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It Is Best to Point for Young Children: A Comparison of Children's Pointing and Dragging

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Abstract — *A mouse is the input device children principally use to control a computer in schools. However, somewhat surprisingly, there has been very little research investigating the appropriate mouse control strategies for children. In this paper we report two studies which compared children's performance with two basic mouse operations; pointing and dragging. In Study 1 we investigated 7-year-old children (*n = *24) who were inexperienced with a computer mouse and found that*

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*they were quicker and more accurate with pointing compared to dragging. In Study 2 we examined the performance of children (*n = 90*) from three different age groups: young (5–6 years), medium (8–9 years), and older (11–12 years). These children were more experienced with using a mouse. We found that older children were quicker and made fewer errors than younger children regardless of the mouse operation. We also found that younger children were slower and made more errors with dragging than with pointing. There were no differences in performance between pointing and dragging for the other two age groups. The implications of these findings for the design of interfaces for children are discussed.*

Keywords — mouse, children, pointing, dragging

The development of graphical user interfaces for educational software means that more and more children are controlling computers with a mouse. There has been a considerable amount of research evaluating mouse-controlled interfaces in human–computer interaction, but it has mainly been concerned with adults (Milner, 1988). Recently there have been a number of studies which have investigated children's use of a mouse (Crook, 1992; Jones, 1991; King & Alloway, 1992, 1993; Wilton & McClean, 1984). The best strategies for adults may or may not be the best strategies for children, because children's motor and cognitive skills are not as good as adult's (Strommen, 1993). Thus there is a need for evaluation of young children's use of this type of interface, to find out the problems they have with them and the methods they find the easiest and the hardest to use. It is possible that interfaces for young children may have to be different to those for adults and older children.

Early research evaluated adults' computer performance with different types of input device, such as joysticks, rollerballs, and mice (Card, English, & Burr, 1978; Greenstein & Arnaut, 1988; MacKenzie, Sellen, & Buxton, 1991). This work concentrated on evaluating performance on pointing tasks and the general finding was that the performance of adult subjects using the mouse as an input device was faster and they made fewer errors than the performance of subjects using other input devices. More recently this work has been extended by investigating whether the same effects found with pointing occurred with dragging (Gillan, Holden, Adams, Rudisill, & Magee, 1990; MacKenzie, 1992; MacKenzie et al., 1991). Research has revealed that adults made fewer errors and took less time pointing than dragging.

The limited amount of research on children has mainly assessed the performance of children at different ages and with different input devices. Wilton and McClean (1984) compared the performance of children aged 7–9, 11–12, and 14–16 years old when they had to move targets around the screen and they found that performance improves with age. Crook (1992) also found that children's performance improved with age using a number of different types of task. King and Alloway (1993) compared children's use of a keyboard, joystick, and mouse. They found that there was a steady improvement with age and that children of all ages were quicker and more accurate with the mouse.

Thus, there appears to be a consistent finding that children are most efficient using the mouse as an input device. However very little research has explored which mouse-controlled interfaces children find the easiest to use. Only work by Strommen (1993) comes close to this. He investigated young children's use of a Nintendo controller to play a simple video game. He compared two different ways of moving a character in the game with this controller: a continuous motion ("walking") versus moving in discrete steps ("hopping"). Strommen reports that the children found "walking" more difficult than the "hopping".

The research with adults is based on Fitts' law (Fitts, 1954). It is a mathematical model of motor behavior, which describes a linear relationship between movement time and the index of difficulty. The index of difficulty is the logarithm of the ratio of the target amplitude to target width. To apply Fitts' law to model the results of a study requires expert or errorless performance (MacKenzie, 1992). The aim of this paper was to investigate children's or novices behavior which is not error-free and it is therefore not appropriate to use Fitts law for this study.

This paper reports two studies that investigated children's use of pointing and dragging, which are two basic mouse operations commonly used in graphical user interfaces. Pointing is used to select objects (i.e., file or application) by the user pressing and releasing the mouse button over an icon. Dragging is used to move an icon to a target location. The user first depresses the mouse button over the icon and by moving the mouse, while the mouse button is still depressed, the user can drag the icon to the target location. Both pointing and dragging are target acquisition tasks, but with dragging the task is performed with the mouse button depressed (MacKenzie et al., 1991).

