SOCIAL INFLUENCE AND PREFERENCE OF DIRECT-MANIPULATION AND KEYBOARD-COMMAND COMPUTER INTERFACES

Michael S. Wogalter and Richard L. Frei
Department of Psychology
Rensselaer Polytechnic Institute
Troy, New York 12180

ABSTRACT

Direct-manipulation and command-based computer interfaces have each found their own following among microcomputer users. This study explores some of the differences between these two groups of computer users. Participants completed a questionnaire that requested their microcomputer usage and ownership, usage and preference of various command methods and pointing devices, the microcomputers most of their friends use, the microcomputer they would be most willing to purchase next, and their preference for several models of microcomputers. The results showed that participants preferred pointing devices (e.g., mouse) compared to other input methods (e.g., arrow keys) regardless of their prior usage. They tended to use an interface similar to that of their friends' and they reported greater willingness to purchase a computer with an interface similar to the one they most often use. In general, the results suggest that social influence and interface familiarity are important factors in determining which interface people choose to use. Being surrounded by others who use a similar computer interface eases the burden (in terms of effort, time, and expense) of obtaining relevant computer information. An implication of this work is that these variables may hinder approval and acceptance of improved computer interface designs offered by human factors specialists.

INTRODUCTION

Human factors specialists have dedicated considerable attention and research to various aspects of computer interface usability. Currently, the marketplace offers two types of interface (Shneiderman, 1987): *keyboard-command* (e.g., IBM and IBM-clone personal computers) and *direct-manipulation* (e.g., Apple Macintosh and Commodore Amiga computers). Keyboard-command interfaces tend to use character-based input and displays and usually employ keyboard arrow keys to position a curser; direct-manipulation interfaces tend use graphic displays, and selection of commands using a pointing device (e.g., mouse).

Both kinds of interface seem to offer advantages and disadvantages. For example, research suggests that experts can issue keyboard commands faster with a keyboard-command interface (Karat, McDonald, & Anderson, 1986); whereas, novices learn direct-manipulation interfaces at a faster rate (e.g., Brems & Whitten, 1987). The kind of pointing method also affects speed and accuracy. Albert (1982) found that in a cursor positioning task, faster methods of input (touchscreen, trackball, joystick) tended to be the least accurate, while the slowest method of input (keyboard) was the most accurate. Nonperformance attributes are also important, such as the user's satisfaction and preference. However, satisfaction and preference do not always concur with performance. For example, Mack and Lang (1989) found that although subjects made significantly more precision pointing errors using a stylus and a mouse, they preferred these two input methods over the keyboard-command input method.

In the last several years, two camps of computer users have developed, with each group championing one interface over the other. Both the direct-manipulation and the keyboard-command users claim that their interface is better than the other. Emotional debate aside, the phenomenon itself appears to be similar to the in-group/out-group bias described by social psychologists. A large body of social psychology research (see Berscheid, 1985) suggests that people like and tend to affiliate with others who have similar likes and dislikes. Conversely, people have greater disliking of others who do not share the same attitudes. This model of social behavior makes several predictions. Because computers involve considerable learning time and effort to develop expertise, people may seek assistance from others who they like (e.g., friends, coworkers) to facilitate their computer-related decisions (e.g., what hardware and software to buy). To balance the relationship, novice users are likely to seek affiliation with persons who previously helped them, and thus, are more likely to develop social relationships. As users become more expert on a particular interface, they will then tend to help others, and are likely to develop a relationship with these persons. Thus, people will tend to affiliate with others, in part, because they have similar preferences in computers.

In addition, Pace and Allison (1990) has recently shown that people tend to value things (e.g., possessions) associated with their in-group more than objects associated with their out-group. Therefore, with greater expertise, users of one interface should increase their liking of the familiar interface and increase their disliking of the less familiar computer interface. Thus, the social psychological model predicts that people will develop an in-group/out-group attitude toward computer interfaces and the people who use them.

So, while both interfaces have certain advantages, people's choice of which computer to use and to purchase may be due to factors other than those that have been the main concern of human factors specialists, that of interface design issues such as usability and ease-of-use. The purpose of the present report is to describe some evidence for the parallel of these social psychological notions with respect to direct-manipulation and keyboard-command interface users.

