

Disparate Modes and Their Effect on Instrument Design

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1. Introduction

Multimode surveys are increasingly common for several reasons including attempts to increase response rates, lower costs, and accelerate data collection. As practitioners of multimode surveys, we concern ourselves with many issues, but few are as important as the production of the electronic (Blaise) instrument. In a multimode survey we may have not only two or more modes, but different question forms for the same item, across modes. This paper elaborates on the concept of *disparate modes* introduced in Pierzchala et al (2006) and their impact on two instrument design methods; *unimode design* and *generalized mode design*. The paper is based largely on the experience Mathematica Policy Research, Inc. (MPR) gained on three complex multimode surveys. The words *instrument* refers to the electronic (Blaise) instrument for data collection or capture.

2. Disparate Modes

In the 2003 National Survey of Recent College Graduates (NSRCG) that MPR conducted for the National Science Foundation, nearly 50 percent of the items had a different question form for at least one of the paper, web, or Computer Assisted Telephone Interviewing (CATI) modes and some items had three question forms (Pierzchala et al. 2004). Some surveys, however, display little difference in question form across modes. For example, the National Beneficiary Survey (NBS) sponsored by the Social Security Administration with CATI and CAPI modes, and the Kauffman Firm Survey (KFS) sponsored by the Ewing Marion Kauffman Foundation with web and CATI modes, exhibit little difference in question form between modes (Pierzchala et al. 2006). An example of different question forms would be an item asked as a SET (code all that apply) question on paper and a series of Yes/No questions in CATI.

We consider four common modes of survey administration. Table 1 shows key differences and similarities between modes in how the respondent receives, processes, and communicates a response to a question. Survey methodology literature uses summaries of this sort to understand differences in responses to same questions across modes.

Table 1: Attributes of Modes of Surveys That Affect Cognition and Response

Aspect / Mode	CATI	CAPI	Web	Paper
Presentation	Aural	Aural	Visual	Visual
Transmission of response	Spoken	Spoken	Typed	Written
Segmentation of form¹	Segmented	Segmented	Varies	Not segmented
Dynamic/ Passive medium²	Dynamic	Dynamic	Dynamic	Passive
Administration	Interviewer	Interviewer	Self	Self
Pace	Respondent / Interviewer	Respondent / Interviewer	Respondent / Computer	Respondent
Communication channel	Telephone	In-person	Browser	Paper

¹ Segmentation refers to seeing only one or a few questions at the same time on a computer screen, as opposed to seeing the entire questionnaire at once on paper (Groves et al. 1980).

² “Dynamic” refers to a computer-assisted mode, and “passive” refers to other modes.

The analysis of interest is in instrument differences that go beyond question statement. An analysis of instruments from several multimode surveys found that three of the dimensions in Table 1 are responsible for nearly all the differences in question form, and in operation, between modes. These dimensions, called *critical dimensions*, are (1) Aural versus Visual presentation, (2) Self- versus Interviewer-administration, and (3) dynamic versus passive medium. Table 2 summarizes the degree of disparity between modes based on this analysis.

Table 2: Degree of Disparity Between Common Modes of Survey Administration

Mode Combination	CAI (CATI/CAPI)	Web	Paper
CAI (CATI/CAPI)	-	2	3
Web	2	-	1
Paper	3	1	-

The paper/web combination has only one degree of disparity because the paper mode is passive and the web mode is dynamic, but both modes are self-administered and visual. The web/CAI combination has two degrees of disparity because the only critical dimension they share is their dynamic nature. The CAI/paper combination is the most disparate because there are differences in all three critical dimensions.

In practical terms, producing a single electronic instrument that works across modes becomes more difficult the larger the degree of disparity and the larger the number of modes. This paper illustrates how differences in each dimension affect the production of one instrument.