Study 1 compared the two mouse operations in terms of accuracy and the time taken to complete a number of computer-based balance beam tasks, which we have used in our previous research (Messer, Joiner, Loveridge, Light, & Littleton, 1993). Study 2 attempted to replicate and extend the previous findings by using children who had more experience with using a computer mouse; collecting information about the children's preferences and comparing children at three different age groups: younger (5–6 years old), medium (8–9 years old), and older (11–12 years old). These studies show that young children have difficulty with dragging and that in certain circumstances pointing may be the most appropriate mouse operation to use.

STUDY 1

In the first study the children were given five separate tasks. The first and last (pretest and posttest) assessed the pupils ability to use a mouse to move the cursor and click on targets. This enabled us to check that there were no initial differences between children who were allocated to two conditions (i.e., their performance at pretest) and to assess whether different experiences had any consequences for their speed and accuracy by the end of the session (i.e., their performance at posttest). The second and fourth tasks were identical to each other and involved using either pointing or dragging to move objects across the screen. These tasks were the main focus of interest as they assessed the pupils speed and accuracy in using pointing or dragging. The third task was a computer task, which presented the children with a problem where they had to balance a beam on a fulcrum.

Method

Design. The experiment employed a between-subjects design with two conditions: a dragging condition and a pointing condition. Children in each condition used a different mouse operation. The names of the conditions refer to these operations and are explained in a later section.

Participants. The children ($n = 24$) used in this study were aged between 7 and 8 ($M = 7$ years 7 months; $SD = 4$ months) and were from two infant schools in St Albans, UK. All the children used in this experiment had no experience with using a mouse. The children were randomly allocated to one of the two conditions. The conditions were matched for age and gender.

Equipment. Two Apple Macintosh SE/30 computers were used in this experiment with a standard mouse input. The screen was monochrome CRT monitor and had a resolution of 512 by 342. The mouse tracking was set at fast.

Procedure. The children were taken in pairs to a quiet area of the school (i.e., unused classroom or library) and were asked to complete a pretest; a time/accuracy test; a computer balancing task; a second time/accuracy test; and a posttest.

Mouse operations. Dragging and pointing were tested in this study and they were used to move objects horizontally across the screen.

In the dragging condition, children initiated the process by moving the cursor onto the target and pressing the mouse button down. Next they moved the cursor to the intended location, with the mouse button still down, and while they were doing this the object would follow the cursor. When they had moved the object to where they intended, they would let go of the mouse button.

In the pointing condition, children initiated the process by moving the cursor onto the target object and clicked the mouse button. The target object was then highlighted. They then located (i.e., pointed) the cursor on the intended location and clicked the mouse button. The object would then move to this location.

Tasks. Three tasks were used in this experiment. All were built in Hypercard 2 to run on an Apple Macintosh SE/30. The first task was used in the pretest and posttest and was called "Honey Quest". It tested how quickly the children moved the cursor from one point to another. The children had to click on a series of five honey pots, which appeared one after the other (Figure 1). The software recorded the time it took to click on each honey pot.

The second task was a time/accuracy test and was in the form of a game, which was set in the circus and involved a seal and a clown (Figure 2). The clown was holding up a beam, which had a mark on it. The seal could move underneath the beam. The children had to move the seal to this mark, using either dragging or pointing. They had to do this five times. Each time the seal started at the same point and each mark was a different distance away from where the seal was placed. This task tested how quickly and how accurately the children moved the seal to a point on the beam. The software recorded the time it took the children, the distance they moved the seal and their accuracy.

The third task was a computer balancing game, which we also used to assess children's dragging or pointing. It involved the same seal and clown used in

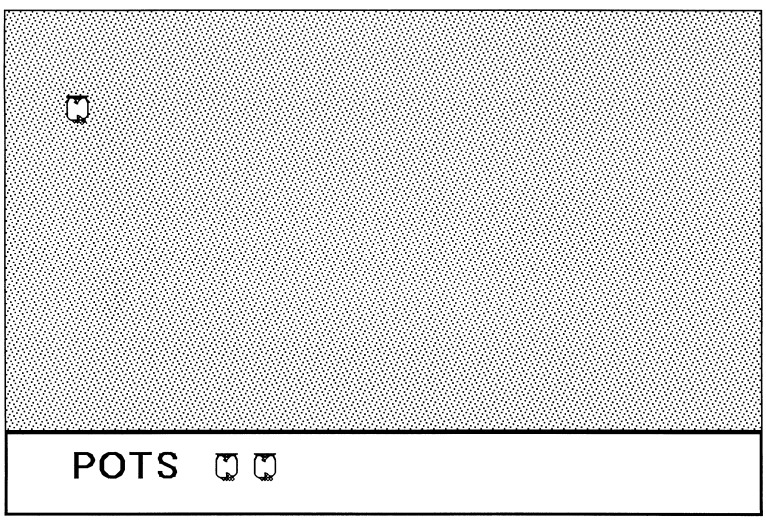

Figure 1. Honey Quest.