Specifically, the present research examines whether users of direct-manipulation and keyboard-command interfaces differ with respect to a number of computer-related factors. Of particular interest is the relationship of prior interface usage (familiarity) and others' social influence on choice of microcomputer interface and purchase intentions. In addition, the present research examines whether the direct-manipulation and keyboard-command interface users differ in their pattern of usage and preference for computer command methods, input devices, time engaged in specific activities, and preference for particular microcomputers.

METHOD

Participants

One-hundred thirty-four students participated. Forty-six were from Rensselaer Polytechnic Institute (Troy, New York) and 88 were from Rice University (Houston, Texas).

Materials and Procedure

The questionnaire was designed and written to avoid showing any bias toward a particular kind of interface. Most items were

open-ended in that participants generated (wrote in) the kinds of computers that they own and/or use, that they wish to purchase, and that their friends use. Only the last item of the questionnaire named particular computer makes and models. The specific questionnaire items are shown below:

(1) **Microcomputer owner:** Do you presently own a micro-computer?

(2) **Time of ownership:** If you presently own a microcomputer, please list which kind(s) of microcomputer(s) you presently own and how long you have owned each (in months).

(3) **Microcomputer use:** Please list the microcomputers that you have used over the past six months. Please list them in an order that corresponds to how much you have used them. Also, next to each please give your best estimate of how much total time you have spent using each in total number of hours for the past six months.

(4) **Microcomputer learned first:** What kind of microcomputer did you learn to use first?

(5) **% time in specific activities:** In the past 6 months, what percentage of your time using microcomputers did you spend for the following activities: (a) accounting, (b) computer aided design (CAD), (c) communications, (d) desktop publishing, (e) electronic mail, (f) games, (g) graphics, (h) music, (i) programming, (j) spreadsheets, (k) statistical analysis, and (l) word processing.

(6) **% time using command methods:** For the following kinds of computer command methods, what percentages of time in the past 6 months did you use to issue commands to micro-computers:
   a) Typed commands (words and letters followed by the RETURN or ENTER key)
   b) Simultaneously-pressed command keys (e.g., Ctrl-C, Control-C, Command-S, etc.)
   c) Keyboard function keys (e.g., F1 key, page down key, etc.)
   d) Choosing commands from menus using the keyboard
   e) Choosing commands from menus using a pointing device (e.g., mouse, trackball).

(7) **Preference for command methods:** How much do you like or prefer the command methods? The same list in question 6 was given. A 9-point Likert-type scale was given with the following numerical and verbal anchors: (0) extremely dislike, (1) very much dislike, (2) slightly dislike, (4) neutral, (5) slightly like, (6) like, (7) very much like, and (8) extremely like.

(8) **% time using pointing devices:** In the past 6 months, what percentages of time did you use the following pointing devices: (a) arrow keys, (b) joystick, (c) light pen, (d) mouse, (e) touch pad, (f) touch screen, and (g) trackball.

(9) **Preference for pointing devices:** How much do you like or prefer the pointing devices? The same set listed in question 8 and the 9-point scale described in question 8 were used.

(10) **Most willing to purchase:** What kind of microcomputer would you be most willing to purchase?

(11) **Friend owners:** What kind(s) of microcomputer) do your friends and/or coworkers use most often? If several kinds of microcomputers are used by them, please order your list with the most frequent first and least frequent last.

(12) **Preference for several computer makes and models:** Which of the following microcomputers do you like or prefer. The same 9-point scale described in question 10 was used. The following microcomputers were listed: (a) Apple II, (b) Apple Macintosh, (c) Commodore Amiga, (d) IBM PCs, (c) PC "clones" (such as, AT&T, Compaq, Tandy, and Zenith PCs).

Space was provided next to the items in the questionnaire for responses. For items requesting names of computers, participants were given instructions emphasizing that they try to give both the make and model. For the items requesting percentages, participants were instructed to be sure that the sums totaled 100%. Virtually all of the participants complied with this request and the data from the few that did not were included "as is" in the analyses. For some items (questions 5, 6, 7, 9, & 13), "other" was listed as an additional alternative response and participants were told to describe their answer if they selected this answer. "Other" was selected very infrequently and was not counted in the analyses. Participants were told that if they were unsure of an answer, that they should give their best guess.

