Subjunctive Interfaces: Visualisations for Parallel Display and Control of Alternative Scenarios

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Introduction

Comparison of alternative scenarios can be indispensable in computer-supported work – whether in information exploration, such as when comparing travel plans that use different airlines; in design, when investigating the influence of image placement on the layout of a web page; or in simulation, when testing how alternative population growth scenarios would affect a country's economy. Especially for complex tasks, which require non-trivial problem solving and have no fixed route to their solution, there is a need for what-if exploration of scenarios of interest, and for interfaces that support comparison of those scenarios.

Many applications do support some degree of comparison between scenarios: information visualisation interfaces (Card et al. 1999) may be used for building visualisations that highlight differences, and in direct manipulation interfaces (Shneiderman 1983) the user can explore alternatives with the help of reversible actions that give immediate, visible feedback. However, Terry and Mynatt (2002) point out that most applications are still anchored to a 'single-state document model' that makes parallel and flexible exploration of alternative scenarios difficult. They suggest that new, generally applicable interface mechanisms are needed to give users better support for experimentation, variation and evaluation. One effort towards such mechanisms is subjunctive interfaces (Lunzer 1999; Lunzer & Hornbæk 2003), which help users to set up, view and control alternative scenarios based on different input-parameter values.

A Subjunctive Interface

We introduce the principles of subjunctive interfaces by showing two census-data browsers. Figure 1 shows a browser based on the 'simultaneous menus' interface used in (Hochheiser & Shneiderman 2000), for browsing data on commercial activity in the state of Maryland. The data set contains 828 records, holding the statistics for nine industry areas in each of twenty-three counties over four successive years. Each record specifies the number

of employees, the number of establishments, and the total annual payroll. The user specifies a record by making selections in three menus (1.1 to 1.3); the statistics appear as results in area 1.4.

Figure 2 shows a subjunctive interface for browsing the same data set. Its facilities exemplify the three principles of subjunctive interfaces, as follows:

First, the user should be able to set up multiple scenarios, that differ in arbitrary ways. When browsing census data, a scenario comprises a set of selections (county, industry and year) and the display of the corresponding results. Say a user wants to compare the results from different years. With the browser in Figure 1 (which we refer to as the 'simple interface', because it supports just one scenario), the user must click each year in turn and read off that year's results. With the subjunctive interface, the years can be set up in parallel scenarios. Panels b and c in Figure 2 show how a user sets up new scenarios as copies of existing ones.

Second, the scenarios should be viewable simultaneously, in a way that helps the user to compare them and to see which values belong to which scenario. With the simple interface, comparing census results requires the user to remember result values. In the subjunctive interface, the results appear side by side; Figure 2a shows four scenarios (for two counties in each of two years). Correspondence between the menu selections and the results for each scenario is shown by position and colour cues in the result displays and in the markers next to menu items.

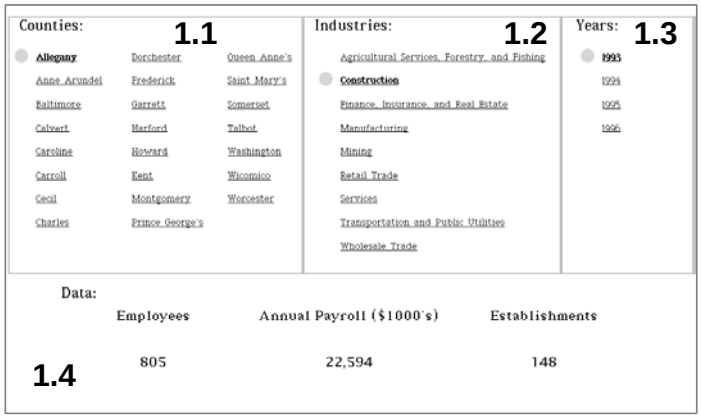

Figure 1. The simple interface for browsing census data. It is based on the simultaneous-menus design that was shown by Hochheiser & Shneiderman (2000) to be more effective than sequentially presented menus. For a selected county (1.1), industry (1.2), and year (1.3), the results area (1.4) shows the number of employees, total annual payroll, and number of establishments.