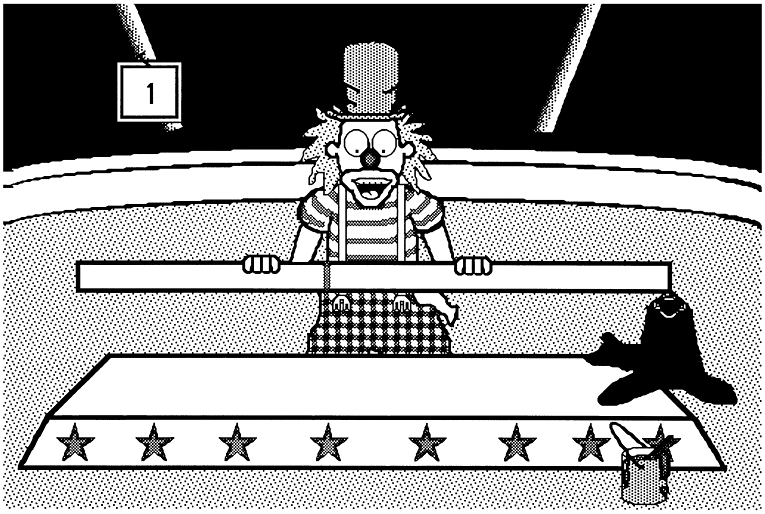

Figure 2. Time/accuracy test.

the time accuracy test (Figure 3). This time the children had to help the seal to balance the beam on her nose by moving her to where they thought she would balance the beam, using either pointing or dragging. Once they had moved the seal to where they thought she would balance the beam, the clown was programmed to release the beam.

If the children were correct they received a round of applause and the clown gave a written message "well done". If they were incorrect the beam would fall in the appropriate direction and the clown would ask them if they wanted another go on this beam or whether they would like to move on to the next. The software contained 20 beams in a fixed order, 5 symmetrical beams (i.e., beams which balanced in their geometric center) and 15 asymmetrical beams (beams which did not balance in their geometric center). The children were allowed 20 attempts to balance as many beams as they could, which meant they could have a few attempts on many beams or many attempts on a few beams. The software recorded how many beams they balanced.

Results

Pretest and posttest. As expected, there was no difference between the two conditions on the pretest, in terms of the total time taken to click on the five honey pots: dragging $M = 21.4$ s, $SD = 10.5$ s; pointing $M = 33.4$ s, $SD = 20.0$ s; $t(22) = 1.7$, $p > .1$. There was also no differences between the two conditions at the posttest: dragging $M = 20.4$ s, SD = 7.4 seconds; pointing $M = 23.4$ s, $SD = 7.0$ s; $t(22) < 1$, $p > .1$. Analysis of the differences

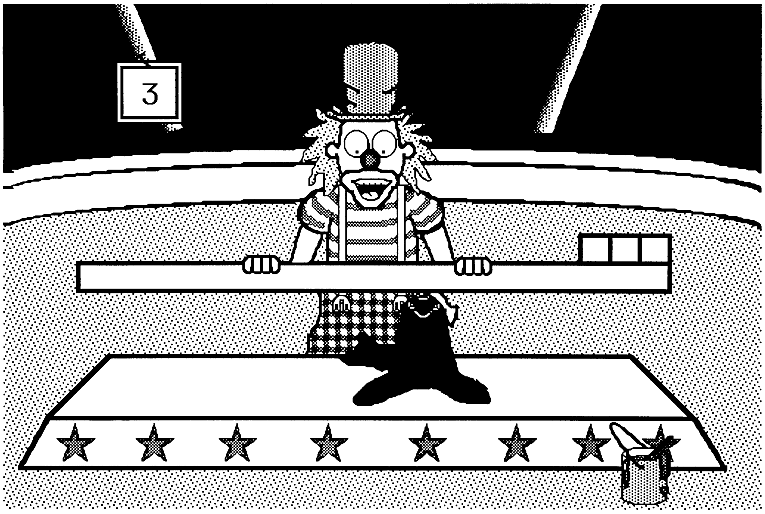

Figure 3. The computer balancing task.

between the pretest times and the posttest times revealed no overall improvement, $t(22) = 1.7$, $p > .1$.