3. Multimode Instrument Design Traditions

Multimode surveys have two instrument design traditions. Both seek to provide the same stimulus to respondents across modes. This paper interprets the *unimode* design (Dillman 2000) as maintaining question form and attributes Don't Know (DK), Refusal (RF), and EMPTY across modes. The NBS is a CATI/CAPI study where the modes are identical in the subject matter questions, the use of the dynamic Blaise system, and the use of interviewers. As a result, its design was naturally unimode. In the KFS, the CATI and web modes differ in two critical dimensions. However, MPR executed a unimode design through compromises in implementation between the modes (Pierzchala et al. 2006).

Generalized mode design seeks to optimize survey implementation in each mode (De Leeuw, 2005). It strives for *cognitive equivalence* across modes. It asserts that, because of the different ways the respondent processes information between modes, this equivalence may at times be better achieved with different question form across modes. This paper also considers differences in operation of the instrument (for example, handling edits or conducting a followup), as an aspect of generalized mode design. The 2003 NSRCG used a generalized mode design in its paper, CATI, and web modes.

In all three surveys, MPR put together one instrument and one database to handle the different modes. CAI and data entry modes were fielded in Blaise Windows and the web mode was implemented in a browser using the C2B software from CentERdata. MPR finds that, the greater the degree of disparity between modes, the more dramatic the impact on instrument design can be. Thus, a CAI/paper survey may be more difficult than a web/CAI survey to field in a unimode fashion.

4. Impact of Differences in Critical Dimensions on Instrument Design

Next we summarize mode differences along the three critical dimensions. This summary is based on an inspection of the three Blaise instruments mentioned in the introduction. In the tables below, the symbol => should be interpreted as a tendency. The notation => UMD or => GMD implies that the aspect of the critical difference tends to be accommodated by unimode design or tends to require a generalized mode design. Where a generalized mode design is indicated, a unimode designs may still be accomplished through compromise in implementation in one or more modes. Differences that require only a change in text from one mode to another are marked as tending to unimode design.

4.1. Aural Versus Visual Presentation of the Survey Question and Responses

The terms *aural* and *visual* refer to how the respondent receives the question statement and any response options. The *aural* method requires the respondent to not only hear and understand the question and choices, but also to remember them.

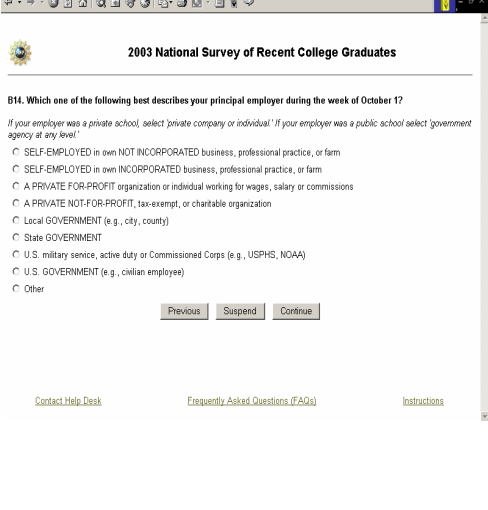
Table 3: Design Implications of Aural Versus Visual Presentation

Question Part or Type	Critical Dimension of Presentation		Instrument Design Implication
	Aural	Visual	
Any question / single question	Interviewer accent or pronunciation can interfere; respondent may not speak study language; speech is linear; pace depends on personal interaction; the respondent must remember information.	Respondent must be literate to the level of the question statement and to the complexity of the subject matter.	-Shorter questions, simpler words in Aural mode. -There may be question wording differences between aural and visual modes. => UMD
Complex sentences	It can take too long to say, and the respondent may not be able to understand all of it without repeating.	Comprehension depends only on the respondent, who can re-read text more easily; you can place larger cognitive burden than for aural modes.	-Break up one question into two or more questions in aural modes. => GMD
Series of related questions: e.g., Yes/No items	Stem is (usually) expressed just once. Treat one item at a time and in sequence.	Respondent can process more than one item at once; respondent can visually navigate and compare items; stem is always visible; respondent can answer in any order.	-Lead-in explanation may be necessary for aural -The question stem may be re-displayed for the interviewer, for every item even if not always said. => UMD
Enumerated (code-one) choices for non scale options (such as educational attainment).	Limited number of choices can be spoken at one time to limit the respondent's memory task.	Many choices may be presented at one time.	-Aural modes may break up the question into two or more branching questions => GMD
SET (code-all-that-apply) choices for non scale options (such as educational attainment).	The question may be rendered as a series of Yes/No questions.	Many choices may be presented at one time.	-Use of Yes/No for all modes => UMD -Alternate forms between modes => GMD
Conversational norms	Wording is more conversational.	Wording may be more formal	-There may be question text differences. => UMD
Open ended	Answer lengths tend to be short.	Respondent may provide longer, more detailed answers	-Provide Blaise OPEN instead of STRING for all modes. => UMD

