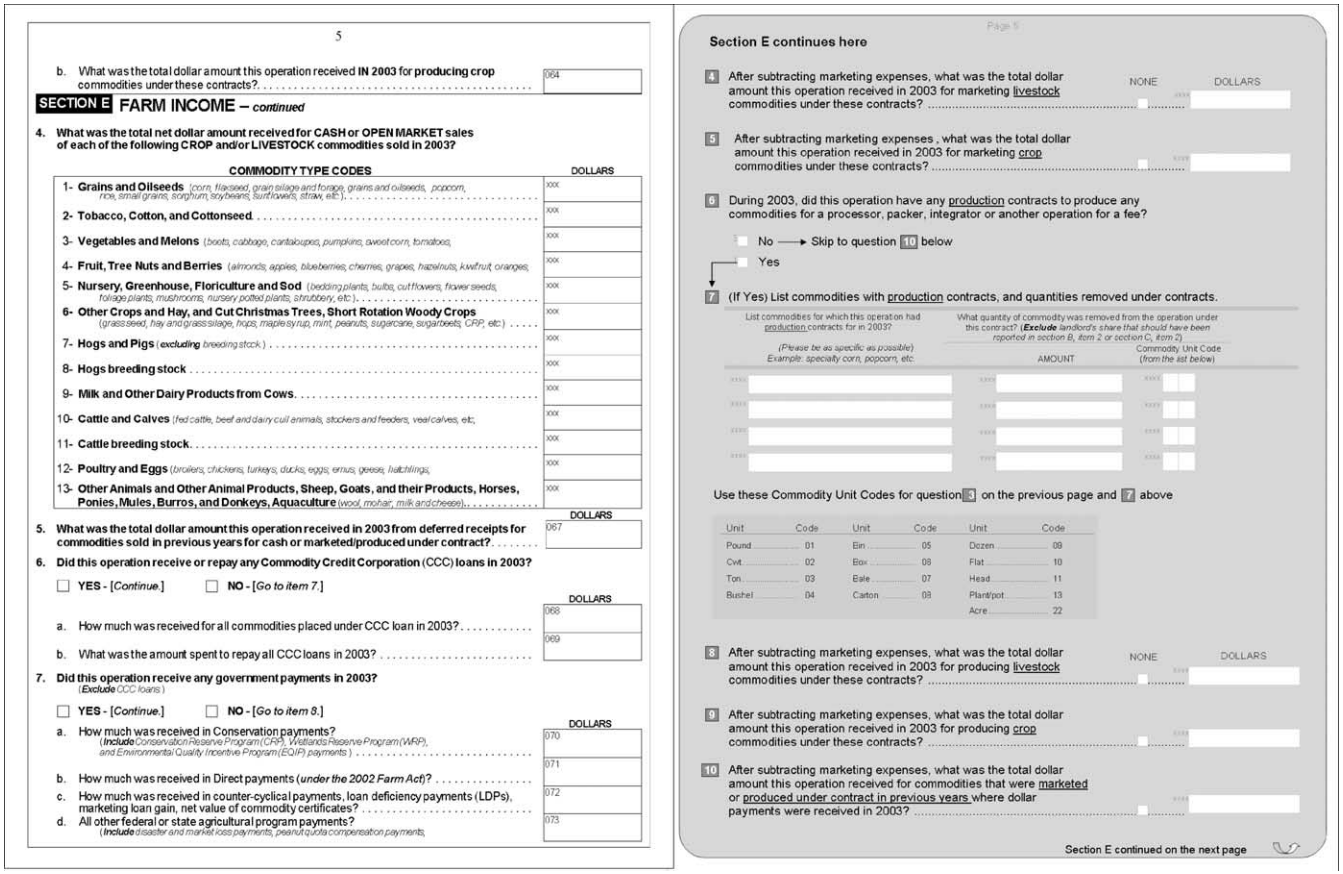
The old ARMS questionnaire required respondents to enter codes for certain answers. In some cases, they were provided elsewhere on the same page, and, in one case, they were required to go to an instruction booklet that was eliminated in the questionnaire revision.

Page 4 of the old questionnaire (Figure 5) provides an example of listing codes (units of measure) for the respondent to enter. There is also a visual mismatch here between the one or two digit number the respondent is to enter and the space provided for the code, which was based upon the amount of width needed to list all of the codes. There is evidence from web survey research that such a mismatch between the amount of space provided and the expected answers leads to respondents not providing the requested answer (Couper, Traugott, and Lamias 2001).

We also observed that the same codes were being used for two questions on adjacent pages. Our solution to this problem was to print the codes in a different figure ground configuration (black print on a darker green color; Figure 6), and resize the answer space so that it showed room for a maximum of two numbers and directed respondents to the box.

A related reason for introducing this visual aspect to the questionnaire was because on a later page, respondents would be used again in order to eliminate the need to go to an instruction booklet to find coding information. The same format was used there to communicate the codes to be used for providing an appropriate answer.