The questionnaire also requested demographic information (e.g., sex, age, handedness) and other items concerning use of workstations, minicomputers, and mainframe computers. These variables were not found to be significant in any of the analyses and, thus, are not discussed in this report.

RESULTS

Categorization of Microcomputers

In an earlier pilot study, names of 11 makes and models of microcomputers were sorted into two piles by 12 Rensselaer Polytechnic Institute students. They were told that in one pile, they should place all those computers that are primarily graphically-based and which usually employ an external pointing device to select commands from menus (direct-manipulation interface). In the other pile, they should place those kinds of computers that are primarily character-based, and which usually employ keyboard arrow keys to position the curser and typed characters to issue commands (keyboard-command interface). Based on the sorting data, it was found that the Apple Macintoshes and Commodore Amiga computers tended to cluster together, and were categorized as *direct-manipulation computers*. The IBM PCs, PC clones (e.g., AT&T, Compaq, Zenith), and Apple II computers tended to cluster together, and were categorized as *keyboard-command computers*. When participants named specific microcomputers on the questionnaire, the computers were placed into one of the two computer interface categories.

Categorization of Interface Users

Several methods were used to classify participants into the two groups according to the type of microcomputer interface they used. The classification schemes were based on the following criteria: the kind of computer they personally own, the kind of computers they use most often, and their preferences. Because these criteria were significantly intercorrelated (*r*s ranged from 0.40 to 0.58, *p*s < .01) and because the results were generally consistent regardless of the categorization method employed, the results of only one method of categorization will be discussed here: the kind of computer interface participants used most often. This variable was based on the reported hours of computer use. Participants indicating that they used direct-manipulation computers for more hours than keyboard-command computers were classified as *direct-manipulation users*. Participants reporting the converse were classified as *keyboard-command user*. A few participants could not be assigned to either interface because: (1) they reported no use of any microcomputer, or (2) they reported the same number of hours of usage for computers of both interfaces. These persons were excluded from most analyses described in this report.

Interface User Differences

Usage time. The mean total hours using the two micro-computer interfaces by the two interface user groups was examined. A 2 (interface user group) x 2 (computer interface) mixed-model analysis of variance (ANOVA) showed a significant

main effect of interface users, $F(1, 128) = 3.95$, $p < .05$. In general, keyboard-command users spent more time using microcomputers (152.7 hours) than direct-manipulation interface users (100.8 hours). However, there was a significant interaction, $F(1, 128) = 47.05$, $p < .0001$. Direct-manipulation users reported using direct-manipulations machines for more hours ($M = 85.6$) than keyboard-command machines ($M = 15.2$); whereas, keyboard-command users reported using keyboard-command machines for more hours ($M = 132.9$) than direct-manipulation machines ($M = 19.8$). There was no reliable main effect of computer interface ($p > .05$).

User sample. Most of the direct-manipulation users were from Rice University (83%) and most of the keyboard-command users were from Rensselaer Polytechnic Institute (67%), $X^2(1, N = 130) = 32.39$, $p < .0001$. The effect of school was examined by entering it as an independent variable along with interface user group. A series of 2 (interface user group) x 2 (universities) ANOVAs using all of the dependent variables discussed in this report failed to show a substantial number of significant interactions (5%) between these two variables. This indicates that, in general, the pattern of interface user effects described below were consistent regardless of school and that the few significant interactions can probably be attributed to chance.

Forty-five percent of the direct-manipulation users were social science and humanities majors, 35% were natural/physical science majors, and 20% were engineering majors. Twenty-six percent of the keyboard-command users were social science and humanities majors, 19% were natural/physical science majors, and 55% were engineering majors, $X^2(2, N = 125) = 15.08$, $p < .0001$.

First learned interface and ownership. Seventeen percent of the direct-manipulation users first learned to use a microcomputer on a direct-manipulation machine, and the remaining 83% first learned on a keyboard-command machine. However, all (100%) of keyboard-command users first learned to use a microcomputer using a keyboard-command machine, $X^2(1, N = 123) = 7.61$, $p < .01$. Thirty-six percent of the direct-manipulation users own some sort of microcomputer; whereas, most of the keyboard-command users own a microcomputer (67%), $X^2(1, N = 130) = 11.72$, $p < .001$. Thise results are not unexpected since keyboard-command computers have been on the market for a longer period of time and generally are less costly than direct-manipulation computers.