Time/accuracy tests. In the time/accuracy tests, we analyzed the children's accuracy and the time taken to complete the task. Accuracy was assessed as the distance from the object being moved to the center point of the target. A total accuracy score was obtained by summing the measures from the five trials. In the first time/accuracy test, there was a significant difference between dragging and pointing, $t(22) = 2.5$, $p < .05$, in terms of accuracy. Children in the pointing condition were significantly more accurate than children in the dragging condition (Table 2). There was also a significant difference between conditions in terms of the time taken to reach the target, $t(22) = 4.7$, $p < .05$, with children in the dragging condition taking longer than those children in the pointing condition (Table 1).

The differences found in the first time/accuracy test were maintained in the second time/accuracy test. There was a difference between the two conditions in terms of accuracy, with pointing still more accurate (Table 2), but this

Table 1. Time Taken to Complete the Task (in Seconds) for Time/Accuracy Tests

	1st session		2nd session	
	M	*SD*	*M*	*SD*
Pointing	42.7	19.1	36.6	12.8
Dragging	68.1	29.7	67.1	24.2

Table 2. Accuracy in Pixels for Time/Accuracy Tests

	1st session		2nd session	
	M	*SD*	*M*	*SD*
Pointing	21.5	20.4	34.3	69.6
Dragging	364.2	250.9	208.9	304.7

difference was not significant, $t(22) = 1.9$, $p > .05$. There was a significant difference between the conditions in terms of time taken to compete the task, $t(22) = 3.8$, $p = .05$. Children using pointing took less time than children using dragging (Table 1).

We also examined whether the children had improved by comparing the children's performance on the first time/accuracy test with their performance on the second time/accuracy test. No overall improvement was found either in terms of accuracy, $t(22) = 1.6$, $p > .05$, or in terms of time taken, $t(22) < 1$, $p > .05$.

Computer balancing task. We also compared children's pointing and dragging with a computer balancing game. There was a significant difference in terms of the speed in moving objects, $t(22) = 2.9$, $p < .05$. Children using pointing ($M = 20.9$ pixels per second, $SD = 10.9$ pixels per second) moved the object much faster than children using dragging ($M = 10.9$ pixels per second, $SD = 6.9$ pixels per second).

Summary of Study 1

In sum, we found that children who used pointing were more accurate, took less time, and moved the objects a lot quicker than children who used dragging. These findings were consistent across both the first and second time/accuracy tests and the balancing task. There was no general improvement either in terms of accuracy or in terms of time taken.

STUDY 2

We decided to carry out a further study to replicate and extend our findings in Study 1. Children in the previous study had no or very little experience of using a computer mouse. Therefore, it is possible that the difficulties children had with dragging were because they had no experience with using a computer mouse and that these difficulties would quickly disappear with practice. In Study 2, children were from a school where computers were used extensively and the computer mouse was the main input device. We also asked the children whether they had used a computer mouse, as a further control for experience. A more detailed assessment of the children's computer experience was attempted but was abandoned because the information obtained from the younger children was very inaccurate.

Study 2 also evaluated older children's use of pointing and dragging. The small amount of research on children suggests that their performance improves with age. A number of studies have evaluated children's performance as a factor of age and found that the performance of the older children was better than that of younger children (Crook, 1992; Jones, 1991; King & Alloway, 1992, 1993; Strommen, 1993; Wilton & McClean, 1984). The interesting question is whether older children are still more accurate and quicker with pointing rather than dragging. Research with adults (MacKenzie, 1992; MacKenzie et al., 1991) suggests that although performance may improve with age, adults still perform worse using dragging than when pointing. In Study 2 we examined whether similar effects were present with children at three different age groups: younger (5 – 6 years old), medium (8 – 9 years old), and older (11 – 12 years old).