The change in figure-ground to black on a darker green, was to make the codes seem not part of the normal sequence of questions signified by black on the same light green but rather a separate piece of information grouped together. We find this not particularly attractive, aesthetically, but concluded that its use was more desirable than prelisting commodities with response units, only one or two of which might be used by a particular respondent. The current solution required considerably less space.



5

b. What was the total dollar amount this operation received **IN 2003** for **producing crop commodities** under these contracts? 064

SECTION E FARM INCOME – *continued*

4. What was the total net dollar amount received for CASH or OPEN MARKET sales of each of the following CROP and/or LIVESTOCK commodities sold in 2003?

COMMODITY TYPE CODES	DOLLARS
1- **Grains and Oilseeds** (corn, flaxseed, grain silage and forage, grains and oilseeds, popcorn, rice, small grains, sorghum, soybeans, sunflowers, straw, etc.)	xxx
2- **Tobacco, Cotton, and Cottonseed**	xxx
3- **Vegetables and Melons** (beets, cabbage, cantaloupes, pumpkins, sweet corn, tomatoes)	xxx
4- **Fruit, Tree Nuts and Berries** (almonds, apples, blueberries, cherries, grapes, hazelnuts, kiwifruit, oranges)	xxx
5- **Nursery, Greenhouse, Floriculture and Sod** (bedding plants, bulbs, cut flowers, flower seeds, foliage plants, mushrooms, nursery potted plants, shrubbery, etc.)	xxx
6- **Other Crops and Hay, and Cut Christmas Trees, Short Rotation Woody Crops** (grass seed, hay and grass silage, hops, maple syrup, mint, peanuts, sugarcane, sugarbeets, CRP, etc.)	xxx
7- **Hogs and Pigs** (***excluding*** breeding stock.)	xxx
8- **Hogs breeding stock**	xxx
9- **Milk and Other Dairy Products from Cows**	xxx
10- **Cattle and Calves** (fed cattle, beef and dairy cull animals, stockers and feeders, veal calves, etc.	xxx
11- **Cattle breeding stock**	xxx
12- **Poultry and Eggs** (broilers, chickens, turkeys, ducks, eggs, emus, geese, hatchlings,	xxx
13- **Other Animals and Other Animal Products, Sheep, Goats, and their Products, Horses, Ponies, Mules, Burros, and Donkeys, Aquaculture** (wool, mohair, milk and cheese)	xxx

DOLLARS

5. What was the total dollar amount this operation received in 2003 from deferred receipts for commodities sold in previous years for cash or marketed/produced under contract? 067

6. Did this operation receive or repay any Commodity Credit Corporation (CCC) loans in 2003?

☐ **YES** - [*Continue.*] ☐ **NO** - [*Go to item 7.*]

DOLLARS

a. How much was received for all commodities placed under CCC loan in 2003? 068

b. What was the amount spent to repay all CCC loans in 2003? 069

7. Did this operation receive any government payments in 2003?
(***Exclude*** *CCC loans.*)

☐ **YES** - [*Continue.*] ☐ **NO** - [*Go to item 8.*]

DOLLARS

a. How much was received in Conservation payments?
(***Include*** *Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), and Environmental Quality Incentive Program (EQIP) payments.*) 070

b. How much was received in Direct payments (***under the 2002 Farm Act***)? 071

c. How much was received in counter-cyclical payments, loan deficiency payments (LDPs), marketing loan gain, net value of commodity certificates? 072

d. All other federal or state agricultural program payments?
(***Include*** *disaster and market loss payments, peanut quota compensation payments,* 073

Page 5

Section E continues here

4 After subtracting marketing expenses, what was the total dollar amount this operation received in 2003 for marketing livestock commodities under these contracts? NONE ☐ DOLLARS xxxx

5 After subtracting marketing expenses , what was the total dollar amount this operation received in 2003 for marketing crop commodities under these contracts? NONE ☐ DOLLARS xxxx

6 During 2003, did this operation have any production contracts to produce any commodities for a processor, packer, integrator or another operation for a fee?

☐ No → Skip to question **10** below

☐ Yes

7 (If Yes) List commodities with production contracts, and quantities removed under contracts.

List commodities for which this operation had production contracts for in 2003? (*Please be as specific as possible*) *Example: specialty corn, popcorn, etc.*	What quantity of commodity was removed from the operation under this contract? (***Exclude*** *landlord's share that should have been reported in section B, item 2 or section C, item 2*) AMOUNT	Commodity Unit Code (*from the list below*)
xxxx	xxxx	xxxx
xxxx	xxxx	xxxx
xxxx	xxxx	xxxx
xxxx	xxxx	xxxx

Use these Commodity Unit Codes for question **3** on the previous page and **7** above

Unit	Code	Unit	Code	Unit	Code
Pound	01	Bin	05	Dozen	09
Cwt	02	Box	06	Flat	10
Ton	03	Bale	07	Head	11
Bushel	04	Carton	08	Plant/pot	13
				Acre	22

