

EVALUATION OF AN ELECTRONIC EVENT HISTORY CALENDAR

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Event history calendars (EHCs) have been used successfully in survey research because they improve accuracy of life event reporting by facilitating a more natural conversational framework and by emphasizing the inter-relationships of events. The natural conversational framework results from the respondent and interviewer working together to fill out the EHC. The interaction becomes less of a point-by-point, question and answer interview, and more of a balanced discussion of how different events in the respondent's life happened at the same time or in a particular sequence and thus influenced each other. The interrelationship of events is further highlighted by the visual display, in which events and situations are shown to overlap—such as pregnancies with relationships, or relationships with residences. Accuracy is improved for two reasons. The visual display makes it easier for the respondent to catch errors or inconsistencies, and conversational interviewing improves respondents' memories. (Belli et al. 1999; Caspi et al. 1996)

The use of EHCs maximizes three different types of memory processing that respondents use: top-down, sequential, and parallel processing. (Belli 1998) *Top-down processing* results from people using important domains—such as life relationships, family, jobs, etc.—to organize their autobiographical memories. Questionnaires without EHCs are generally ordered according to domain or topic. *Sequential processing* involves the temporal ordering of events within topical domains. To a certain extent this is possible without graphical representation as well, but is greatly enhanced with a visual aid and by the process of filling out such a calendar. Finally, *parallel processing* is greatly a result of looking at an EHC or other graphical display, because it is the ability to remember events based on the interrelationships between domains—e.g., “I was living in Pittsburgh for those months, so those must be the months I was dating John.” The advantage of EHCs in promoting accuracy is clear. Because they encourage respondents to use multiple routes to process and retrieve

memories, as opposed to just one, they facilitate more thorough reporting of life events.

Electronic EHCs have emerged as an option for studies using computerized methods, including CATI, CAPI, and ACASI environments. (See Belli et al. 1999; Duffer and Peterson 1999) Because of the EHCs ability to improve accuracy in reporting lifetime event data, the National Longitudinal Study of Adolescent Health (Add Health) is adding an electronic EHC to its questionnaire for the third wave of data collection, which will be fielded in the Spring of 2001. Add Health is a longitudinal study of the health-related behaviors of a cohort of individuals who were first interviewed as adolescents in grades 7-12. Wave 3 will consist of a follow-up interview with the 20,745 in-home respondents from Wave 1. Respondents will range from 18 to 24 years in age. They will complete an in-home interview which will take approximately 90 minutes. It will be a primarily CAPI interview, with an ACASI component. The EHC will be used as a memory aid during both the CAPI and ACASI portions of the interview to help respondents answer questions about events like romantic relationships, births and pregnancies, marriages, and graduations.

We faced two fairly unique issues during the development of the Add Health EHC. The primary purpose of an EHC is to help respondents remember and accurately date the occurrence of important events. Unlike most EHCs documented in the survey research literature, the Add Health EHC will not be used as a data collection instrument. The interviewer and respondent will work together during the CAPI section to fill out the EHC. Then the respondent will continue to use it as a memory aid during the CAPI section and through a short ACASI component. So, for this study, the most important aspect of the EHC was that it be understandable and usable to the respondent—not that it be easy for the interviewer to input data. Our testing of the calendar was focused on developing a design for the calendar that respondents could easily use and enjoy using.

The second unique issue was that the principal

investigators of the project had a strong interest in using a vertical time design for the EHC. Vertical time designs represent a departure from the majority of the survey research literature on EHCs, where it appears that most calendars have displayed time horizontally. (See Belli et al. 1999; Kelly et al. 1996; Freedman et al. 1988) We decided to evaluate the effectiveness of the two orientations through cognitive testing.

Designing Horizontal and Vertical EHCs

We drew four major considerations from the survey research literature in developing our two EHCs. First, landmark events should be used to anchor time periods and reduce forward telescoping. (Loftus and Marburger 1983) Second, color should be used to specify and distinguish domains. (Duffer and Peterson 1999) Third, time intervals should be clearly marked. (Caspi et al. 1996) Finally, the EHC should maximize all three memory-processing methods — top down, sequential, and parallel. (Belli 1998) This final consideration was achieved through several approaches. Topic domains were clearly identified, and placed at the top of the calendar to use as a conceptual anchor to encourage top-down processing. The time sequence (whether vertically or horizontally displayed) was marked to encourage sequential memory. Visual organization was balanced so parallel events connected visually as they do conceptually in respondents' autobiographical memories. We applied these four main considerations to both the vertical and the horizontal EHC before they were evaluated with the cognitive interviewing.