We also collected the children's opinions of the two mouse operations. In Study 1, this was difficult because the children used either dragging or pointing, whereas in Study 2, the children that were tested used both dragging and pointing and were then asked which they preferred.

Method

Design. This experiment employed a three-factor mixed design with type of mouse operation, age, and distance as the three factors. Two types of mouse operation were used: dragging and pointing. The children were selected from three age groups: younger ($M = 5$ years 10 months, $SD = 3$ months); medium ($M = 8$ years 7 months, $SD = 3$ months); and older ($M = 11$ years 9 months, $SD = 3$ months). There were five distances between the origin and the target: 50, 100, 200, 300, and 400 pixels.

Participants. The study involved 90 children (45 girls and 45 boys) aged between 5 and 12 years old from a combined school in Milton Keynes. This school was selected because it had a very high concentration of computers and had just received an excellent grade for its IT provision in a recent school inspection.

Equipment. One Apple Macintosh Performa 630 with a standard mouse input was used in this experiment. The screen was a 14-inch color CRT monitor with a resolution of 640 by 480 pixels. The mouse tracking was set at fast.

Procedure. The children were taken individually to a quiet area of the school by an experimenter. They were asked if they had used a mouse. A total of 11 children said they had no experience with a computer mouse and these 11 were given a brief demonstration of how to use a mouse.

All the children used both pointing and dragging. The order was counterbalanced across the sample. Half the children first tested dragging and half the children first tested pointing. Each testing consisted of a scripted demonstration by the experimenter, a practice of 10 trials with some assistance where necessary by the experimenter, and then the actual test, which consisted of 20 randomly selected trials, 4 trials for each distance. Directly afterwards the children were asked whether they preferred pointing or dragging.

Mouse operations. The two mouse-controlled interfaces used in this experiment were identical to those used in Study 1.

Task. The task was a built in Hypercard (Figure 4) and similar tasks have been used in the adult literature (Greenstein & Arnaut, 1988; MacKensie et al., 1991). The aim was to move an object onto a target using either dragging or pointing. Once they had moved the object onto the target it would turn black. If they dropped the object when it was not on the target this was recorded as an error and was signalled by a beep. After the children had made an error they could then carry on with moving the object.

The object was a square icon measuring 20 × 20 pixels. The target was either 50, 100, 200, 300, or 400 pixels away. The children had to perform the task 10 times in practice and 20 times in the test—four times for each distance. The

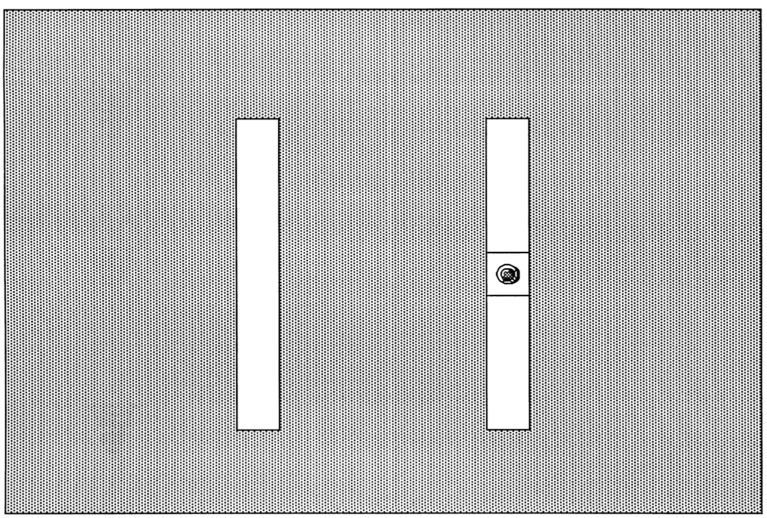

Figure 4. Computer task for Study 2.

computer randomly selected the distance for each trial, recorded the time it took them to complete the task and the number of errors they made.

Results

A $2 \times 3 \times 5$ ANOVA was calculated with mouse operation (dragging and pointing), age (younger, medium, and older), and distance (50, 100, 200, 300, or 400 pixels) as the three factors and time taken as the dependent measure. There was a significant main effect of age, $F(2, 87) = 74.3$, $p < .05$. Post hoc analysis (Table 3) showed that there were significant differences between all three age groups. There was a significant main effect of distance, $F(4, 348) = 83.8$, $p < .05$. The greater the distance the longer the time taken to move the object.

