The menu metaphor: food for thought

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Abstract. Menu selection in human/computer interaction is a metaphor of the restaurant menu. Although menu selection is widely used, its scope is currently limited, ill-defined, and information lean. A comparison of the restaurant menu and the computer menu reveal three avenues of improvement in menu systems. The correspondence of elements and features between restaurant and computer menus suggests that this powerful metaphor should be more fully developed. Second, there are a number of advantages of dynamic computer menus over static listings common to restaurants. Finally, restaurant menus currently have the advantage of breadth, richness, and graphic layout as well as a natural support system (the server) that is unparalleled in current computer applications. An analysis of deficiencies in computer menus should prove invaluable in developing the next generation of menu selection techniques.

Human/computer interaction has received considerable interest of late as systems accommodate a diversity of users. Both researchers and designers are contributing to a growing literature on the theory of human/computer interaction and the body of design principles and guidelines (e.g., Shneiderman 1987, Smith and Mosier 1986, Card et al. 1983). The greater part of this is concerned with facilitating human/computer interaction by providing a method of cognitive control that is fast, meaningful and efficient. Four major forms of interaction have been used to mediate human control over computer processes: (a) command language, (b) form fill, (c) direct manipulation, and (d) menu selection. Each mode of interaction makes use of a familiar metaphor. Command language uses the metaphor of language with syntactic and semantic structure. It has prompted an intense interest in the development of natural language systems to take advantage of the vast language capabilities of the human user (e.g., text editing, Moran 1981). Form fill uses the metaphor of a printed form. It prompts the user to input information to well-defined fields. It has proven extremely useful in structured data entry tasks (e.g., purchase order forms, Shneiderman 1987). Direct manipulation uses the metaphor of physical movement to allow the user to perform operations. Files may be moved or copied from one volume to another by dragging an icon from one point on the screen to another (e.g., Xerox Star™, Macintosh™). Finally and central to this paper is menu selection which takes as its metaphor the restaurant menu. The system presents users with a list of items and a method of selection (e.g., automated catalog systems, Norman and Chin 1988). Research on each of these modes of interaction has sought to understand the cognitive processes involved and to explore design options that facilitate interaction and improve performance.

In this paper we investigate the menu metaphor. Metaphors facilitate learning and transfer of knowledge. Moreover, metaphors play a major role in the way that the order of actions and operations in a restaurant are dictated by convention, interaction in menu selection is dictated by the user's model of system protocol. The user's intuitions about menus help them to transfer their implicit knowledge about how menus work in restaurants to how menus work to control computer processes.
Second, it will be shown that the restaurant menu has a number of interesting characteristics that correspond to computer menus. A comparison of these characteristics reveals some interesting differences in the way in which menus are implemented on the computer as opposed to the restaurant. Such characteristics influence the use of the menu and in turn the facilities of the system. Features such as system warnings, inactive options, jump ahead commands, multiple selections, and menu customization are subcomponents of the restaurant menu metaphor that facilitate interaction.

Finally, an analysis of the restaurant metaphor reveals a number of deficiencies in computer implementation of menu selection. For example, the server is an important component of the restaurant that is currently missing from the menu interface. The richness of the restaurant menu metaphor provides many avenues for designers and researchers to explore.

1. Metaphors and design/user models

The purpose of a metaphor as a literary device is to transfer the reader’s concrete knowledge about a familiar thing to the subject being written about. The author draws upon the wealth of existing knowledge to shed light on a novel topic. It has been suggested that the same process of transference may be capitalized upon in human/computer interaction. Carroll and Mack (1985) ask, ‘Can interfaces be designed to take advantage of the metaphors new users generate spontaneously as they apply their prior knowledge to this novel learning situation?’ The extent to which the design suggests and actually conforms to the metaphor determines the amount of transference of knowledge.

Metaphors play an important part not only as food for user models of the system but also as a recipe for design. Designers may exploit the metaphor as a model and language of design. The metaphor can help to suggest how a function should be implemented to take advantage of existing user knowledge or how it should deviate from the metaphor to solve problems in the metaphor itself. For example, the metaphor ‘a word processor is a typewriter’ suggests that a screen based editor should be used rather than a line editor to take advantage of the subsidiary metaphor ‘the screen is a page’. However, the typewriter metaphor has the problem of producing an uneditable copy. Consequently, we introduce the idea of a file containing the text of the paper.

