Supporting Life History Research with Interactive Visualizations

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Abstract. We present two novel interfaces for in-field and self-report data collection and analysis of life histories. LifeHistory interface enables direct input of multifaceted longitudinal data via a timeline grid annotated with pictorial representations of landmark events. TrajectoryView is an interactive visualization of life history data for a side-by-side comparison of parameters of an individual's life history. The two interfaces are intended as an alternative to paper-based tools and methods currently used by qualitative researchers. Beyond a mere automation of data collection and presentation, the interfaces offer enhancements supporting recall of events and visual analysis of data. We expect that the use of LifeHistory and TrajectoryView will simplify data collection and analysis processes, leading to greater accuracy of data and better opportunities for insights.

Keywords: Visual interface · Data collection · Life history · Longitudinal research methods

1 Introduction and Motivation

Life history (a.k.a. *life course*) research [9] is a core methodological approach employed in longitudinal studies in many disciplines, including sociology, epidemiology, health sciences, psychology, anthropology, and business. Here, we are using the term longitudinal to refer to the research examining people, cases, or events over a period of time. A life course perspective examines life histories within the social, cultural, and political contexts of the period in order to identify situational changes over time and place [5], focusing attention on transitions and turning points across an individual's life trajectory [10]. Life history researchers employ a variety of methods, including surveys and in-depth interviews in data collection and analysis. The work presented here addresses the challenge of automating life history data capture during an interview or a self-report and their subsequent analysis for transitions and turning points.

State-of-the-art software packages for qualitative and mixed-methods research such as Qualtrics [13], MAXAPP [14] and Atlias.ti Mobile [15] provide capabilities for collecting survey, audio, video, and image data, limited coding and tagging of interview data and other documents. However, they do not provide support for a common tool for collection and analysis of life history data, called a *life history calendar* [6].

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Life History Matrix #_____ Age:_____ Race:_____ Sex___

Age								
DATE								
Residence								
Family								
Partners								
Work history (licit and illicit)								
Education								
Health Status								
Social Life								
Religion Spirituality								
Law Involvement								
Treatment History								
Substance Use								

Fig. 1. A sample of Life History Matrix – a paper-and-pencil data collection tool.

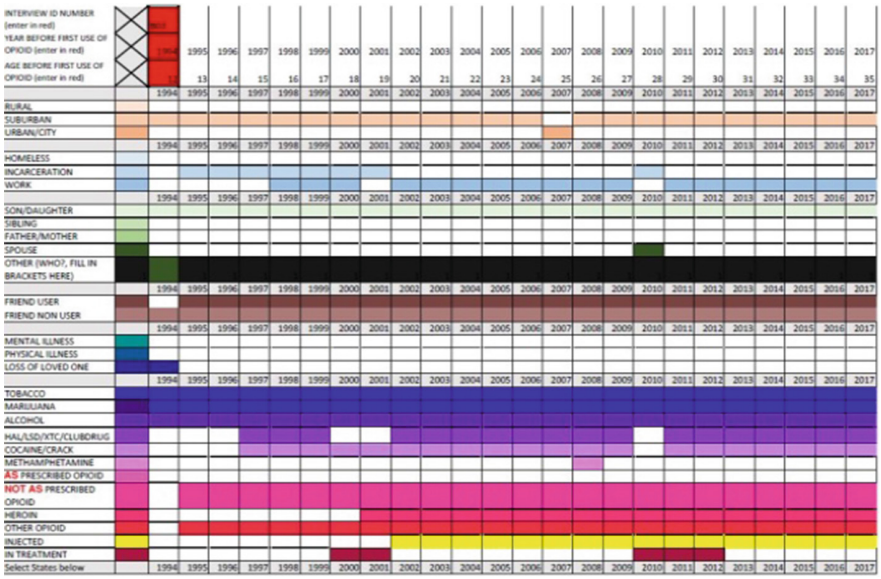

Fig. 2. An Excel spreadsheet used for life history data collection.