There were three significant two-way interactions in terms of time: between age and mouse operation, $F(2, 87) = 3.0$, $p < .05$; between age and distance, $F(4, 870) = 6.7$, $p < .05$; and between mouse operation and distance, $F(4, 870) = 4.0$, $p < .05$. There was also a significant three-way interaction $F(4, 870) = 3.1$, $p < .05$ (Figure 5). Simple analysis was carried out to further investigate these interaction effects. As Figure 5 shows, for the two older age groups, there were no significant differences between pointing and dragging: medium age group, $F(1, 29) < 1$, $p > .05$; older age group, $F(1, 29) < 1$, $p > .1$. For the younger children there was an interaction effect between mouse operation and distance, $F(4, 116) = 4.5$, $p < .05$. The younger children took a significantly longer time dragging than pointing for the larger distances: 200 pixels, $F(1, 29) = 4.1$, $p < .05$; 300 pixels, $F(1, 29) = 3.0$, $p > .05$; 400 pixels, $F(1, 29) = 7.6$, $p < .05$. For the shorter distances there was no significant difference between pointing and dragging: 50 pixels, $F(1, 29) < 1$, $p > .05$; 100 pixels, $F(1, 29) = 3.4$, $p > .05$.

Another $2 \times 3 \times 5$ ANOVA was calculated with mouse operation, age and distance as the three factors, but this time number of errors was the dependent measure. There was a significant main effect of age, $F(2, 87) = 30.6$, $p < .05$. Post hoc analysis (Table 4) showed that there were significant differences between all three age groups.

Table 3. Time Taken to Complete the Task in 1/60th Seconds

	Younger		Medium		Older	
	M	*SD*	*M*	*SD*	*M*	*SD*
Pointing	3596.9^{a}	764.3	2622.5^{b}	584.6	1931.4^{c}	502.8
Dragging	4233.4^{a}	1476.8	2667.5^{b}	1048.5	1831.5^{c}	558.3

Note. Means in the same row that do not share the same superscripts differ at $p < .05$ in the Scheffé comparison.

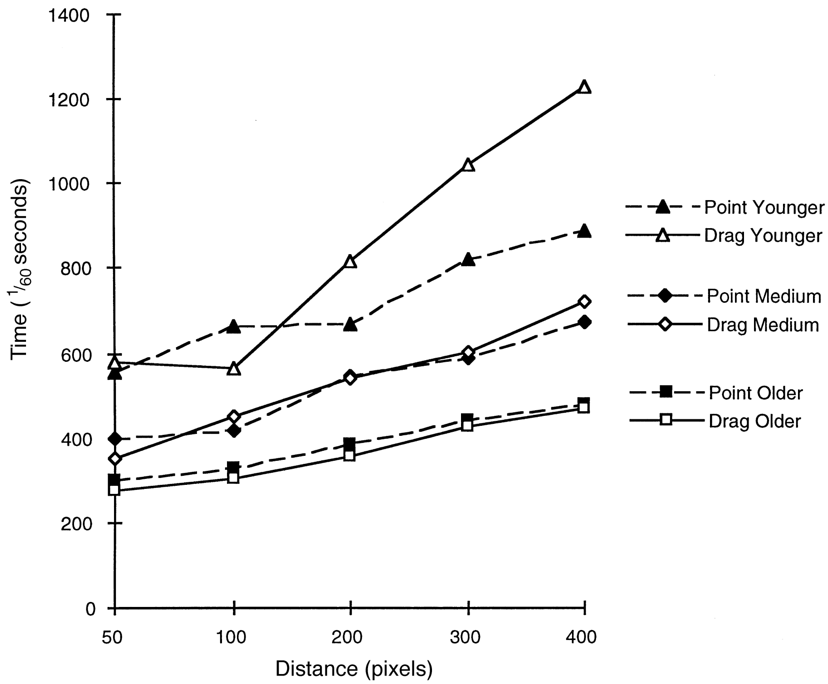

Figure 5. Mean time by age, mouse operation, and distance.

Table 4. Number of Errors

	Younger		Medium		Older	
	M	*SD*	*M*	*SD*	*M*	*SD*
Pointing	2.6[a]	2.5	1.1[b]	1.2	0.7[c]	1.2
Dragging	6.1[a]	4.3	2.7[b]	3.2	0.8[c]	1.3

Note. Means in the same row that do not share the same superscripts differ at $p < .05$ in the Scheffé comparison.