An example from the 2003 NSRCG illustrates a few differences in question form across modes. The question, concerning description of employer, was asked as an

enumerated question on paper and on the web, but was implemented as a group of four branching questions in CATI. The reason for the difference in question form between modes is that the statement of the response choices is long and complex. It would be impossible for a respondent to remember the meaning of all choices if presented aurally.

Figure 1: Question B14 in Paper, Web, and CATI Modes from the 2003 NSRCG

Paper	Web
<p>B14. Which one of the following best describes your principal employer during the week of October 1?</p> <p>Mark (X) one answer.</p> <ul style="list-style-type: none"> <input type="checkbox"/> SELF-EMPLOYED in own NOT INCORPORATED business, professional practice or farm <input type="checkbox"/> SELF-EMPLOYED in own INCORPORATED business, professional practice or farm <input type="checkbox"/> A PRIVATE FOR-PROFIT organization or individual working for wages, salary or commissions <input type="checkbox"/> A PRIVATE NOT-FOR-PROFIT, tax-exempt, or charitable organization <input type="checkbox"/> Local GOVERNMENT (e.g., city, county) <input type="checkbox"/> State GOVERNMENT <input type="checkbox"/> U.S. military service, active duty or Commissioned Corps (e.g., USPHS, NOAA) <input type="checkbox"/> U.S. GOVERNMENT (e.g., civilian employee) <input type="checkbox"/> Other – Specify <input type="text"/> 	
CATI	
<p>B14_1. Was your principal employer during the week of October 1, 2003. . .</p> <ol style="list-style-type: none"> 1. a private company or individual (go to B14_3) 2. a government agency at any level (go to B14_4) 3. were you self-employed (go to B14_2) 4. did you work for some other type of employer (go to B14_specify) <p>DK, RF</p> <p>B14_2. Were you. . .</p> <ol style="list-style-type: none"> 1. Self-employed in your own NOT INCORPORATED business, professional practice, or farm 2. Self-employed in your own INCORPORATED business, professional practice, or farm <p>DK, RF</p>	<p>B14_3. Was that . . .</p> <ol style="list-style-type: none"> 1. A private for-profit organization or individual paying your wages, salary or commissions 2. A private not-for-profit, tax-exempt, or charitable organization <p>DK, RF</p> <p>B14_4. Was that . . .</p> <p>IF EMPLOYER WAS A SCHOOL: [State schools, colleges, universities are “state government” and schools run by local school districts are “local government”].</p> <ol style="list-style-type: none"> 1. Local government, such as city or county government 2. State government 3. U.S. military service, active duty or commissioned corps, such as USPHS or NOAA 4. U.S. government as a civilian employee <p>DK, RF</p>

4.2. Self Versus Interviewer Administration of the Survey

Both self- and interviewer-administered modes of interviewing have advantages and disadvantages. With an interviewer, there can be comprehension problems between the interviewer and the respondent. For sensitive questions, a respondent may be influenced to give *socially desirable* answers (O’Reilly et al, 1994). On the other hand, interviewers secure cooperation. They are skilled at persuading the sampled person to respond and can keep a respondent engaged until the end of the interview. In addition, an interviewer is trained in the data collection software and instrument and can perform complex actions such as error correction and navigation that one would not expect in self administration. However, interviewer modes are usually more costly. Table 4 shows how aspects of this critical dimension influence choice of unimode versus generalized mode design. Any difference in the operation of the instrument (for example, handling edits) is labeled as tending to a generalized mode design.

