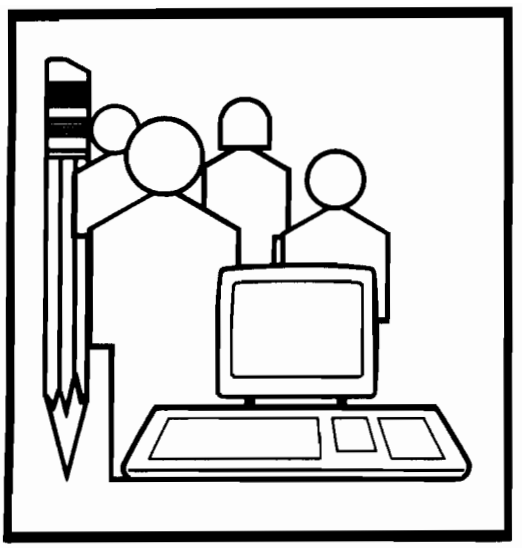

TECHNICAL REPORT

USER PREFERENCE RE CBI MENU CHOICE MECHANISMS

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USER PREFERENCE RE CBI MENU CHOICE MECHANISMS

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ABSTRACT

Two studies were carried out to investigate users' preferences regarding the use of menu pointing mechanisms. The first study focused on user preference for type of pointing mechanism (arrow or reverse video bar). Subjects were equally divided in their preference for type of pointing mechanism. A breakdown of preference by subjects' self-rating of computer experience showed that six of the seven subjects who were beginners preferred the arrow. The second study examined user preference for default position of the pointing mechanism (a null position vs. a tracking position). Subjects preferred the default position that pointed to the next lesson (or module) in the course over the null position by a two to one margin. When asked in the post-treatment interview if their preference would vary depending on how they normally would access the lessons, half of the subjects indicated they would alter their choice based on the type of task. If always accessing the lessons sequentially, the next default position was preferred; if always accessing the lessons randomly, the null position was preferred.

PURPOSE OF THE STUDY

Menus are being used to access a wide array of informational and/or functional units in many different types of software packages. Menus are often assumed to be user-friendly in and of themselves, but this is not necessarily the case. A poorly designed menu can be more difficult to use than a well-designed command interface.

What makes a menu interface easy to understand and use? That sounds like a simple enough question, but the answer is deceivingly elusive. In some cases the users of a particular menu interface may be similar in terms of computer expertise. In other cases their experience may vary widely. In the latter situation, menus must be simple enough to be intuitively understandable to the novice without being so cumbersome that they frustrate experienced users.

A number of studies investigating menu design parameters have appeared in the recent human factors literature. One line of inquiry focuses on the structure of menus: grouping of items, breadth and depth of menu structure, and cues that facilitate subjects' cognitive mapping of menu hierarchies. Another line of inquiry focuses on method of selection: alphanumerics, mnemonics, or pointing mechanisms. These studies provide useful information for instructional developers who design menus for computer-based courseware.

Research has shown that a meaningful organization of items on a menu facilitates the learning of the menu structure, and hence ease of access to items on the menu (Snowberry et al., 1983; Liebelt et al., 1982). As McDonald and his colleagues point out, the "interface becomes a conceptual model for the system itself" (McDonald et al., 1983). Some educational theorists suggest that understanding the structure of a body of content facilitates assimilation and retention of facts and concepts that constitute that body of knowledge (Ausubel, 1963; Reigeluth et al., 1980). Thus a CBI menu structure that reflects the structure of the subject matter should help students build a conceptual model of the content they are learning.

It is not easy to discern the structure of the subject matter you want to teach, much less fit it into a neat set of nested menus. The task is further complicated by the fact that it is difficult for subjects to locate items accurately on deeply nested menus (Snowberry et al., 1983). In one sense, the depth issue may be of less concern to course developers since learners usually access items on a menu (lessons) sequentially, at least the first time they take the course. However it has been observed that learners seem to have a hard time keeping track of their place in a course when the menu structure is more than two levels deep. If, for purposes of instructional integrity, it is necessary to

use more than two levels of menus, the isomorphism between the structure of the subject matter and the structural design of the menus takes on even greater importance.

There are ways to help people understand and access a hierarchical menu structure. For example, Billingsley (1982) has found that access to a map of the menu structure facilitates the development of a workable, relatively long-lasting mental model of the structure. Many CBI courses have used maps to orient learners to the course structure. Experience and informal pilot evaluations suggest that learners find them helpful (Seidner, 1983).