There was a significant main effect of distance, $F(4, 348) = 3.8, p < .05$. The greater the distance the more errors were made. There was a main effect of mouse operation in terms of errors, $F(1, 87) = 19.7$, $p < .05$. Children made over twice as many errors using dragging ($M = 3.4$, $SD = 3.8$) than using pointing ($M = 1.4$, $SD = 1.9$). However there was a significant two-way interaction between age and mouse operation, $F(2, 87) = 6.3$, $p < .05$ (Figure 6). A simple analysis revealed that younger children committed fewer errors, $F(1, 29) = 14.9$, $p < .05$, when they used pointing than when they used dragging. There were no significant differences between pointing and dragging for the other two age groups in terms of errors: older, $F(1, 29) < 1$,

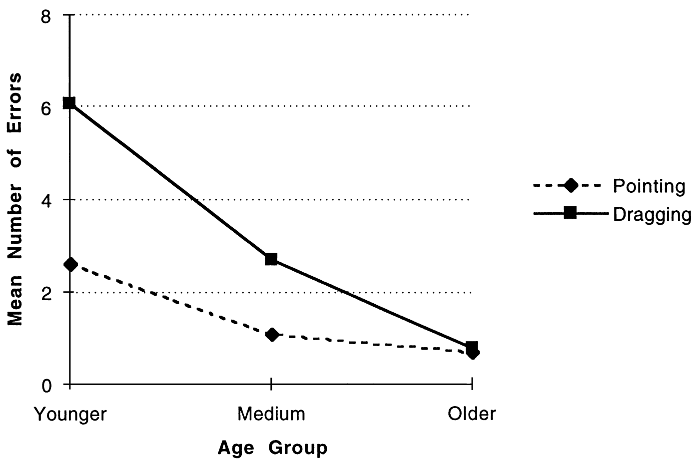

Figure 6. Number of errors by age and by mouse operation.

$p > .1$; medium $F(1, 29) < 1$, $p > .1$. There were no other significant two- or three-way interactions.

One possible reason why the younger children had more problems with dragging than pointing, compared with the children in the other two age groups, was because the younger children were less experienced with the mouse than the children in the other two age groups. There certainly was an age difference in experience. All 11 children who had not used a mouse were in the younger group. To check whether this could have accounted for the interaction effect we used a 2×2 ANOVA, with mouse experience (yes or no) and mouse operation (dragging and pointing) as the two factors and number errors and mean time as the two dependent measures. This analysis revealed that for the younger age group there was no significant difference in performance between those children who had experience with using a mouse, compared with those children who did not, both for time taken, $F(1, 28) < 1$, $p > .1$, and for number of errors, $F(1, 28) < 1$, $p > .1$.

Table 5 shows children's preference for the two mouse operations and we found no significant difference ($\chi^2 = 2.5$, $df = 2$, $p > .05$). We also carried out a 2×2 ANOVA with order and mouse operation as the two factors to check for order effects. There were no effects of order either in terms of time, $F(1, 88) < 1$, $p > .1$, or errors $F(1, 88) < 1$, $p > .1$.

Table 5. Software Preferences

	Year 1	Year 4	Year 7
Pointing	12	16	18
Dragging	18	14	12

DISCUSSION

This paper compared children's performance on a number of computer tasks using two basic mouse control operations: dragging and pointing. Study 1 found that 7 – 8-year-old children, with no experience of using a mouse, were quicker and made fewer errors when they used pointing than when they used dragging. Study 2 examined whether the same effects were present with an older group of children, a younger group of children and in a sample of children who had more experience using a computer mouse. There was a significant difference between all three age groups, with improvement occurring with age—both in terms of the number of errors and time taken. Study 2 also partially replicated Study 1. We found that 5 – 6-year-old children were slower and made more errors dragging than pointing. Further analysis suggested that the performance difference between pointing and dragging, found with the younger children, was not due to a lack of experience in using a computer mouse. The main reason for the younger children's poor performance was because they accidentally "dropped" the object (i.e., they let go of the mouse button) before they had reached the target. Similar problems with dragging have been reported in the adult literature (MacKenzie, 1992; MacKenzie et al., 1991). Interestingly, there were no performance differences between dragging and pointing for 8 – 9-year-old children or 11 – 12-year-old children.