Table 4: Design Implications of Self versus Interviewer Administration

Question Part or Type	Critical Dimension of Administration		Instrument Design Implication
	Self	Interviewer	
Social desirability for sensitive questions	More likely to give honest answers	Interviewer presence may elicit socially desirable, but not correct, responses	-There may be special modules and/or software in for sensitive sections, as in Laptop CASI. => GMD
Training	Untrained	Trained	-Interviewer can resolve consistency edits and navigate => GMD
Probes	Not possible	Interviewer can probe within same question form.	-More text in interviewer mode. => UMD
Instructions and optional text	Not possible or limited	Can expect the interviewer to follow instructions or to read optional text if necessary.	-More text in interviewer mode. => UMD

An example of a difference in instrument design based on self- versus interviewer-administration is in the application of a consistency edit. Such an edit compares data between two or more fields and flags seemingly inconsistent values. The resolution of such an edit is a high-level action that requires the interviewer to be able to communicate the error to the respondent, navigate to the field in error, make the correction, and get back to the point of the interviewer, all the while keeping the respondent engaged in the interview. When the edit involves widely separated fields (especially on widely separated browser screens), it is not usually appropriate for the web mode, but is invoked more commonly for interviewer-administered modes. Figure 2 shows the Blaise source code for such an edit.

Figure 2: Edit Statement Blaise Source Code for Interviewer-Administered Mode

```

IF AdministrationMode IN [CATI_, CAPI_, Editing] THEN
  IF WeeklyPayroll/(NumEmployees * 40) < 3.0 THEN
    ERROR "The hourly rate seems too low."
  ENDIF
ENDIF

```

The edit as specified above would be applied only in interviewer-administered modes or in post collection processing. It would be bypassed for web mode or for data capture from paper. However, this kind of consistency edit has been applied in a web survey at MPR using “WebSurv”, its own in-house web survey software.

4.3. Dynamic Versus Passive Data Collection Medium

A *dynamic* medium implies the use of a computer-assisted system where text statement, routing, appearance, computations, language, sampling, and edits can all be executed during data collection. A *passive* system usually refers to paper collection, but it can also refer to a static HTML page used either in an email survey or in some web survey systems. Dynamic systems provide far more flexibility than passive ones in most respects; on the other hand, they rarely provide the overview and context that paper questionnaires provide. The concept of *space* is vastly different between the two kind of media. A dynamic medium offers a virtually unlimited number of pages for an instrument, whereas a paper questionnaire is limited to a finite, usually much smaller, number of pages. The much more constrained space of the passive medium, in conjunction with the fact that all the questions can be seen at one time, often influences question form.