Items on menus may be accessed in different ways. Users may type in a number, letter or mnemonic that stands for the item on the menu. Alternatively, pointers (an arrow or cursor) can be used to indicate which item on the menu the user wishes to access. Experienced users seem to prefer some type of direct character string matching while new users are often more comfortable with pointing mechanisms (Heines, 1984). Most of the computer-based courses developed at Digital use some type of pointing mechanism to access menu entries; some courses provide the option to type the lesson number as well.

It seems likely that the option to access menu items in a CBI course through the use of a pointing mechanism will remain one of the options available to students, since many CBI users are relatively inexperienced computer users. Given the decision to use a pointing mechanism, different options are available. First, what should the pointer look like? Should it be an arrow, a cursor, a reverse video bar? What should be the default position of the pointer? Course designers usually make these decisions on the bases of personal preference, peer concensus, an informal sampling of the target audience, or a combination of these sources of information. It was the purpose of this research to find out, in a systematic way, what type of menu pointing mechanisms are preferred by typical people who take CBI courses.

DESIGN OF THE STUDY

The two studies described in this paper investigated learner preference with regards to the use of pointing mechanisms. One study focused on subjects' preferences for type of pointing mechanism (arrow or reverse video bar). The other study examined subjects' preferences for default position of the pointing mechanism (a null position vs. a tracking position). Both studies utilized a within-subjects design.

The subjects in the studies had not taken a computer-based course of the type used in this study, although four subjects had done some computer-based exercises designed to accompany a text-based self-instructional course. When asked to rate themselves on the basis of their experience at a computer terminal, most subjects classified themselves as beginners or at an intermediate level.

The experimental procedures in both studies were similar. Two existing CBI courses on word processing were stripped of the major part of their lesson content, so that only the introductory and summary screens for each lesson remained. This enabled subjects to go through the shortened versions of the courses rapidly. The menu structure for the courses was two levels deep. Each course had three modules. Modules could be accessed from a Main Menu or, in Modules 1 and 2, from a selection at the bottom of the menu named "Next Section of the Course." The number of lessons in each module varied from 2 to 6.

Each subject took both courses. By the time the subject had completed both courses he or she had experienced the two variations in menu design being investigated. The order of conditions was counterbalanced so that presentation order was not a confounding variable.

At the beginning of the study, subjects were instructed to view the introductory and summary screens for each lesson in the first course specified by the experimental condition. Subjects accessed the lessons through the course's menu structure. When they finished the first course, subjects engaged in a short series of seek tasks. The purpose of the seek tasks was to give subjects the experience of accessing lessons randomly, rather than sequentially, from the menus. Starting from the main menu, subjects accessed a series of specific lessons, as the lessons were named by the researcher. Subjects repeated the procedure for the second course. They accessed the introductory and summary screens for each lesson sequentially and then completed the seek tasks.

At the end of the study, subjects participated in a short post-treatment interview. They were asked their preferences with regards to the menu feature that had been varied and the reason for their choice. Subjects were also asked to give a subjective judgment of their level of computer experience.

The task for subjects was not an entirely artificial one. Subjects who participated in the study were interested in learning word processing; most of them were secretaries. The subjects were told that they could use the actual word processing course after they had completed the experimental task. Since the time they could use the course would be limited, they could use the experimental task (reading the introductions and summaries of the lessons) to learn about the contents of the course. When they were taking the word processing course, they could then use

their time more efficiently, studying only those word processing features they were most interested in learning.

The word processing courses used for the treatment were designed for a microcomputer. However, the truncated version of the courses used in the treatment was run on a VAX 11/780 to accomodate the tracking program designed to record subjects' responses.

STUDY A: PREFERENCE FOR TYPE OF POINTER

The menu selection characteristic that was varied in Study A was the type of pointer. In one course, subjects used an arrow to point to the module or lesson they wanted to access. When subjects had made their selection they pressed the DO (return) key to activate their choice. In the other course, a reverse video bar identified the lesson that would be accessed when the DO (return) key was pressed. In both courses, the pointing mechanism defaulted to the first item on the menu.