Study 2 also showed that performance improved with age both in terms of number of errors and time taken. Similar improvements in children's performance with a computer mouse have been reported by a number of researchers (Crook, 1992; King & Alloway, 1993; Wilton & McClean, 1984). There could be a number of explanations for this finding and they are probably not mutually exclusive. One possible explanation is that the difference in performance was because the older children had more experience using a mouse. Although the older children probably had used a mouse more, simply because they have been at school for longer, this explanation is unlikely. Crook (1992) showed that after 10 days of practice with a mouse, children's performance had reached a plateau. Whilst it is possible that some of the 5 – 6-year-old children had not reached this level, this cannot be true for the two older age groups and there was significant difference in performance between the 8 – 9-year-old children and the 11 – 12-year-old children. A more probable explanation is that the younger children's motor and cognitive skills were not as advanced as the older children. Research has shown that children's motor performance improves with age (Thomas, 1980) and similar improvements have been reported for their cognitive information processing rate (Kail, 1991; Miller & Vernon, 1997).

Comparing Study 1 with Study 2 we find an interesting difference. In Study 1, children aged 7 and 8 years were slower and less accurate dragging than they were pointing, whereas in Study 2 there was no difference in performance between pointing and dragging for children who were only 1 year older. This difference between the two studies could simply be accounted for in terms of differences in practice with a mouse. In Study 1 the children had no experience with a computer mouse, whereas in Study 2 they had considerable experience with a computer mouse. There was also evidence in Study 1 that after a certain amount of practice the difference in performance between pointing and dragging was smaller. For example, the difference in accuracy between dragging and pointing in the second time/accuracy test was not as great as in the first test. Thus, with more practice the difference found in Study 1 between pointing and dragging would probably disappear.

Another important and interesting finding was that children aged between 5 and 6 years old in Study 2 were slower and made more errors dragging than pointing, whereas there was no difference in performance observed for the other two age groups. Again, lack of experience with a mouse is a possible explanation, but unlikely, because there was no difference in performance between children who had experience with a mouse compared with those who did not. A more probable explanation is that young children have difficulty controlling their limb movements which are necessary for controlling a computer mouse. Research has shown that young children's motor control is not as well developed as older children's (Thomas, 1980). This explanation could also account for why the differences in time taken were only significant for the larger distances. At larger distances there is more chance of an error in motor movement.

The increased number of errors the 5–6-year-old children had in Study 2 with dragging, strongly suggests that one problem they had with this mouse operation was maintaining pressure on the mouse. Strommen (1994) has also observed children having similar difficulties with a computer mouse. A possible solution to this problem would be to use pointing instead of dragging. This solution would work on simple applications but would probably cause other problems for more complex application. Sellen, Kurtenbach, and Buxton (1990, 1992) points out that the muscular tension of holding the mouse down and the object being dragged with the cursor provides a continuous reminder that one is in a particular mode of operation (i.e., moving an object). Pointing has much weaker feedback: there is no muscular tension and the object while highlighted remains in its original position. The lack of modal cues would have little effect on simple applications where the children were only performing one task, but it might increase modal errors in applications where there are many possible actions.

An alternative solution would be to use a different input device. MacKenzie et al. (1991) showed that tablets are as efficient as a mouse for adults. No work has been done to evaluate their effectiveness with children, but if the problem is due to inadequate motor control then they will have similar problems to a mouse because they also require the use of the large limbs to control them. A games controller maybe a more effective input device, because they only require the use of the fingers to control them. They also have the advantage that a lot of children are familiar with them and already have experience using them. Strommen (1993) has compared different methods of movement control with a video games controller, but there has been no research which compared a games controller with other input devices.

To conclude, we found that for young children and older children with little or no experience using a mouse had difficulty dragging compared with pointing. Furthermore, such problems were greater when an object had to be moved over a large distance. However, it is also apparent that, by about 8 years, children who are experienced with using a computer do not appear to have difficulties when dragging an object. This suggests that children can overcome their earlier difficulties as their motor control increases with age and practice. Thus, our findings support the use of dragging for young children, but indicate that such interfaces may be difficult for very young children or those inexperienced in using a mouse. Software designers should be aware of these difficulties if they are producing material for children.

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