A life history calendar, sometimes referred to as *event history calendar* or *life history matrix* [1], is a grid with columns referencing time points (typically, years, but other units are used as appropriate) and rows representing different conditions, grouped by

themes (e.g. health, family, etc.). An example of a life history matrix, used in a study by the second author [3], is shown in Fig. 1. In the absence of an interface automating life history data collection, researchers use a pencil-and-paper version to record information, which then has to be manually transferred into electronic format. A semi-automated version designed by Boeri and presented in Fig. 2 employs an Excel spreadsheet to capture the responses using color. The use of the spreadsheet, however, requires initial training of the person administering the survey. Furthermore, the transfer of the response data into format appropriate for data analysis tools is not automated.

Figure 3 presents another sample tool that researchers use in the process of life history data collection during an interview. It is a *textual timeline* which is used in order to activate the respondent's memory of specific time periods [2, 8]. Landmark historical events listed in a textual timeline provide a context in which respondents can place events in their lives to recreate a more accurate account.

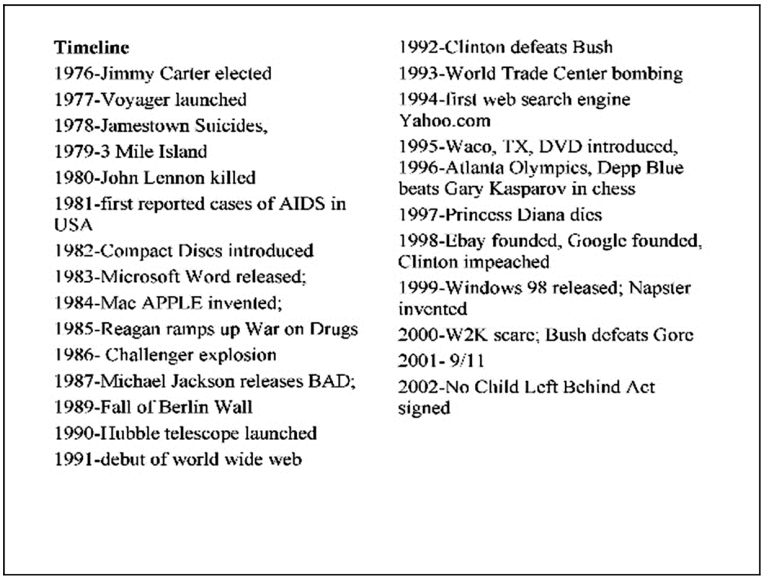

Fig. 3. Textual timeline from a study of drug users by Boeri et al.

In this paper we present two prototype interfaces that we developed to support life course research:

1. LifeHistory data collection tool – a visual interactive interface for collecting life history data for a set of specified conditions. LifeHistory enables data entry via a direct interaction with a grid-based timeline illustrated with pictorial representations of landmark events.
2. TrajectoryView – an interactive visualization of life history data for side-by-side comparison of parameters within individual's life history, to help identify relationships between events, patterns and turning points.

In designing these interfaces we aimed to help researchers administering in-field life history data collection and post-collection analysis in the following ways:

- Combining the matrix and a visual timeline in one computerized interface will alleviate the difficulties associated with handling multiple paper-and-pencil tools for administering a life history survey during a face-to-face interview. The simplification of the data collection procedure will promote greater reliability of the data, as the researcher and/or interviewee will be able to direct more attention to cross-checking the chronology of events and coming up with insights and further questions.
- Display of visual landmark cues should facilitate more accurate recall of events by participants [11].
- Electronic capture of response data will minimize the effort and errors associated with transferring the data into computerized format for future analysis. This should lead to improvements in data accuracy and reliability of the results of data analysis. Visualization of life history trajectories that enables easy side-by-side comparison of parameters will facilitate post-collection analysis and discovery of important relationships of events and conditions.