The two courses modified for use in the treatment were the "System Overview" course (identified as Overview in Table 1) and the "Introduction to Word Processing" course (identified as Intro to WP in Table 1). The order of the courses and the order of the experimental variable were balanced to create four experimental conditions. Twelve subjects participated in Study A, three in each condition. As Table 1 illustrates, subjects in condition one first took the "Introduction to Word Processing" course using the arrow as a pointing mechanism; then they took the "Overview" course using the reverse bar as a pointing mechanism. The order of the remaining conditions can be discerned from Table 1.

Table 1

DESCRIPTION OF CONDITIONS FOR STUDY A

COND.	FIRST COURSE		SECOND COURSE	
	Content	Pointer	Content	Pointer
1	Intro to WP	Arrow	Overview	Reverse Bar
2	Intro to WP	Reverse Bar	Overview	Arrow
3	Overview	Arrow	Intro to WP	Reverse Bar
4	Overview	Reverse Bar	Intro to WP	Arrow

Subject Preference Data

Subjects were equally divided in their preference for type of pointing mechanism. Six subjects preferred the arrow and six subjects preferred the reverse video bar. Table 2 presents the preference data by condition. Given the small size of the sample, the observed differences by condition could not be assumed to constitute a consistent pattern.

When asked the reason for their choice, subjects who preferred the arrow noted that it was a familiar symbol, something that was easy to interpret. The subjects who preferred the reverse video bar all mentioned its visibility and emphatic qualities.

Seven of the subjects in Study A identified themselves as computer novices, and the remaining five indicated an intermediate level of experience. A breakdown of preference by subjects' self-rating of computer experience presents an interesting pattern. As can be seen in Table 3, six of the seven subjects who were beginners preferred the arrow.

Selection Time Data

It has been observed that sometimes people have trouble interpreting the meaning of a reverse video bar, and thus do not immediately identify it as a pointing mechanism (Billingsley, 1983). This can be particularly true in computer-based instruction because the reverse video bar is sometimes used in other ways, for example, to highlight a title or a section of instruction. In the treatment used in this research, subjects saw a brief introductory section that described the use of menus. The type of pointing mechanism was identified in this section. Thus, one might assume that subjects would have no trouble identifying the reverse video bar as a pointing mechanism. An additional cue (specific to the software program that drove the treatment) was a

Table 2

SUBJECT PREFERENCE BY CONDITION

	CONDITION			
SUBJECT PREFERENCE	1	2	3	4
Arrow	1	1	2	2
Reverse Bar	2	2	1	1

blinking cursor at the end of the pointing mechanism, whether that was an arrow or a reverse video bar.

An indirect indication of subjects' understanding of pointing mechanism functionality is the time it takes them to make their first selection from the main menu. A response tracking program linked to the treatment recorded each menu selection made by the subject and marked it with the system time stamp. Thus it was possible to see how long it took subjects to make their first selection.

Table 4 presents time data for subjects by condition. The average time it took subjects to make their first selection from the main menu when the arrow was the pointing mechanism was 16.5

Table 3

SUBJECT PREFERENCE BY LEVEL BY EXPERIENCE

	PREFERENCE	
LEVEL OF EXPERIENCE	Arrow	Reverse Bar
Beginner	6	1
Intermediate	Ø	5

Table 4

MEAN FIRST MENU SELECTION TIME BY TYPE OF POINTER

	TYPE OF POINTER				
	Arrow		Reverse Bar		
COURSE	N	Mean (sec)	N	Mean (sec)	Significance
First	6	23.5	6	33.3	ns
Second	6	9.6	6	15.3	p < .Ø5
Both	12	16.5	12	24.3	p < .1Ø

seconds. The average time for the first main menu selection using a reverse bar pointer was 24.3 seconds. A one-tailed t-test indicated a significance level of .1Ø for all subjects across courses. A similar pattern was observed when times for first courses were compared, although the difference was not significant. The mean time for subjects from conditions 1 and 3 who took the first course using the arrow pointer was 23.5 seconds, while the mean time for subjects from conditions 2 and 4 who took the first course with the reverse bar pointer was 33.3 seconds. The time it took subjects to make their initial selection in the second course was predictably shorter, but the time differential between the two types of mechanism prevailed. For the second course, the mean selection time was 9.6 seconds for the arrow and 15.3 seconds for the reverse bar. The difference between these means was significant at the .Ø5 level.

While none of these significance levels are particularly impressive, the consistency of the results suggests that the time differential is reflecting a real phenomenon. We can only speculate on the exact nature of that phenomenon. However, it seems reasonable to suggest that the symbolic meaning of an arrow is already well established, and thus subjects do not have to go through an additional cognitive transformation in relating the symbol to its current purpose as may be the case with a reverse video bar.