8 After subtracting marketing expenses, what was the total dollar amount this operation received in 2003 for producing livestock commodities under these contracts? NONE ☐ DOLLARS xxxx

9 After subtracting marketing expenses, what was the total dollar amount this operation received in 2003 for producing crop commodities under these contracts? xxxx

10 After subtracting marketing expenses, what was the total dollar amount this operation received for commodities that were marketed or produced under contract in previous years where dollar payments were received in 2003? xxxx

Section E continued on the next page

Fig. 6. Page 5 of original and revised ARMS questionnaires

3.12. Rule 12: provide strong visual guides for changes in respondent use of answer spaces

When respondents have been taught over the course of several pages to respond in a particular way, and it is necessary to change that pattern for a particular question, strong visual signals need to be sent so that respondents are aware of the change. Such a situation existed for the price received per unit in the last column of Section E, Question 2 on the old questionnaire. Respondents needed to change from reporting whole dollars to reporting cents as well.

Our proposed solution followed the format of the old questionnaire by introducing a decimal and two blank spaces. They were made more dominant by placing them in a black font. The lack of other lines in the white answer spaces tended to increase their dominance, thus making this important specification more visible to respondents.

An even more striking use of this rule is the addition of "tenths" of acre information to the potato and tobacco acreage request for Question 1 in Section B of the questionnaire (Figure 3). Tenths of acres are well-known to these farmers because of contractual and government policy issues, but we wanted to avoid possible carryover to other questions while having very limited space to accomplish it. Our visual solution was to use a black line within the box that would visually group with a black work under the box, and to make the box slightly longer. Together, the three changes send a strong visual message of a change for those particular questions, which should not be applied to others.

The strong visual guides that will enhance the usability of necessary changes to response patterns are inherently disruptive of the established visual pattern, yet the alterations may have an emotional design benefit. For instance, the new format of Question 2 in Section E, Figure 5 now includes text beneath the answer figure that maintains the visual pattern of the other instruction text throughout. While still disrupting the simplicity of the figure, the transition to reporting "cents" has more visual rhythm than before. By placing the disruptive information just outside the answer response figure in print that no longer matches the previous border lines, the visual guides are constructed to be separate appendages of a different figure rather than visual clutter within the answer space. This, then, adds a touch of positive emotional affect through the visual comfort of simple figures.

4. Summary and Conclusion

Traditionally, written questionnaires have been viewed as depending only upon words and sentences as the source of question meaning. However, in recent years it has become clear that the meaning of questions also depends upon information communicated through the paralanguages of numbers, symbols and graphics (e.g., Jenkins and Dillman 1997; Redline and Dillman 2002; Christian and Dillman 2004).

In this article, we have proposed that additional concepts from usability theory, as proposed by Norman (1988; 2004), which describe the cognitive and emotional attributes of objects that make them either easier or more difficult for people to use, also play an essential role in communicating expectations to questionnaire respondents. We have also proposed that better usability may be achieved through use of the same visual design principles as those shown to directly influence questionnaire comprehension and meaning.

Upon seeing the newly constructed ARMS questionnaire, for which five of the 16 pages are presented here, a survey sponsor asked the question, "What evidence do we have that pretty questionnaires are more likely to get answered or produce more accurate answers?" The arguments offered by Norman (2004) for why and how emotional design is important, which have not previously been a focus of survey methodology, tend to reorient such a question from a purely aesthetic one of whether respondents state a like or dislike for a questionnaire, to what features of visual layout promote immediate acceptance and ease of cognitive entry into the displays of questions. Emotional design, as suggested here, is far more complex than appealing directly to individual conceptions of whether something looks nice.

Each of the twelve rules for construction described here, which link cognitive, emotional and visual design principles, may be viewed as a hypothesis about the linkage between visual design and usability effects that future studies should be designed to evaluate. However, these principles are also intricately interconnected because of the need to be consistent in the application of gestalt psychology concepts. This consideration suggests the importance of testing the joint impacts of rules as well as their individual effects on response behaviors.

Had we chosen a different questionnaire for application of the design concepts reported here, it is likely that some rules (e.g., Rule 10 on matrices and Rule 11 on placement of codes) might not have been needed, whereas a need for other rules would have occurred. Thus, we see the construction rules introduced here as an initial step for linking usability and visual design concepts in practical ways that can be extended to other survey design situations.

Yet to be answered is the critical question of whether the resultant design of ARMS improved reporting by respondents. The new version of this questionnaire was used for implementation of the 2004 ARMS study, but without the benefit of an experimental control group that received the old version of the questionnaire. Response rates, item nonresponse, imputation rates, and respondent evaluations of this questionnaire, are now being analyzed (Ott 2005).

Finally, this article has represented an effort to use theories and concepts, most of which have not yet been thoroughly researched, by survey methodologists. We hope that one of the outcomes of this effort to conceptually link usability research with visual design concepts will be to encourage others to experimentally test the many specific ideas we have proposed, and that improved methods for surveying both businesses and individuals will result.

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