Figure 1 depicts the cognitive interviewing version of the horizontal EHC, which we call Mock A. The topic domains are indicated on the left side of the calendar, in bold lettering, and distinguished with a unique color which extends across the entire domain. A readily apparent temporal sequence is displayed at the top and bottom of the calendar by the cells indicating month and year. Parallel events can be connected within months — the dashed vertical lines facilitate this parallel processing. To help spark the respondent's memory and to serve as anchors, the landmark events are listed in a bold color at the top of the calendar.

Figure 2 depicts the cognitive interviewing version of the vertical EHC, or Mock B. Again, as in the horizontal calendar, the domains clearly anchor the structure, but in this version they are listed at the top of the table rather than along the left side. On the left side, the months display the vertical temporal order. Since columns are used to fairly rigidly demarcate the domains, color is instead used to indicate continuity within a domain —

something we felt this design was lacking. Thus, the first event within a domain appears in blue, the second event appears in green, and the third event appears in purple. The Notable Events column uses only one color -- distinct from the colors in the rest of the calendar, except when there is more than one event in a given month. Color is further used to distinguish landmark events within the same month. The notable events column includes landmarks as well as residential address. These landmarks are located just beside the month/year column — to make them more accessible because of their important role in sparking memories. Finally, dashed lines are also used in this calendar. They too promote parallel processing because they separate the events of a given month across domains. Figure 1 and Figure 2 present six months of example data from each of the two calendars evaluated in our cognitive interviews. The only difference between the two calendars was the presentation of the information. The content was identical in the two figures.

Since it was not cost-effective to carry out an evaluation of such fundamentally different designs in fully developed CAI implementations, we used paper representations for the cognitive interviews. Personalized calendar data for each respondent were formatted appropriately (using WordPerfect and Excel) and then printed in full color on white sheets of paper. We formatted the calendars to fit on one sheet of paper each, because we envisioned the electronic EHC taking up no more than one screen.

Methodology

Our cognitive interviewing evaluation was designed to evaluate the visual display options of the two event history calendars. We intended to use the results of the interviews to choose the final design of the Add Health EHC. We considered two main issues as part of the testing. Primarily, we were concerned with the accuracy and accessibility of the information recorded in the EHC. The Add Health EHC will be used as a memory aid, rather than a data input device. Respondents will be using it to provide a chronological framework when they answer questions. Thus, we wanted to choose a calendar design that would be easy for respondents to understand. We decided that a good indicator of ease of use would be to ask respondents to find a mistake embedded in the information in the calendar. The second issue to be considered in the testing was respondent preference between the two design options. To assess this, we asked respondents to evaluate the depiction of horizontal versus vertical time, the use of color in the calendars, the labeling of domains, and how the domains were displayed

— that is, the techniques that were used to separate one domain from another.

Cognitive interviewing was chosen as the method for the usability test. Since we could only talk with a small number of respondents, we maximized the benefits of these interactions by structuring them as one-on-one interviews using think-aloud techniques. By using cognitive interviews, rather than a small-group method such as a focus group, we were able to tailor the calendars to the individual and simulate the processes that they would go through in the actual Add Health interview.

In addition to the actual cognitive interview, the evaluation process consisted of a 10-minute telephone interview to collect the information to load into the paper calendars. The in-person cognitive interview was also short, on average it took about 15 minutes. During this personal interview, respondents reviewed their information in the calendars and then answered questions about each calendar design.

The telephone interview was informal and unscripted. Respondents were asked questions about key events in the previous 12 months. The data that were gathered during the telephone interview included three landmark events, the respondent's age and birth date, education history, work history, and place of residence. At the close of the telephone interview, an appointment was set for a cognitive interviewing session in which the respondent viewed both calendars, which were personalized with the data from the telephone interview.