To the best of our knowledge, LifeHistory is the first timeline-based interface built specifically for data entry via direct input into a timeline grid. Other timeline-based tools, such as TimeLineJS [16], TimeLineCurator [7], Timeline Storyteller [4, 17] and LifeFlow [12], have been used most prominently in journalism and storytelling, to convey chronological order of events and plans, display multiple narrative lines, compare and contrast personal histories. While these applications present examples of customizable visualizations capable of processing and depicting chronologically arranged event data, they lack essential capabilities for their use in data collection. Our long-term research goal is to develop novel computerized methodologies supporting longitudinal research, aiding in simultaneous input and visual analytics of chronological data. The two interfaces introduced here present the first step in achieving this goal. Both interfaces are implemented as web-based prototypes using javascript and D3.

In the rest of the paper we describe LifeHistory and TrajectoryView, present results of a pilot user evaluation of LifeHistory for self-reporting of personal data, and outline conclusions and future work.

2 LifeHistory Data Collection Tool

LifeHistory data collection tool presented in Fig. 5 provides a data entry interface for collecting yes/no responses to a set of questions over a specified range of years. Each yes/no response is indicated via clicking on a cell in the matrix with columns corresponding to years and rows corresponding to questions (a.k.a. conditions). For example, the matrix cell containing the mouse pointer in Fig. 5, indicates a positive response to the condition abbreviated as ‘High School’ in year 2007.

The main component of the LifeHistory interface is a data entry matrix occupying the middle part of the screenshot presented in Fig. 5. It is constructed from a list of questions organized into thematic categories specified by a researcher using a text file.

The top part of the interface depicted in Fig. 4 enables the researcher to enter the following options that are used in generating life history input matrix: (a) the thematic categories to be included in the survey, (b) the range of years to include. These options are specified using the UI controls displayed when the user opens LifeHistory. Figure 4 shows four categories: Family Status, Education, Residence, and Exercise displayed next to checkboxes indicating selection of questions of the checked categories. Upon user making the selection of categories, the range of years, and clicking on the Submit button, the LifeHistory interface generates and displays the input matrix as shown in Fig. 5.

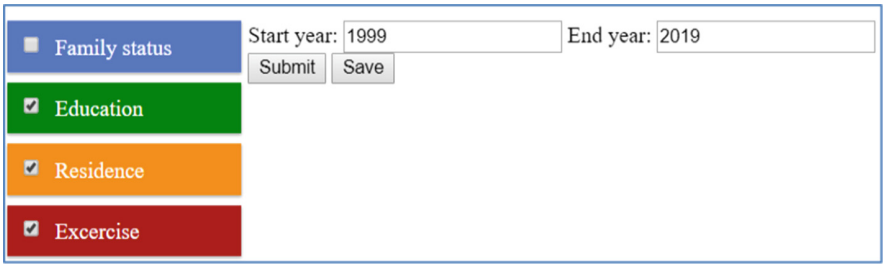

Fig. 4. The top part of the LifeHistory interface provides selection options for generating the input matrix based on a selection of categories and range of years.

The matrix is organized as follows: per each category, it displays the category questions and blocks of cells, which can be selected/unselected via clicking or touching, indicating a positive/negative response. The first column of the matrix displays the abbreviated text of the questions. The timeline indicating years associated with the columns is displayed in the bottom. Each cell represents a 'yes' or 'no' answer to the condition appearing in the fist column, for the year corresponding to the cell's column. The cells are colored according to their category. On the bottom, the matrix displays a timeline of years, annotated with images corresponding to the landmark events. The matrix is scrollable, in case not all questions and/or years fit the screen.

Beyond the features visible in Fig. 5, LifeHistory interface also enables users to view full question specifications, by hovering over the abbreviation in the first column and reading the tooltip. Furthermore, to simplify verification of the year associated with a column, a tooltip in each cell reveals the corresponding year. The state of the matrix can be saved in a json file on the client computer at any point by clicking on the Save button.