Purchase intentions. The direct-manipulation users reported that they would be more willing to purchase a direct-manipulation microcomputer (80%) than a keyboard-command microcomputer (20%); whereas, the keyboard-command users were more willing to purchase a keyboard-command microcomputer (67%) than a direct-manipulation microcomputer (33%), $X^2(1, N = 121) = 25.93$, $p < .0001$.

Social influence. Direct-manipulation users tended to have more friends/coworkers that use microcomputers with a direct-manipulation interface (86%) than a keyboard-command interface (14%). However, keyboard-command users tended to have more friends/coworkers that use microcomputers with a keyboard-command interface (71%) than a direct-manipulation interface (29%), $X^2(1, N = 129) = 42.85$, $p < .0001$.

Command Methods

Usage time. Percentage time using different computer command methods by the two interface user groups was examined. The means can be seen in Table 1. A 2 (interface user group) x 5 (command modes) mixed-model ANOVA showed a significant main effect of command method, $F(4, 512) = 32.48$, $p < .0001$. Newman-Keuls comparison test showed that use of keyboard commands and pointing devices did not differ, but both were used significantly more ($ps < .05$) than the other methods which did not differ among themselves. The ANOVA showed no significant effect of interface user group ($p > .05$), but none was expected here since participants were told to balance their responses among the command methods so that they totaled 100%. However, interface user group did enter into a significant interaction with command method, $F(4, 512) = 18.79$, $p < .0001$. Simple effects analysis showed that the direct-manipulation users selected menus using a pointing device significantly more often than the keyboard-command users. However, the keyboard-command users reported using typed commands, keyboard function keys, and keyboard menu selection significantly more than the direct-manipulation users.

Table 1. Mean Percentage Time using Command Methods by Interface User Group

	Direct-Manipulation Users	Keyboard-Command Users	*mean*
Typed commands	27.54	38.14	32.84
Simultaneously-pressed command keys	9.14	13.05	11.09
Keyboard function keys	7.21	15.70	11.45
Selecting menus with keyboard	4.05	15.05	9.55
Selecting menus with pointing device	51.72	17.60	34.66

Preference. Preferences for the command methods showed a pattern of effects that was different from usage rates. The 2 x 5 ANOVA showed only a significant main effect of command method, $F(4, 512) = 30.38$, $p < .0001$. Newman-Keuls test showed that menu selection using a pointing device ($M = 6.42$) was preferred significantly more than keyboard function keys ($M = 5.11$). Keyboard function keys were preferred significantly more than the other methods which among themselves did not differ (selecting menus with the keyboard, $M = 4.66$; typed commands, $M = 4.39$; simultaneously-pressed command keys, $M = 4.20$). No significant main effect of interface user group, or interaction was noted ($ps > .05$).

Pointing Devices

Usage time. Percentage time using several pointing (input) devices by the two interface user groups was examined. The means can be seen in Table 2. A 2 (interface user group) x 7 (pointing device) mixed-model ANOVA showed a significant

Table 2. Mean Percentage Time using Pointing Devices by Interface User Group

	Direct-Manipulation Users	Keyboard-Command Users	*mean*
Arrow keys	15.81	51.42	33.61
Joystick	2.05	4.00	3.02
Light pen	1.18	2.84	2.01
Mouse	77.83	38.98	58.40
Touch pad	0.38	0.60	0.49
Touch screen	0.08	0.19	0.13
Trackball	2.02	0.52	1.27

main effect of pointing device, $F(6, 768) = 220.30$, $p < .0001$. Newman-Keuls test showed that the mouse was used significantly more than arrow keys. Arrow keys, in turn, were used significantly more than the other pointing devices which among themselves did not differ. No significant main effect of interface user group was shown, as expected, since these were percentages ($p > .05$), but interface user group interacted significantly with pointing device, $F(6, 768) = 48.61$, $p < .0001$. Simple effects analysis showed that direct-manipulation users spent a significantly greater percentage of their time using a mouse compared to keyboard-command users. However, keyboard-command users spent a significantly greater percentage of their time using arrow keys compared to direct-manipulation users ($ps < .05$). The two groups did not differ for the other pointing devices ($ps > .05$).

