Preference for and Accuracy with 55- and 99-Page ThinkScribe Selection Slots

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Abstract

Previous experiments with slot selectors indicated that providing about 1.1 mm per target resulted in 100% selection accuracy. The current experiment evaluated selection accuracy for 55 and 99 pages using a 73 mm slot (0.74 mm per page for 99 pages). Participants in the 55-page condition used a single-page advance control to reach pages greater than 55. Considering all targets, participants were slightly but consistently less accurate with the 99-page slots, but their within-slot selection accuracies were equal. All participants (n=16) preferred the 99-page slot due to the inconvenience of acquiring pages greater than 55 with the single-page advance control.

ITIRC Keywords

ThinkScribe
TransNote
Selection slot
Selection accuracy
Selection sensitivity
Pen-based systems
Absolute selection device
Relative selection device

Contents

Introduction

Selection slots are special hardware controls for pen-based systems, initially introduced with the CrossPad2[1] and currently used in IBM's new ThinkPad TransNote with ThinkScribe digital notepad[2]. The selection slot is a slot placed over a set of radio receivers. To use the selection slot, the user places the tip of the pen in the slot (activating a radio transmitter in the pen via a tip switch – see Figures 1 and 2) and slides the pen. Activation of the transmitter in the slot causes the system to present a set of alternatives in a small LCD, with one of the alternatives highlighted (see Figures 3 and 4). Sliding the pen in the slot scrolls the list of alternatives, and lifting the pen out of the slot results in the selection of the highlighted alternative. Note that this lift-off strategy for selection is consistent with a well-known touch screen strategy that allows users to select very small targets (Lewis, 1992).

Figure 1. ThinkScribe pen assembly

Figure 2. Close-up of transmitter

[1] CrossPad2 is a trademark or registered trademark of Cross Pen Corp.
[2] ThinkPad, TransNote, and ThinkScribe are trademarks or registered trademarks of International Business Machines Corp.

Figure 3. The selection slot

Figure 4. The pen in the selection slot

Lewis (2001) previously investigated the selection of ink file names from a selection slot 22 mm in length containing 20 names (1.1 mm per name). Ten of ten participants made 100% correct selections of a number of target names from the list of names. All participants reported that the selection of names from the slot was easy.

The recently announced IBM TransNote with ThinkScribe digital notepad uses selection slots for a number of purposes, including the selection of actions such as keywords and to-dos, ink file names, and page numbers. The current page number limit for a ThinkScribe is 55 pages in a 73 mm slot (1.33 mm per page), which provides a little more slot length per page than the 1.1 mm per choice previously investigated in Lewis (2001). The purpose of the current experiment was to investigate the possibility of increasing the maximum number of pages in the ThinkScribe page selector slot to 99. Doing so would provide only 0.74 mm per page, making this the most sensitive slot selection control yet investigated. On the other hand, failure to increase the sensitivity of the slot would mean that users would have to repeatedly tap the single-page advance control (the dimple under the selection slot shown in Figure 3) to reach pages numbered higher than 55. The inconvenience of repeatedly tapping the single-page advance control could well overcome the inconvenience of some loss of accuracy. This is the fundamental design tradeoff investigated in the current experiment.

Method

Participants

Sixteen IBM employees participated in the experiment. Half were male and half were female, with half of each group over and under 40 years of age.

Materials and Experimental Design

Participants selected four target pages (pages 25, 50, 75 and 95) using two TransNotes. The ThinkScribe of one TransNote had standard firmware setting the maximum number of pages to 55. The other had special firmware setting the maximum number of pages to 99. Half of the participants made their selections with the 55-page version first and half used the 99-page version first. Table 1 shows the experimental design.