Table5: Design Implications of Dynamic Versus Passive Medium

Question Part or Type	Critical Dimension of Medium		Instrument Design Implication
	Dynamic	Passive	
Space in terms of number of pages or screens	Unlimited browser or Windows pages	Limited number of paper pages	Dynamic medium allows for more questions or probes per same instrument => GMD
Space within a page or screen	Browser: respondent controlled Windows: Controlled by survey organization Either: Less space than paper questionnaire.	Paper page has massive pixel density. Great freedom in display of text, instructions, directions, and other elements.	Design possibilities within a page are far greater for a paper questionnaire than for a dynamic medium => GMD
Freedom of movement	Software limits user movement.	Great freedom.	Paper gives better overview, respondent can see where to go. => GMD
Required answers	Can require answers, but may allow EMPTY.	Cannot require answers.	Passive mode may leave some answers blank => UMD with complex conditions, or => GMD
Probes	Can be provided in a follow-up question.	No follow-up questions are possible.	More probes in dynamic modes => GMD
Skips	Automatic and enforced (taking into account allowed EMPTY)	Arrows on page and other instructions, respondent may not follow skips.	In paper, on-route data may not be answered, and off-route data may be provided => UMD (with extra programming)
Consistency Edits	Possible to compare two or more values during data collection	Not possible to compare two or more values during data collection.	Disable edits in passive modes during capture => GMD
Responses	Difference between code-one and code-all can be enforced.	Respondent can answer more than one choice for a code-one.	Define question as code-all for all modes, but enforce code-one in dynamic through edits. => UMD
Question statement and responses	Can customize text dynamically based on previous answers.	Cannot customize text.	Text-only differences between modes => UMD
Question and response order	Can rotate or randomize questions or responses.	Cannot rotate or randomize, except with custom printing.	Anchor text for data capture => UMD

The following example illustrates the relative power and the limitations of dynamic and passive media. In collecting monetary amounts in the KFS, the dynamic mode allows probes if the respondent does not give an exact amount. Figure 3 shows this in the web mode; the CATI mode works the same way.

Figure 3: Collecting Monetary Amounts in the KFS

Kauffman Firm Survey	
<p>F17a. Now we are going to ask about the expenses the business paid. Expenses are the costs paid for the operation of the business, including wages, salaries, interest on loans, capital leases, materials, etc.</p> <p>How much, if any, did ABC business pay in expenses during calendar year 2004?</p> <p><i>For example, enter '10000' for \$10,000. If none, enter '0'.</i></p> <input type="text"/>	
<input type="button" value="Back"/> <input type="button" value="Suspend"/> <input type="button" value="Next"/>	
<p>F17b. Would you say it was . . .</p> <ul style="list-style-type: none"> <input type="radio"/> \$500 or less <input type="radio"/> \$501 to \$1,000 <input type="radio"/> \$1,001 to \$3,000 <input type="radio"/> \$3,001 to \$5,000 <input type="radio"/> \$5,001 to \$10,000 <input type="radio"/> \$10,001 to \$25,000 <input checked="" type="radio"/> \$25,001 to \$100,000 <input type="radio"/> \$100,001 to \$1,000,000, or <input type="radio"/> \$1,000,001 or more? 	<p>If the respondent leaves the box empty the browser screen to the left appears.</p>

This pattern of two screens, for each financial item, appears several times in order to collect expense information for a business. A respondent who gives exact values will never see the probes. The KFS does not have a paper mode. If it did, however, this kind of probing would not be possible. Furthermore, a paper version would display the expense information as one data collection structure on one page.

5. Question Attributes and Consistency

Question attributes such as Don't Know (DK), Refusal (RF), or EMPTY are usually presented to the respondent differently between modes. A common web and paper convention, for example, is to not provide explicit DK or RF options, but to allow an EMPTY answer. On the other hand, CATI and CAPI usually require the interviewer to answer with a DK or RF if a valid response is not possible.

Handling these conventions differently for each mode complicates specification and programming. Branching conditions have to take into consideration the mode of administration. MPR has been able to easily implement these additional conditions, but with a different programming strategy, as shown in Figure 4.