STUDY B: DEFAULT POSITION OF POINTER

The next study used the same counterbalanced design. The same modified courses were used in the treatment, but the variable under study was changed. It was decided that an arrow would be used as the pointing mechanism, and what varied was the default position of the arrow. In one course, the arrow position always defaulted to a null position above the first item in the menu. This default position is identified in Table 5 as "Null." In the other course, the arrow defaulted to the lesson on the menu that followed the lesson the subject had just completed. This default position is identified as "Next" in Table 5. In the Next variation of the treatment, the arrow position defaulted to an item on the menu named "Next Module in the Course" after subjects completed the last lesson in a module. Twelve subjects participated in Study B, three in each condition.

Subject Preference Data

As can be seen from from the data in Table 6, subjects preferred the default position that pointed to the Next lesson (or module) in the course. There was no pattern associated with condition.

When asked the reasons for their preference, all four of the subjects who preferred the null default said that the requirement to actively choose made them think about what they were doing. Most subjects who indicated a preference for defaulting to the next lesson noted that it was faster and easier; only two subjects said that it helped them keep track of their place.

The data was examined to see if level of experience made a difference in the pattern of subjects' responses. Of the twelve subjects in this study, eight indicated that they were beginners, three classified themselves as intermediates, and one was an expert. As Table 7 shows, subjects who classified themselves as intermediate or expert computer users all chose the default to the next lesson (all gave reasons related to speed and convenience). Beginners were equally divided. The two subjects who

Table 5

DESCRIPTION OF CONDITIONS FOR STUDY B

COND.	FIRST COURSE		SECOND COURSE	
	Content	Position	Content	Position
1	Overview	Null	Intro to WP	Next
2	Intro to WP	Null	Overview	Next
3	Overview	Next	Intro to WP	Null
4	Intro to WP	Next	Overview	Null

Table 6

SUBJECT PREFERENCE BY CONDITION

SUBJECT PREFERENCE	CONDITION 1	2	3	4
Null	1	1	1	1
Next	2	2	2	2

mentioned the tracking function of the next default were beginners. Interestingly, the expert mentioned that she would prefer to access the lessons directly by typing a number or letter that identified the lesson. This is consistent with other informed observations (Heines, 1984).

In Study B, the default position of the pointer affected the way subjects performed the seek tasks. In one condition (Null), they always had to move the pointer down to the correct choice, and this always required a few key strokes. The conceptual task was the same in each case: move from a null default to position the correct lesson. In the other condition (Next), an active choice was also required in most cases. The default position of the arrow prior to that choice might have been counter-productive to the individual seek task. The sequence of seek tasks was deliberately chosen so that in some instances, subjects had to move the arrow up within the same menu to reach the designated lesson. It seems to make less sense to have the pointer default to the next lesson when the next selection you wish to make is not the next lesson in the sequence. For this reason, subjects were asked in the post-treatment interview if their preference would vary if they were going to take lessons sequentially or randomly choose the lessons they wished to study.

As shown in Table 8, about half of the subjects said they would stick to their choice, regardless of whether their task was to access lessons sequentially or randomly. The other half of the subjects indicated they would alter their choice based on the type of task. Two of the four subjects who preferred the null position said they would prefer the default to the next lesson if they were <u>always</u> going to access the lessons sequentially. Three of the eight subjects who preferred the next default said they would choose a null default if they were <u>always</u> going to access lessons randomly. One subject who initially preferred the next default said that either null or default would be acceptable in a random access mode. When subjects were asked which default they

Table 7

SUBJECT PREFERENCE BY LEVEL BY EXPERIENCE

	PREFERENCE	
LEVEL OF EXPERIENCE	Null	Next
Beginner	4	4
Intermediate and Expert	Ø	4

would prefer if they would be accessing lessons both sequentially and randomly, all reverted to their original choices.