Preference. Though the pointing device usage pattern is not surprising, preference data yielded a different pattern. The 2 x 7 ANOVA showed only a significant main effect of pointing device, $F(6, 512) = 48.61$, $p < .0001$. Newman-Keuls test showed that the mouse ($M = 6.59$) was preferred significantly more than all of the other pointing devices. This was followed distantly by arrow keys ($M = 4.73$) which was preferred significantly more than all other pointing devices (except touchscreen, M = 4.49). The other methods (including touchscreen) did not differ significantly among themselves (touch pad, $M = 4.17$; trackball, $M = 4.09$; light pen, $M = 4.06$; and joystick, $M = 4.03$). There was no significant effect of interface user or interaction ($ps < .05$)

Computer-related Activities

Percentage time using various computer activities by the two interface user groups was examined. The means can be seen in Table 3. A 2 (interface user group) x 12 (activities) mixed-model ANOVA showed a significant main effect of specific activities, $F(11, 1408) = 107.09$, $p < .0001$. Newman-Keuls test showed that microcomputers were used significantly more for word processing than other activities. This was followed by programming which was significantly greater than the other activities except for games. Time spent on games was significantly greater than the remaining (lower percentage) activities, followed by spreadsheets which, too, was significantly greater than the remaining activities. The eight lowest percentage activities did not differ among themselves. The ANOVA also showed a significant interaction, $F(11, 1408) = 18.74$, $p < .0001$. Simple effects analysis showed that the direct-manipulation users spent a greater percentage of their computer time on word processing than the keyboard-command users ($p < .05$). However, the keyboard-command users spent greater percentages of their computer time on computer aided design (CAD), games, programming, and spreadsheets than the direct-manipulation users ($ps < .05$).

Table 3. Mean Percentage Time in Specific Activities by Interface User Group

	Direct-Manipulation Users	Keyboard-Command Users	*mean*
Accounting	0.23	0.70	0.46
Computer Aided Design	0.08	6.21	3.14
Communications	1.70	2.65	2.18
Desktop publishing	1.95	1.37	1.66
Electronic mail	1.59	1.65	1.62
Games	8.05	16.28	12.16
Graphics	1.61	3.09	2.35
Music	0.13	0.58	0.35
Programming	7.89	17.12	12.50
Spreadsheets	1.98	13.77	7.87
Statistical analysis	2.41	0.59	1.49
Word Processing	68.01	33.42	50.72

Additional examination of the activities data was made with respect to the number of hours involved. A new variable was formed based on the product of each participant's reported microcomputer usage hours (during the preceding six months) and the proportions of time allocated to the different activities. The pattern was virtually identical to the percentage of use analysis presented above with one exception: The difference between the two interface user groups for word processing disappeared, showing that both groups spent the same number of hours at this task during the previous six month period.

Microcomputer Preference

Preference for several selected makes and models of microcomputers by interface user group was examined. The means can be seen in Table 4. A 2 (interface user group) x 5 (microcomputer) mixed-model ANOVA showed a significant main effect of microcomputer, $F(4, 512) = 39.82$, $p < .0001$. Newman-Keuls test showed that the Apple Macintosh was preferred most, followed (in respective order) by IBM PCs, PC clones, Apple II, and Commodore Amiga. All differences were significant ($ps < .05$) except for the difference between the two least preferred computers, Apple II and Commodore Amiga. The ANOVA showed no significant effect of interface user group ($p > .05$), but this variable entered into a significant interaction with microcomputer, $F(4, 512) = 14.10$, $p < .0001$. Simple effects analysis showed that the direct-manipulation users preferred the Apple II and Apple Macintosh computers significantly more than the keyboard-command users. However, keyboard-command users preferred the IBM PCs and PC clone computers significantly more than the direct-manipulation users. No reliable difference between groups was found for the Commodore Amiga.

Table 4. Mean Preference for Selected Microcomputers by Interface User Group

	Direct-Manipulation Users	Keyboard-Command Users	*mean*
Apple II	4.72	3.79	4.26
Apple Macintosh	6.86	5.81	6.34
Commodore Amiga	3.99	4.42	4.20
IBM PCs	5.14	6.14	5.64
PC clones	4.52	5.81	5.17

Quantity of Interface Usage

The relationship of the quantity of computer interface usage and preference was examined. A new variable was created based on the difference between participants' reported hours using direct-manipulation and keyboard-command computers in the previous six months. The resulting measure reflected not only which interface was used most, but also the magnitude of differential usage. For example, if a participant used a direct-manipulation computer for 10 hours and a keyboard-command computer for 40 hours, then the score on the new variable would be -30. Thus, a high positive score indicates much greater usage of direct-manipulation computers and a high negative score indicates greater usage of keyboard-command computers.