Prior to the cognitive interviewing session, one of two errors was added to each calendar. No respondent received the same error twice. Four respondents were handed Mock A first, while 4 were handed Mock A second. Of both groups of 4 respondents, each respondent had one mock with the incorrect birth month and one mock with either the incorrect residential move date or the incorrect end date of a job.

The first two components of the cognitive interview applied think-aloud techniques. First, respondents were shown the first mock and asked to read out loud the information that the calendar contained, starting anywhere they liked. They were encouraged to describe their thought processes as they “moved about” the calendar. Second, respondents were shown the second calendar and asked to do the same thing. We expected most respondents to report the errors we had introduced

during these think-aloud components. If respondents did not mention an error when reading the information that the calendar contained, they were probed as to any errors in the document. The third component of the interview was a series of debriefing questions asking respondents' thoughts on specific issues relating to the calendar, such as ease of use, “finding their way around”, their thoughts on color, and suggestions for improvement. The results of the interviews are summarized below.

Accuracy and Accessibility

Overall, Mock A appeared to be the better tool for ensuring accuracy in data. Caspi et al. (1996) argue that accuracy is improved by the EHC because respondents have the ability to look at a visual graphical display of their information, and then are more likely to find errors and correct them. This advantage only works if the EHC is designed simply enough for respondents to be able to readily find their errors. Six people found the errors in the horizontal mock without prompting. One person found an error after being prompted, and only one never found the error embedded into the horizontal model. Only 4 people found errors in the vertical model without prompting. Two more found errors after being prompted, and two never found the errors. Of the 4 people who viewed the horizontal mock first, only one person did not find the error. Of the 4 people who viewed the vertical mock first, 3 people did not find the error. We assumed that when people were viewing their second mock, they would have learned to look for an error by their experience with the first mock. Thus, since 3 people who viewed the vertical mock first did not find the error and only 1 person who viewed the vertical mock second did not find the error, it appears that respondents learned from the first mock that errors were embedded and otherwise might not have found so many errors in the vertical mock. With only eight cases, it is hard to be certain, but these data suggest a tendency for the horizontal mock to be more accurate.

Respondent Preferences

Overall, respondents slightly preferred the horizontal (5 out of 8) to the vertical mock. Reasons they gave for preferring it were

- It was more pleasing to look at.
- The bars are easier to read, compared to Mock B which is overwhelming with the events repeated over and over.
- There is no redundancy — everything is temporally and spatially together and concise. On the other hand Mock B is redundant.
- It's easier to figure out where things stop and

start.

- Mock A flows like a time line and looks more natural.

Those same 5 respondents also made negative comments about the vertical mock:

- Notable events are all kind of stuck together — making them unclear.
- Mock B has too much repetition.
- Mock B would have been confusing with more events.

Three out of 8 respondents preferred the vertical mock. Reasons for preferring Mock B:

- I like looking down lists as opposed to across .
- It's easier to go from block to block.
- I can't readily see everything in Mock A, but I can with Mock B.
- It's more spaced out and easier to read.

Respondents who preferred Mock B did not have as many negative things to say about Mock A as the respondents who preferred Mock A had to say about Mock B. Only one made a negative comment, that she couldn't "readily see everything in Mock A."

Ease of Use

Most respondents thought both calendars were pretty easy to use. One commented that in Mock A, she had to look at the whole thing to be able to figure it out, but with the vertical mock, she could find her way just by looking at the individual block. It was familiar because it was like looking at a school schedule. Another one thought that the dates at the top and bottom especially helped maneuvering through Mock A.

Colors

Among those who expressed opinions on the usefulness of color, all said that the colors were more useful in the horizontal mock. In general, people did not understand or like the way we used color in the vertical mock. One said that our color scheme made his birthday look like the most important event on the calendar. In this case, his birthday was the only second event in a month and thus the only pink event in a list where the rest were orange. Furthermore, he had only one educational event and one job, so both of those categories were one solid color as well (blue). Another person who had one long term event in both the Education and Work categories suggested using colors to code those categories so they wouldn't both be blue, and so that related events would be the

same color. In the vertical mock, respondents said that the colors "don't seem to do anything" and they "seemed to be ... mixed up — I'm not sure what they represent."