In most metaphors for computer operations, the base is more familiar but the novel area is more functionally rich. The typewriter is well understood, but it’s functionality is considerably less than a word processor. Similarly, the card catalog is well understood, but it’s functionality is considerably less than an online catalog. However, when it comes to metaphors for human/computer interaction the functionality of the base is generally greater than that of the computer application. Natural language has greater familiarity and functionality than computer command languages. Designers of computer languages continue to draw on the rich heritage of natural language as a means of communication. In a similar, but more structured way, restaurant menu selection has a greater familiarity and functionality than computer menu selection.

2. Human/Computer Interaction is menu selection

Computer menu selection is, quintessentially, a metaphor. The original knowledge base for this protocol is that of ordering items in a restaurant. However, the
correspondence of elements between the two domains runs deeper than a superficial application of the metaphor. Webster (1976) gives the following definition for a menu:

**menu n.** [Fr., small, detailed, from L. minutus, pp. of minuere, to lessen, from minor, less] 1. a detailed list of the foods served at a meal; bill of fare. 2. the foods served.

The menu presents a finite set of items available at the establishment. The customer then makes a selection and informs the server. The order is then prepared and served to the customer.

In a similar vein the computer displays a detailed list of options available using that program. Several definitions of menu selection have been offered: Smith and Mosier (1986) define menu selection as follows:

**Menu selection** – A type of dialogue in which a user selects one item out of a list of displayed alternatives, whether the selection is by pointing, by entry of an associated option code, or by activation of an adjacent function key.


**menu/menu panel** – A defined panel type characterized by a panel body consisting of one or more selection fields, with optional headings and instructions. Users select choices from those displayed. The term ‘menu’ is the user term.

To understand the menu metaphor relating these two applications, we must first consider the interactive process that takes place in the restaurant between the customer and the establishment and between the user and the computer. The interaction can be characterized by a series of events and expectations called a ‘script’. Schank and Abelson (1977) outline the process of entering a seafood restaurant. They describe a normal pattern of actions as listed in the left-hand panel of figure 1. The typical computer menu script may parallel a restaurant sequence and is shown in the right-hand panel of figure 1.

<table>
<thead>
<tr>
<th>Restaurant Menu Script</th>
<th>Computer Menu Script</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter the restaurant</td>
<td>Enter the computer system</td>
</tr>
<tr>
<td>Be seated at a table</td>
<td>Navigate through the menu tree</td>
</tr>
<tr>
<td>Order from a menu</td>
<td>Select an alternative</td>
</tr>
<tr>
<td>Eat food</td>
<td>Use the function selected</td>
</tr>
<tr>
<td>Pay the bill</td>
<td>Save or delete files</td>
</tr>
<tr>
<td>Leave the restaurant</td>
<td>Exit the computer system</td>
</tr>
</tbody>
</table>

Figure 1. The stereotypical restaurant and computer scripts.
The stereotypical script may vary in form from one instance to another. For example, at a fast food restaurant, the script is that one orders the food and pays before being seated and eating. This sequence assures that the customer pays for the meal and allows the customer to leave right after finishing rather than having to wait for the check. Similarly, some programs require specification of a filename prior to entering data rather than upon completion. Some programs may also periodically save the contents into this file during the session to prevent accidental loss due to system failure. Thus, there may be deviations from the expected sequence of events. The restaurant is rich in detail and variability.

An element that is generally present in the restaurant script and not found in menu systems is a preview of the menu itself. Often the menu is displayed in a prominent place for customers to preview what an establishment offers. Customers may determine if the restaurant is the appropriate choice. In most applications with menu systems, the menu listing is not available for the user to determine whether the application will meet the user’s needs. All too often the user is required to enter the application, traverse the menu, only to find that the desired object or function is not available. There are many hidden costs involved with entering an application without preview. For example, the time to load an application program just to get a notion of what the program does may be excessive. Once in the program, the user may get lost and have little idea of how to get out or to exit from the program. This is analogous to entering a restaurant without knowing the price range of the entrees. Once seated and given the menu, the customer may end up paying for a costly meal that had not been anticipated.