Third, the user should be able to control scenarios in parallel, so that an adjustment to an input parameter can be applied to more than one scenario at a time. In census browsing, the input parameters are the menu selections. With the simple interface, a change to a menu selection updates the single scenario that the interface supports. In the subjunctive interface, any change affects all scenarios that the user has currently selected as 'active'. In Figure 2a the bottom two scenarios (those for 1994) are active; if the user wishes to change the year of these scenarios to 1996, this requires just one click on 1996. Additionally, by holding down the Alt key the user can force all scenarios to be changed at once; for example, changing them all from Construction to Manufacturing with a single Alt-click on Manufacturing.

This is just one example of a design implementing the three principles of a subjunctive interface. Other approaches are possible, such as overlaying the scenarios' displays or using different visualisations of the results. For descriptions of such design choices see (Lunzer 1999; Lunzer & Hornbæk 2003).

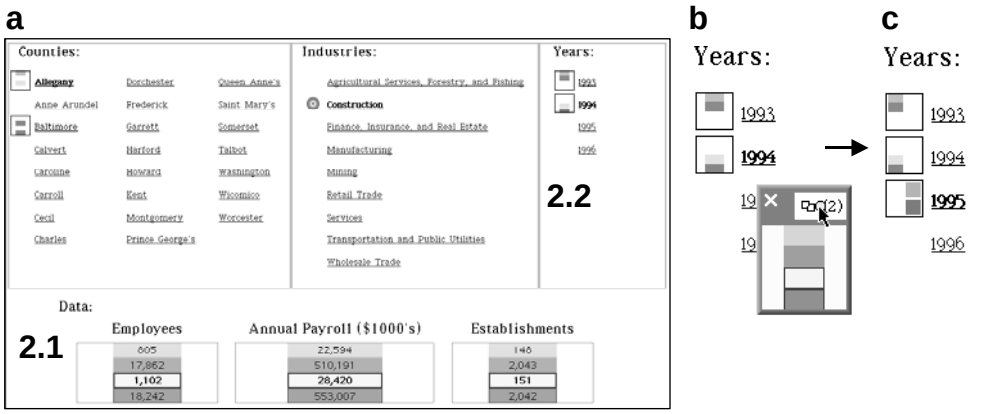

Figure 2. The subjunctive interface, with four scenarios holding the Construction statistics for both Allegany and Baltimore, in 1993 and 1994. Correspondence between menu selections and result values is indicated with position and colour cues in the result displays (2.1) and the markers next to menu items (e.g., 2.2); for example, the values 805, 22594 and 148 at the top of the result displays are for Allegany in 1993. The bottom two scenarios are currently 'active', i.e., affected by mouse operations. Panel b shows the user copying these two scenarios, by clicking and holding the mouse on 1995 and selecting the copy icon at top right in the resulting pop-up; panel c shows how the Years menu will appear with the new scenarios for 1995.

Preliminary Evaluation Results

We have run two experiments that assess the usability of the above style of subjunctive interface as compared to the simple interface. In the first experiment, twenty subjects were each given sets of tasks to complete with each interface. The subjects significantly preferred the subjunctive interface, and rated it as being more satisfying to use. With the simple interface, subjects depended to a larger extent on writing down or remembering data, as suggested by more interim marks made on paper and by reports of higher mental workload. They also used fewer interface actions to complete the tasks when using the subjunctive interface. However, we found no corresponding reduction in task completion time, mainly because some subjects encountered problems in using the facilities for setting up and controlling scenarios.

The second experiment involved seven subjects. Based on detailed analysis of subjects' actions in the first experiment we modified the subjunctive interface to alleviate frequent problems, such as accidentally adjusting only one scenario when the intention was to adjust them all. The subjects used this redesigned interface over five sessions, each lasting approximately one hour. In the fifth session, subjects were completing tasks 27% more quickly with the subjunctive interface than with the simple interface.

The experiments show that a subjunctive interface, with careful design, can give performance benefits that are both statistically significant and large.

References

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