Suggestions for Improvement

Respondents had many suggestions to help improve both calendars. They made the following suggestions for the horizontal EHC:

- Put the age category at the top because it seems the most important.
- It would be more natural for the address to stop and start at one point and not overlap within a month.
- Use a slight color (shade) change to differentiate between address changes — the black bar does not divide it enough.
- Display more information within a month, such as the date at which something occurred or began.
- Put category names in caps.
- Use a numeric representation of the date rather than abbreviated month name.

For the vertical mock, they suggested:

- In the Notable Events category, use one color for moving dates and one color for other events. Make all the events in one category the same color.
- Make more color coordinated. Match colors with categories.
- Don't repeat examples of events. Figure out a way to use a vertical bar or an arrow like the horizontal one in Mock A.
- Put spaces between different events so the different colors aren't so close.
- Make colors more meaningful — the same in each column.

Implications of the Cognitive Interviewing

The results of the cognitive interviewing showed a slight preference for the horizontal over the vertical design. Since the results of the cognitive interviews did not dramatically favor either design, and since we expected the vertical display to work better in a partial display on a laptop screen, we decided to implement the vertical design for the Add Health questionnaire. **Figure 3** displays the EHC design that the Add Health project will be using in the field in 2000

We made quite a few changes to the EHC as a result of

the cognitive testing and as a result of later developments in the plans for the use of the EHC. For example, the content of the EHC has been scaled back for substantive reasons. The revised EHC is organized into 3 domain columns: Public Events, where public landmark events are displayed, Personal Events, where personal landmark events are displayed, and Relationships, which displays the respondent's partners or spouses.

The two strongest criticisms of the vertical design were that it was hard to interpret and that the use of color was confusing. As a result, we have abandoned the use of multiple colors within a column. Only one color will be used for each domain. The domain is further linked to its events by displaying the domain name in the same color as the data within that domain. (For example, relationship data are now entered in green and the title of the domain, "Relationships" is also green.) This greatly simplifies the use of color. Furthermore, meaning within each domain is easily established — the single colors solidify each column conceptually, and the thick vertical bars further distinguish them as well. The EHC has not been fielded yet, but we believe this will be a much easier tool for the respondent to use than the original vertical EHC.

Future research should pursue a larger-scale test of a vertical EHC. Examples of this kind of research could include a larger-scale comparison of respondent reactions to horizontal vs. vertical designs, or reports from studies which have fielded vertical EHCs. Vertical EHC displays have not yet been widely used or tested, but, given the results of our work, they should be considered more seriously and examined more closely.

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Figure 1: Horizontal Calendar Design

	Jan-95	Feb-95	Mar-95	Apr-95	May-95	Jun-95
Events	First Job			Car Crash		Dad Moved
Addresses	123 Main St, Chapel Hill, NC					
School	8th grade					Night classes
Work	Hardee's					Marshalls
		Farmwork at home				
Age	15					16th Birthday

Figure 2: Vertical Calendar Design

MO YR	NOTABLE EVENTS	EDUCATION	WORK
JAN 95	First Job	8 th Grade	Hardees - Part Time
FEB 95		8 th Grade	Hardees - Part Time Begin Farm Work at Home
MAR 95		8 th Grade	End Hardees - Part Time Farm Work at Home
APR 95	Car Crash	8 th Grade	Farm Work at Home
MAY 95		8 th Grade	Farm Work at Home
JUN 95	16 th Birthday Dad Moved	End 8 th grade Begin Night Classes, Wake Tech	Farm Work at Home Begin Marshalls

Figure 3: Final Calendar Design

DATE	PUBLIC EVENTS	PERSONAL EVENTS	RELATIONSHIPS
Jan - 95		First Job	Bill
Feb - 95			ended Bill
Mar - 95	Americans arrive at Mir space station		
Apr - 95	Oklahoma City bombing	Car Crash	dating Oscar
May - 95	Christopher Reeve paralyzed		Oscar
Jun - 95	Capt. Scott O'Grady rescued from being shot down in Bosnia	16 th Birthday Dad Moved	Oscar