Correlations showed that greater usage on one interface was

associated with greater the willingness to purchase a computer having a similar interface, r (119) = .41, $p < .0001$, and with greater likelihood that their friends use a similar interface, r (127) = .36, $p < .0001$. Participants who spent more time using direct-manipulation computers also had the strongest preference for the Apple Macintosh computer, r (128) = .43, $p < .0001$, and those who spent more time using keyboard-command computers also had the strongest preference for IBM PCs, r (128) = -.26, $p < .05$, and PC clones, r (128) = -.33, $p < .0001$.

DISCUSSION

The evidence collected in the present study parallels the social psychological notions discussed in the introduction. Computer users tend to have friends who use the same computer interface as they do. In addition, with increasing use of a particular interface, participants more strongly preferred it, and more strongly desired to purchase a computer with a similar interface. Apparently, more "expert" users have a stronger in-group/out-group bias with respect to microcomputers. Of course, with the present data, cause and effect cannot be separated. At this point, it can not be determined whether the type of computer people use leads to friendships with others using the same interface, or whether friendships with others led to the choice of using one interface over another (cf. Stafford, 1967). Undoubtedly, effects in both directions probably occur.

A number of interpretations can be offered to explain these social influence relations. For example, being surrounded by others who use a similar computer interface eases the burden of accessing new and relevant computer-related information. This consideration is particularly relevant given the effort, time, and expense involved in staying current with today's rapid computer developments. For example, people may consider the savings of learning time, and the costs of mistakenly purchasing inappropriate software and hardware for their needs. Certainly, it is more convenient to ask someone they know for advice and help than it is to make these decisions all alone.

For the most part, the usage and preference data showed a pattern of results that were unexpected given the social psycholological model presented earlier. The results showed that, in general, participants preferred pointing devices such as the mouse regardless of their usage rate. So, while usage rates showed an interaction indicating that keyboard-command users employ arrow keys and several command methods relatively often, the preference data showed no such corresponding effects. These results indicate that the patterns of usage and preferences are dissociated, at least with respect to input methods. Moreover, this finding suggests that keyboard-command users might use a mouse if it were available. Recently, more direct-manipulation features such as the mouse are becoming available in systems that in earlier years were exclusively keyboard-command based.

Some caution is appropriate when interpreting the results of this research. The participants were university students who are probably not representative of all users of microcomputers. Clearly, some of the results are due to the environmental and situational factors that influence the decision of which microcomputers to use. Many students have inadequate finances which prevent them from purchasing a microcomputer or constraining their choice to less expensive models. Thus many students are limited to those computers that are available the campus facilities and to those owned by friends. In addition, for some courses which involve computers (e.g., a computer science or statistics class), might restrict the kind of computer (and software) that may be used for class assignments. However, it is possible that some of the effects noted in this report might have been stronger if more participants were able to afford (and purchase) the microcomputer they most wanted.

Undoubtedly, the kind of interface that is most desirable depends on the task. This was indirectly apparent from the participant's major (e.g., engineering differing from humanities and social sciences), and the results showing that some activities were used more often by users of one interface than the other.

The present research may have implications for the difficulty that human factors specialists often have in implementing improvements to interfaces. Simply improving an interface may not be sufficient to gain acceptance. For example, while users may prefer certain aspects of different computer interfaces, people may not be willing to make wholesale changes in the computer interface they use, even if it reflects a more ergonomically-sound design. The resistance to change might be overcome by modifying the currently used interface while still incorporating the aspects of the old interface that the user is used to. This is apparently happening in the recent evolutions of interface design. Since computers are used for multiple tasks that are often benefitted by different input methods and devices, one way to integrate users onto a common interface would be to allow many kinds of input mechanism to be connected and integrated coherently so that users can easily switch to the one that best fits the task. However, the major point of the present research is that factors other than interface design are involved in people's choices of using and owning microcomputers such as prior usage and social influence.

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