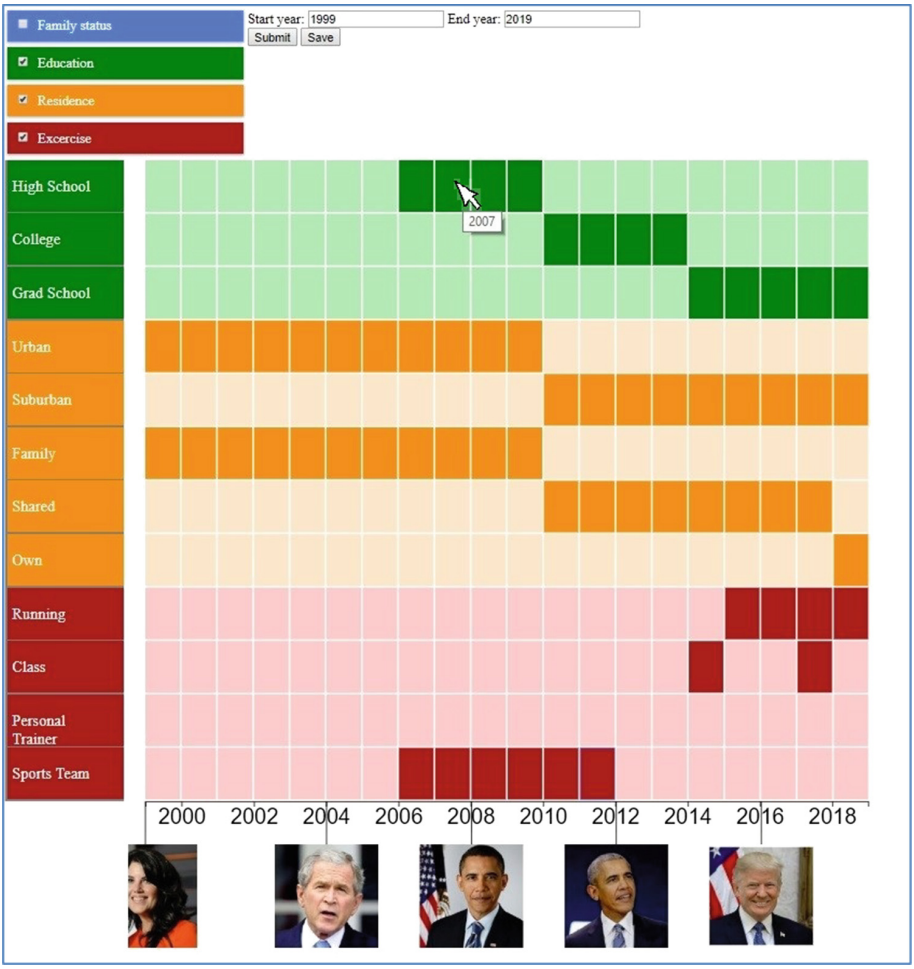

Fig. 5. A screenshot of LifeHistory interface showing the selection parameters, the input matrix and a timeline enhanced with images provided as landmark event cues.

3 TrajectoryView Interactive Visualization for Trajectory Analysis

A *trajectory* is a distinguishable pathway across life's span. *Transitions* are changes from one state to another that are often found along a typical trajectory (from student to employee) or less typical trajectory (e.g., drug user to drug dealer). *Turning points* are times or events that take a person in a different direction—one of many possible trajectories.

A separate interface was developed for visualizing the collected life history trajectory data for analysis and identification of turning points and trajectory patterns. The TrajectoryView visualization of drug-use trajectory data collected in a study of drug

use [3] is depicted in Fig. 6. This visualization follows the on-paper design presented in [3] by Boeri et al. displaying a matrix constructed from binary data for a set of conditions listed in the column on the right. The added interactivity allows to select a set of rows that would be also displayed next to each other below the timeline, for a side-by-side comparison, as shown in Fig. 6.