Selection Time Data

It was anticipated that, because of the nature of the default function, it would take subjects less time to complete the courses when the the arrow pointed to the next section of the course than when the arrow returned to a null position after each lesson. This was, in fact, the case. As the data at the top of Table 9 indicate, it took subjects an average of 9 minutes and 35 seconds to complete the Overview course when the arrow defaulted to a null position, as compared to 7 minutes and 9 seconds when the arrow defaulted to the next lesson. Average completion time for the Introduction to Word Processing course was 12 minutes 45 seconds for the Null condition as compared to 10 minutes and 44 seconds for the Next condition. The difference in completion time between the two courses reflected the actual length of the courses, and was expected. The difference was significant at the .10 level for the Overview course, the shorter of the two courses in the treatment, but was not significant for the Introduction to Word Processing Course.

The seek task at the end of each course required subjects to locate six lessons. After repositioning themselves at the main menu, subjects located each lesson as it was named by the researcher. The lessons accessed after each course were located in the same relative position, but because the number of lessons in a module varied across courses, the minimum number of key strokes required to complete the task also varied somewhat. The minimum numbers of keystrokes required to successfully complete

Table 8

SUBJECT PREFERENCE BY MANNER OF LESSON ACCESS

	LESSON ACCESS			
	Sequential		Random	
ORIGINAL CHOICE	Null	Next	Null	Next
Null n=4	2	2	4	0
Next n=8	0	8	3	4
Totals	2	10	7	4

the seek tasks with the null default were 40 and 43, respectively, for the Overview and Introduction to Word Processing courses. The minimum numbers of keystrokes required to complete the seek tasks when the arrow defaulted to the next lesson or module were 23 and 27, respectively, for the Overview and Introduction to Word Processing courses. It is somewhat surprising, given the difference in required keystrokes, that the time required to complete the seek tasks was not significantly different when seek task times were pooled for the two courses. As the data at the bottom of Table 9 illustrate, the average time across subjects for the Null condition was 3 minutes and 23 seconds, while the average time across subjects for the Next condition was 3 minutes and 2 seconds. This suggests that after subjects got the hang of it, they were able to move the arrow down from the null position fairly quickly.

SUMMARY

These two studies examined learner perference for type of pointing mechanism and default position of the pointer in CBI course menus.

Subjects in Study A were equally divided in their preference for type of pointing mechanism; half preferred an arrow and half preferred a reverse video bar. Cross-tabulation of the data by expertise of subject suggested that people who were less familiar with computers, and hence the graphic capabilities of a computer terminal, were more comfortable with a familiar indicator, such as an arrow. It took subjects longer to make an initial

Table 9

MEAN COMPLETION TIMES BY DEFAULT POSITION

	DEFAULT POSITION				
	Null		Next		
COURSE	N	Mean (min:sec)	N	Mean (min:sec)	Significance
Overview	6	9:35	6	7:09	p < .10
Intro to WP	6	12:45	6	10:44	ns
All Tasks	12	3:23	12	3:02	ns

selection from a menu when the pointing mechanism was a reverse video bar than when it was an arrow. The time differential was consistent across courses and approached a reasonable level of significance for such a small sample. It should be remembered that prior to making their first selection, subjects had viewed an introductory section that explained the type of pointing mechanism used to make selections from the menus. Without this explanation, the difference might have been even greater.

A possible explanation for the difference in initial selection times is that it takes more time for subjects to interpret the symbolic meaning of a reverse video bar in this context. The symbolic meaning of an arrow is already well established, and thus subjects do not have to go through an additional cognitive transformation in relating the symbol to its current purpose, as they probably do with the reverse video bar. This would be particularly true if the reverse video bar had already been used in a course in different ways, for example, to identify a title.

The subjects in Study B preferred a pointing mechanism that defaulted to the next lesson over one that defaulted to a null position at the top of the menu by a two to one margin. The reason most frequently cited by subjects who preferred the next default was that it was easier and it took less time. In fact, it did take subjects less time to through the courses when the arrow defaulted to the next lesson than when it defaulted to a null position at the top of the menu. Another default option not addressed in this study is the default to the lesson that was just completed. This option provides a marking function and requires fewer keystrokes than the null default, but it does require an active choice on the part of the user. Anecdotal data from informed observers suggest that some learners find this compromise appealing.

Given the small sample, these results should be interpreted with caution. However, if faced with the task of choosing which type of menu pointing mechanism to use in a CBI course for novice computer users, the cumulative thrust of the data suggests that an arrow pointer might be an appropriate choice. If one has to choose between a null default position and a default position which marks the user's place in the course, the latter choice seems appropriate if the lessons are likely to be accessed sequentially. If, however, students are more likely to access lessons in a random fashion, then the null default should be seriously considered.

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