Figure 4: Handling DK, RF, and EMPTY Differently Between Modes

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FIELDS
  NumEmployees "How many employees do you have?"
                : 0..1000, DK, RF, EMPTY
  . . .
RULES
  NumEmployees
  IF AdministrationMode IN [CATI_, CAPI_, Editing] THEN
    NumEmployees <> EMPTY "Answer required."
  ENDIF

```

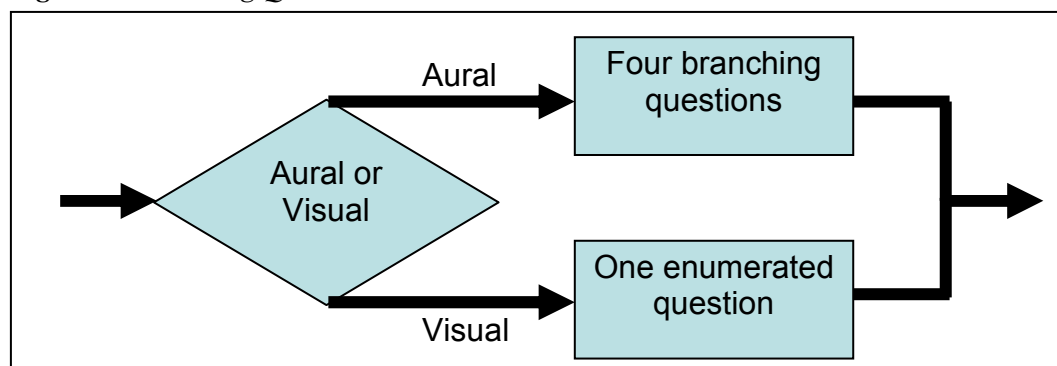
In the example above, the DK and RF would not be displayed in the browser by use of configuration options; technically they are available but the respondent does not have a way to select them. The EMPTY attribute, not typically employed for CAPI/CATI surveys, is used in multimode surveys involving web or paper modes. The Blaise language can allow this differential mode treatment at the item level through edits added in the RULES, for every item, in CAPI or CATI. The extra work to implement these validation edits is minimal. More important, what has changed in the self-administered modes is the concept of record validity. We are simply more willing to accept data faults in web and paper modes than in CATI or CAPI. The important things are to (1) get data in a mode in which the respondent is willing to provide it, (2) get the data less expensively, and (3) accelerate data collection schedules. We do not wish to dissuade a respondent from completing the questionnaire. A good faith respondent in web or paper modes will not cause problems. One who skips questions, or makes routing errors, can be treated in a followup, as detailed below.

6. Special Capabilities of a Multimode Instrument

Special capabilities of a multimode instrument include handling disparate question forms between modes in one instrument, switching modes in mid-case, and critical item followup.

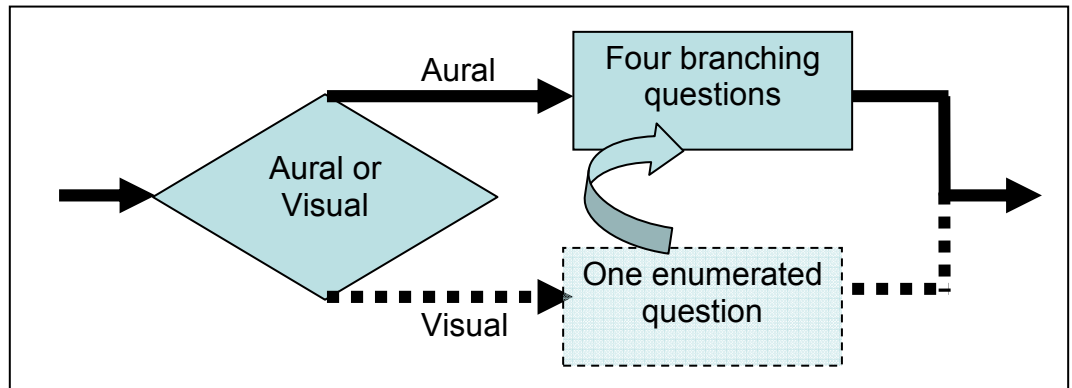
6.1. Handling Different Question Forms Between Modes in One Instrument

Where there are two (or more) question forms in one instrument, it is necessary to branch to the specific question form depending on mode as shown in Figure 5 for the 2003 NSRCG question B14 (Figure 1 above).

Figure 5: Branching Question Forms Between Modes

6.2. Mode Switching Within a Record

Sometimes it is necessary to switch modes in a case (for example to complete a case in CATI that was started in web mode). Where there are different question forms between modes, it is necessary to transfer data from one question form to the other as shown in Figure 6.

Figure 6: Data Transfer Between Question Forms When Switching Modes

This item-level data transfer is done on the fly as the case is brought up in the second mode. This way there are no issues with branching, and the interviewer is free to navigate to the current point of the interview.

6.3. Critical-Item Followup in the Blaise Windows Platform

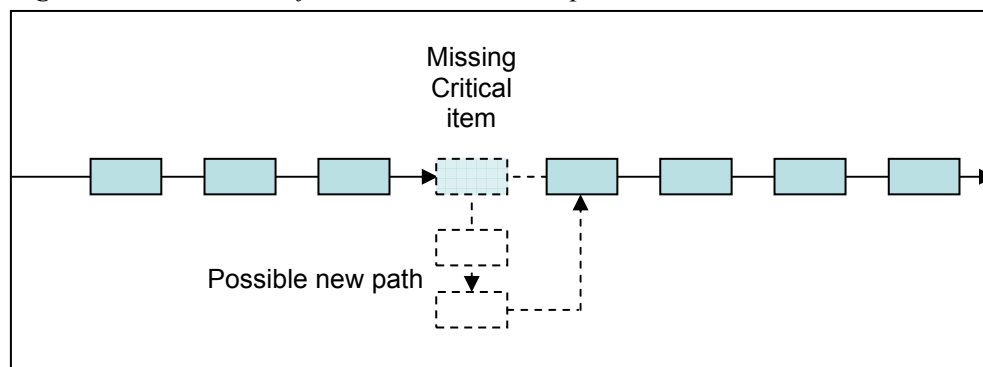
A case completed in any mode may have a severe data issue. For example, critical items may have been answered with a DK or RF, or they may have been left EMPTY. Depending on the survey, and at the discretion of the client, it is possible to follow up these cases. MPR conducts this followup in the Blaise Windows platform because of its native navigational capability. A key part of this capability is the Blaise selective checking mechanism that recalculates flow every time a data value is entered. It is desirable to maintain the data collection path and the original values in the context of the originating data collection mode, in other words, to divorce platform from mode. The item followup is within record and within place, in the original data record. Figure 7a shows source code that marks an item for critical-item followup.

Figure 7a: Marking an Item for Critical Item Followup