This visualization allows a researcher to pick an individual case and examine multiple factors in one's life history, focusing on identification of the relationships and critical connections between such factors.

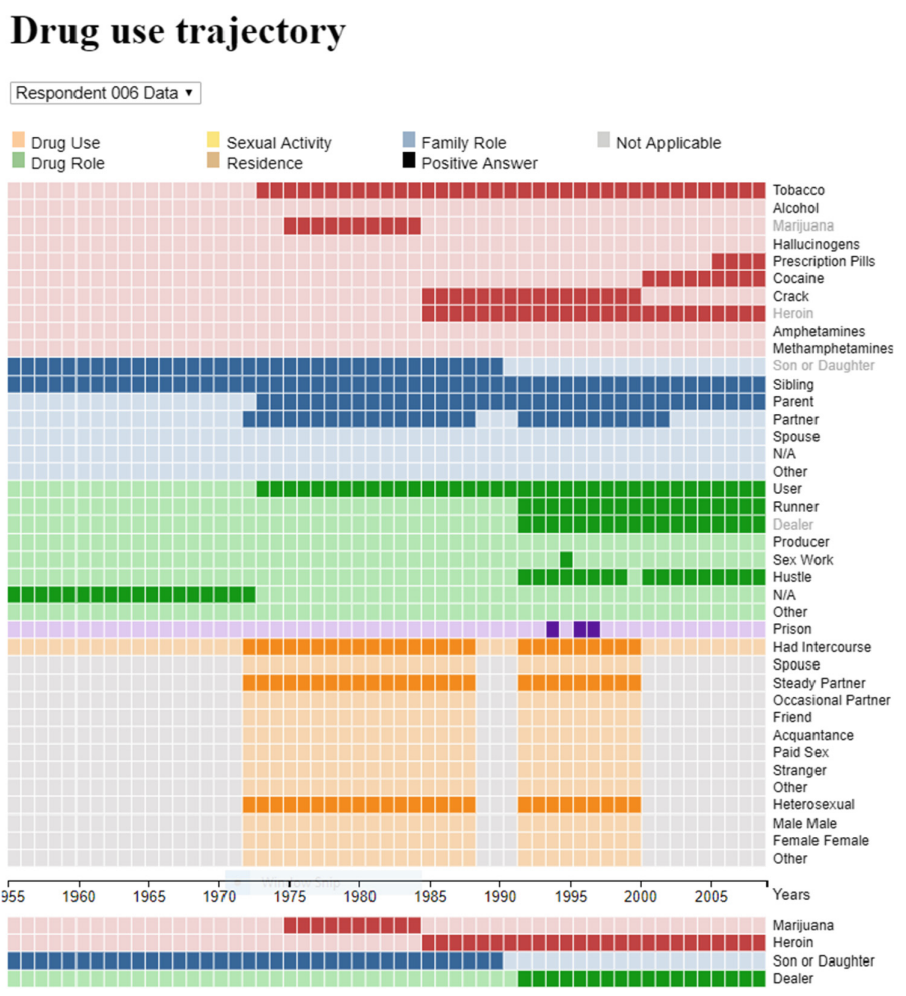

Fig. 6. A screenshot of TrajectoryView displaying a visualization of a drug user's life trajectory.

4 Pilot User Study of Self-reporting Using LifeHistory

We conducted a pilot user study to assess the usability of the LifeHistory interface when used for self-reporting without any prior training of the respondent. There were 6 participants in the study, with age ranging from 24 to 48. Participants were recruited from graduate and undergraduate students, faculty, and professionals in a business university. All participants were fluent computer users.