3. A comparison of restaurant and computer menus

A sample of restaurant menus and computer menu systems were analysed in order to compare statistics. In this particular sample the computer programs contained nearly three times as many selectable items as the restaurant menus. However, the ratio of pages in restaurant menus to frames in computer menus did match that ratio. Restaurant menus contained considerably fewer pages with many more items per page. The organization of items also varied. The number of items per category level (i.e., per frame) was somewhat greater for restaurant menus for first level categories but fewer for bottom level. At the top level, restaurant menus average eight categories (e.g., appetizers, sandwiches, main courses, beverages, etc.); whereas, computer menus averaged only six (e.g., File, Edit, Search, Format, Font, and Style). At the bottom choice level, restaurant menus averaged 2.5 items (generally several sizes such as large, medium or small); whereas, computer menus averaged 4.7 (e.g., a list of font sizes, or band rates).

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Restaurant</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of selectable items</td>
<td>119.0 (83.1)</td>
<td>316.4 (158.5)</td>
</tr>
<tr>
<td>Number of pages (Frames)</td>
<td>3.8 (3.5)</td>
<td>70.2 (65.7)</td>
</tr>
<tr>
<td>Number of 1st level categories/items</td>
<td>11.0 (6.3)</td>
<td>7.8 (3.6)</td>
</tr>
<tr>
<td>Average items per 1st level category</td>
<td>8.0 (4.7)</td>
<td>6.0 (3.2)</td>
</tr>
<tr>
<td>Average items per 2nd level category</td>
<td>3.4 (1.7)</td>
<td>5.4 (3.2)</td>
</tr>
<tr>
<td>Average items per bottom level category</td>
<td>2.5 (3.0)</td>
<td>4.7 (3.0)</td>
</tr>
</tbody>
</table>

Note. The computer programs were Smartcom II™, Lotus 1-2-3™, Wordstar 3-31™, Procomm 2-4™ and Word Perfect 4-2™.
4. Common features

A comparison of descriptive features reveals that restaurant and computer menus share a number of common aspects.

4.1. Customization

Both allow for customization depending on subject domain, time or type of customer. Menus vary from restaurant to restaurant and from meal to meal. Restaurants specialize by nationality, type of food (e.g., seafood, steak, vegetarian, etc.), and speed. Furthermore, restaurants change their menu for breakfast, lunch, and dinner, and by day of the week. Similarly, menus vary from one computer application to another. One picks the package that will be the most functional for the task at hand. The selection of a restaurant serves to restrict the set of options available to the customer. Similarly the selection of a particular software package, restricts the functionality. In turn, the menu reflects the speciality of the restaurant or software package.

4.2. Complexity of selection

Both restaurant and computer menus can allow for complex selection procedures. The restaurant allows the customer to order (a) multiple items, (b) several of any one item, and (c) combination platters. In a similar manner, some computer applications provide pick lists, multiple selections, and preprogrammed selections. In particular, direct manipulation allows a complexity of selection not unlike one's selection at a buffet where a combination of items can be selected to create the desired entree.

4.3. Multiple methods of selection

Computer and restaurant menus allow multiple selection methods. Current computer menus often display a simple letter or number along with an icon and a menu option name for users to either press a key or point and/or click. Many ethnic restaurants list numbers, pictures and names associated with a food item so that customers simply say either the number, the name, point at the picture, and make an attempt to pronounce the name.

4.4. Jump ahead commands

If the customer is familiar with the menu, there is no need to refer to it when ordering. The customer verbalizes the desired items from memory. Similarly, many computer menus incorporate this feature with jump ahead or menu bypass commands (Laverson et al. 1987).