```

RULES
  IF (NumEmployees <> RESPONSE) AND (FollowUp = Yes) THEN
    CHECK
    ERROR "Your response to this question is important.
          Can you tell me how many employees you have?"
  ENDIF
  
```

This method of followup has several advantages. It puts the data value directly in its place in the data record. If the value results in a new path opening up, the data along this newly opened path can be collected as part of the followup. This includes the collection of other critical items that might be found on the new path (see Figure 7b). Finally, it avoids having to put together a different system (on paper or by computer) to collect these critical values and then merge them later.

Figure 7b: Illustration of Critical Item Followup in Blaise Windows

7. Discussion

MPR has been able to implement both unimode and generalized mode designs into a single Blaise instrument operating on one database. For some surveys, it has been appropriate to use the browser and Windows computer platforms simultaneously. MPR uses them differently, and they have different capabilities and users. Concepts of what constitutes a page, and how pages should be arranged, are also different. Because the screens in both platforms are computer generated, not hand drawn, this dual platform capability comes at very low cost.

The higher cost in producing a dual- or triple-mode instrument comes from handling different question forms and from accounting for the additional cost of specification and programming when conventions between modes are different (for example, DK, RF, and EMPTY are handled differently). From the standpoint of ease of specification, programming, and cost, unimode design is preferred.

The choice between unimode and generalized mode design also involves measurement issues. It is true that the same question form in different modes may lead to different response patterns, and that in order to achieve cognitive equivalence, a generalized mode design might be preferred. However, in addition to the additional costs of implementation, the rendering of a survey question into two or more forms will also incur the cost of evaluating the different options. This evaluation would be carried out wherever there are different question forms.

8. References

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