We have asked the study participants to use the LifeHistory visualization to enter details of their Education, Residence and Exercise habits for the past 20 years. Users were provided instructions shown in Fig. 7 and no training in how to operate the interface. Following their use of LifeHistory, we asked them to answer six Likert-scale usability-related questions and four open response questions (all detailed below) based on their perceptions regarding the visualization and their experience.

Instructions:

1. Specify the range of years in the input fields below.
2. Click the **Submit** button and scroll down to see the page with a timeline that appears on the bottom.
3. In the matrix that appears, point to the labels in the left column to **reveal the questions**.
4. For every year, provide answers to questions appearing in the leftmost column. To answer **'yes'** - the appropriate year cell must be highlighted by clicking on it.
5. When you are done, click on the **Save** button.

Fig. 7. Instructions on using the LifeHistory interface given to users in a pilot study.

4.1 Results

All users were able to complete the task using the interface.

The summary of usability-related questions and responses is presented in Table 1. As if is evident from the responses, perceptions of complexity of the interface and difficulty of interacting with it vary, depending on the user. The scores for questions 1 and 4 average around the neutral stance (Neither Agree nor Disagree, value 4 on *interface was complex*) or slightly higher (value 5 on the *difficulty to work with* the interface). This implies training or a video tutorial would be necessary to bring first-time users to a level where they would be more comfortable using the interface. Usefulness of the timeline and images to users' recall of life details also varied, averaging to neutral (questions 5 and 6); more feedback on the visual timeline is provided by the answers to the open-response questions.

Table 1. Summary of usability questions and responses.

Question	Min - Max, Rounded average of answers on a 7-point Likert scale: 1 (Strongly Disagree) – 7 (Strongly Agree)
1. The interface was complex	1–6, 4 (Neither Agree nor Disagree)
2. The interface was crowded	1–6, 4 (Neither Agree nor Disagree)
3. The interface was interactive	2–7, 5 (Agree Slightly)
4. The interface was difficult to work with	1–7, 5 (Agree Slightly)
5. Having the timeline annotated with images was useful to me in answering the questions	2–7, 4 (Neither Agree nor Disagree)
6. Timeline images helped me recall details of my life	3–6, 4 (Neither Agree nor Disagree)

We have asked users to answers to the following open-response questions:

1. *What did you like about the interface?*
2. *The interface provided event cues using images associated with political events. Was this choice of pictures helpful to you? (Answer yes, no or somewhat) If not, what type of events would be most useful to you (please write in a response)?*
3. *Please provide any suggestions for improving the visualization.*

In response to the first of the above questions, users mentioned liking the simplicity of the interface and the data entry mechanism, clear differentiation of categories by colors, and having images to help with their recollection. Question 2 led to mixed answers, with one user responding 'yes', two others 'somewhat', and three - 'no'. Participants suggested using other events, for example, financial ones. One person who responded with a 'no', commented: "I didn't realize that the presidents could be helpful to recall events from my life. Now I see that they could."

Suggestions for improvement provided by users included:

- providing ability to select multiple years at once by holding the touch/mouse button down while moving it over multiple columns,
- making the boxes smaller to avoid scrolling,
- providing a choice of different types of events to include on the timeline,
- associating different timeline images with different question categories.

5 Conclusion and Future Work

We have presented two novel user interfaces for longitudinal life history data collection and analysis. The interfaces automate and enhance existing manual practices and tools used by qualitative researchers when conducting longitudinal studies in many fields. In a pilot user study of using LifeHistory tool for life history self-reporting survey, users were able to successfully use the interface without prior training. Users' perceptions of

the usefulness of the landmark event images to their recollection of their life were mixed. This might be attributable to the choice of landmark event images depicting U.S. presidents whose term started in the specific year.

The feedback collected from the participants of the study will inform the future development and fine-tuning of the interface. In particular, it will be interesting to explore giving participants a choice of landmark events to put on their timeline. We also plan to conduct a user study with researchers utilizing our tools and develop enhancements supporting easy customization of the survey instrument for different age groups and cultural contexts.

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