4.5. Specials of the day

Restaurant menus handle specials of the day by clipping them to the standard menu or display them on a chalk board. Such specials take advantage of seasonal variation, market fluctuations, or the whim of the chef. Some timeshare systems make use of this too. Variety adds interest to the menu for regular users that are looking for something new. In addition, computer systems may take advantage of prevailing system conditions such as access to the LAN, the printer, or other system resources.
4.6. Warnings

Warnings may be issued to inform people about the possible consequences of their selections. For example, one of the restaurant menus that was sampled had a number of warnings, including one concerning ordering too much!

Warning: Be careful when you order. Each Alyson's Chicago Deep Dish Pizza has about twice the food content as pizzas you are probably accustomed to eating.

Some selections carry with them a certain level of risk that the customer or user should be aware of. Both the server and the menu may provide helpful warnings to the customer at a restaurant. The customer may then go ahead and order more than what is recommended, but he or she must bear the consequences. This allows avoidance of unpleasant consequences and prevent errors in selection. For example a particular item may take more time to produce. A club sandwich might require more labour and processing time while spaghetti might take very little time. The server might warn the customer that a sandwich might take more time than she or he is willing to wait. This is analogous to application programs that signal warnings to the user about the length of execution time for a particular command.

5. Advanced features of computer menus

There are several aspects of the computer menu that do not correspond to the static menus of restaurants. These result from the dynamic nature of the computer and its ability to update its display.

5.1. Hierarchical menus

Although restaurant menus typically organize and group items by course or food category, they are limited in terms of the number of levels that can be meaningfully displayed. Computer menus have the capability of organizing and displaying items in a hierarchical structure with unlimited depth. Unfortunately, it is not clear if this is a real advantage in terms of user comprehension and performance.

5.2. Inactive options

One thing that computer menus have over most restaurant menus is the dynamic ability to add or delete items from the menu depending on the current state of the system. For example, Macintosh™ pull down menus display grayed-out items if they are not currently available. In contrast, the restaurant customer may place an order only to be informed the kitchen has run out of that item. In a sense this is equivalent to generating an error message. The computer menu has the capability of avoiding such errors.

5.3. Self adapting

Currently, most of the menus are fixed. They do not change in their structure or content. Future computer menu systems may become dynamic. The menu could automatically infer the optimal arrangement of the menu based on previous user interactions. The system can adjust for changing user expertise and needs. Berke and Vidal (1987) propose the use of a Most Frequent Use (MFU) metric as the basis for restructuring the menu system. Frequently selected menu items may be placed at more accessible nodes of a menu tree or network. This may extend the life of the menu system (Maguire 1982). Greenberg and Witten (1985) believe that adaptation helps to reduce
the differences between the designer's original conception of the system and the user's model of the system.

There are some possible disadvantages with self-adaptation. Trevelyan and Browne (1987) argue that self-adapting menus may become mal-adaptative menu systems. Restructuring of menus along only a single dimension, such as frequency, may be inadequate. For example, a self-adapting computerized restaurant menu may place all the hot and spicy foods on the first page of the menu since the user has a history of choosing tangy foods. However, if the user wants a change of pace or prefers not to perspire while eating a spicy dish, the milder foods will be harder to find. Worst yet, the positions of the menu items may have changed, leading to more confusion for the user/customer. This confusion may be avoided by allowing the user to perform the changes in the menu structure rather than the system. Chin (1988) proposes the development of user adaptable menus.

5.4. User adaptable

In the user adaptable menu system, the user has the power and flexibility to rearrange the menu structure, allowing the user to create new paths between nodes that may facilitate navigation through the menu system. The user could personalize the menu so that the name of menu options could be changed to more distinctive, memorable and comprehensible labels. This is important to consider when users often have difficulty choosing the correct category heading for the intended target items. In fact, the user averages less than 50% success in finding the correct category name (Dumais and Landauer 1984).

There already appears to be a movement towards user adaptable interfaces in general. One example of this approach is the pulldown tearoff menus in Hypercard™ which allow the user to 'tear off' the options of the pulldown menu panel and place them anywhere on the screen for easy access to frequently used menu items. This type of menu gives the user the option of operating only with a pulldown menu to save valuable screen space or having a static menu showing the options at all times. Menu systems of the future may allow users to customize the menu in terms of both content and structure.

Figure 2. The introduction of the server as an intelligent interface for the database.
6. Deficiencies in computer menus

Despite the power and versatility of the computer, restaurant menus still possess two major features not yet shared by computer menu systems. The first is the appeal and complexity of graphic layout. The second is really a sub-metaphor, namely, the server.

Visual inspection of the restaurant menu in comparison to the computer menu reveals that the typical computer menu is extremely information lean, displaying generally only alphanumeric lists of items. In contrast, the restaurant menu may display tantalizing pictures, descriptions of entrees, and stylized type of various font sizes. The graphic layout of a menu not only helps to organize items but it also conveys additional information about the items. The intent of the restaurant menu, however, is not only to inform, but also to sell. Eye catching graphics help to do this. Computer menus are only beginning to exploit this aspect of the metaphor. For example, HyperCard™ provides a menu system that allows designers full graphics capability.

Perhaps the greatest deficiency of computer menus is a part of the restaurant script that is missing in computer applications. In the restaurant the server facilitates communication between the customer and the kitchen. The counterpart in a computer system would be a natural language parser in conjunction with a menu to provide the user with extensive online help concerning the choices on the menu.

The restaurant server can answer questions and field requests. Many times the customer wants to modify a selection on the menu. The customer, for example, may order a menu that lists a sandwich with mustard. However, the customer does not want mustard. The server is able to parse the customer’s utterances concerning the deletion of the mustard from the sandwich and alters the item.

The server possesses a great deal of knowledge about the menu and the relationships between items. The server functions as an intelligent database interface (See figure 2). Customers may query items by aspects such as cost and food type. For example, a customer may ask for the least expensive and most spicy chicken entree that is cooked in curry. The server may also give suggestions upon the request of the user.

As computer menus become more and more complex, the user needs an expert system analogous to the server to assist in navigating and pruning the menu tree. For example, a server could perform complex relational searches by specified conditions and generate a shortened menu or narrow the user’s search in a large menu.

The server can implement items not on the menu. In restaurants, customers may request new items that are not on the menu. The server may offer possible alternatives available to satisfy the customer’s request. These alternatives may come from unusual combinations not listed on the menu or selections that are always present but not listed on the menu. Similarly, a computer menu server may help the user print a file although a print command is not listed on the menu. The server may suggest the use of a copy command since, unknown to the user, the program prints files by ‘copying’ a file to the printer. Moreover, the server may alter the order of operation. A system may require the user to select an operation followed by the operand. A server may be able to reverse that order. Furthermore, a server could be used to build macros and higher level forms of interaction.

The server acts as a constantly available context-dependent help facility. The server is called upon for suggestions, definition of terms, and even directions. Likewise, online help in computer menu selection is needed to provide context-dependent help.
7. Summary

Current applications of computer menu selection bear a strong correspondence to restaurant menus and reinforce the metaphor. The metaphor has proved useful for both users and designers. However, a comparison of the restaurant menu and the computer menu reveals deeper layers of the metaphor. The next generation of menu selection needs to exploit additional aspects of the metaphor by incorporating graphic menu layout and the concept of a server. Graphic layout that will prove to be a potent factor in selling systems, creating the right image, and facilitating the choice process. The concept of the server will close the gap between the user and the system by providing a superimposed interface to facilitate menu selection.

Designers should also consider dynamic menu systems as an approach that would allow greater flexibility. Customization and personalization of menus may result in better performance and greater user satisfaction. It is felt that future menu systems should incorporate both self-adapting and user-adaptable features. However, the flexibility of dynamic menus must maintain the consistency of fixed menus to avoid overburdening or confusing the user.

Overall, future menus should display more than a series of items. Menus need to be sophisticated, intelligent and flexible. The menu system should be able to assist the user in accomplishing the tasks at hand rather than serve as a simple mechanism of hiding the complexity of the program. Menus need to exploit the restaurant menu metaphor to provide a firm, concrete and consistent context for users. The use of the metaphor could provide intuitive understanding of a complex interface.

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Note

1 The term ‘server’ is being used with increasing frequency in restaurants to avoid the gender distinction required by the terms ‘waiter’ and ‘waitress’. This term will be used in the present context for the same reason.

References