Table 1. Experimental Design

Person	Gender	Age	Order
1	M	<40	55-99
2	M	<40	99-55
3	M	<40	55-99
4	M	<40	99-55
5	M	>40	55-99
6	M	>40	99-55
7	M	>40	55-99
8	M	>40	99-55
9	F	<40	55-99
10	F	<40	99-55
11	F	<40	55-99
12	F	<40	99-55
13	F	>40	55-99
14	F	>40	99-55
15	F	>40	55-99
16	F	>40	99-55

Procedure

After receiving brief instructions regarding the purpose of the experiment and the operation of the slots (see Appendix A), participants selected their target pages using the systems in the order indicated in Table 1. The measure of accuracy was the difference in the number of pages between the actual selection and the target. If a participant did not select the correct target, he or she used the single-page advance or single-page return controls to adjust the initial selection. Participants used the single-page advance control to acquire target pages greater than 55 when using the 55-page selection slot. After making all eight selections (four selections with each system), participants stated which version they preferred using.

Results

Overall Accuracy

The average absolute difference between actual selection and the target with 55 pages in the slot was 0.2 pages. 86% of these selections had no deviation from the target; 97% deviated by no more than one page. With 99 pages, the average absolute difference between actual selection and the target was 0.4 pages. 75% of these selections had no deviation from the target; 92% deviated by no more than one page. The difference between the mean deviations was marginally statistically significant ($t(15) = 2.03$, $p = .06$), but small (0.2 pages). Analysis of variance indicated no significant effects of gender, age, or order of use of the two ThinkScribes (all $p > .10$). Table 2 shows the patterns of deviation for each ThinkScribe.

Table 2. Percentage Patterns of Deviation of Actual from Intended Target Page

Slot Type	0 Pages	1 Page	2 Pages	3 Pages	4 Pages	5 Pages
55	86	11	2	2	0	0
99	75	17	5	0	2	2

Accuracy for Targets within the Slot

Part of the reason that participants were more accurate in selecting pages with the 55-page slot was that their selection accuracy was perfect when selecting pages greater than 55 using the page-advance control. Restricting the data analysis to those target pages that were within the limits of the slots on both ThinkScribes (target pages 25 and 50) revealed that their within-slot selection accuracies were not significantly different ($t(15) = .324$, $p = .75$), with average deviations of 0.38 pages for the 55-page slot and 0.34 pages for the 99-page slot.

Preference

All 16 participants indicated that they preferred using the 99-page slot for page selection. The primary reason for this preference was the inconvenience of using the single-page advance control to acquire higher-numbered pages on the ThinkScribe with the 55-page slot. Table 3 lists the participants' comments.

With a sample size of 16 participants and unanimous preference for the 99-page selection slot, the lower limit of a 90% binomial confidence interval for percentage of users preferring the 99-page selection slot is 83%. In other words, the data allow us to be 90% confident that the true percentage of users who would prefer the 99-page selection slot should be no less than 83%, and is most likely closer to 100% (the observed percentage).

Table 3. Participants' Comments

Participant	Comments
1	Quicker to get to pages with 99-page slot. Easier to visualize scale of 1-99 than 1-55.
2	99-page accuracy was fine.
3	Tapping is a pain. If slider only goes to 55, implies 55-page limit.
4	Accuracy is not an issue.
5	<No comments.>
6	1-99 is an intuitive scale. All pages are rapidly accessible. Sensitivity is about right.
7	More logical and direct. Reasonably accurate.
8	Repeated tapping is tedious. Hard to keep pen tip on target when tapping fast.
9	Multiple tapping is cumbersome. The 99-page selector is accurate.
10	<No comments.>
11	Don't like counting or tapping.
12	Tapping takes too long and is too error prone.
13	The 99-page selection slot is accurate and easier to use.
14	The 99-page slider is faster and just as accurate.
15	Stopping at 55 is non-intuitive. Don't like tapping.
16	Too much tapping with 55-page selection slot.

Discussion

The data strongly support the proposed change to a 99-page selection slot for future ThinkScribes. Increasing the sensitivity of the slot to 99 pages did not affect selection accuracy for target pages that were in the slot. Participants were very aware of the inconvenience of tapping to acquire higher-numbered pages, and generally disliked the idea of pages that existed outside of the slot. The preference for the 99-page selection slot was independent of participants' gender, age, or the order in which they used the slots.

References

Lewis, J. R. (1992). *Literature review of touch screen research from 1980 to 1992* (Tech. Report 54.694). Boca Raton, FL: International Business Machines Corp.

Lewis, J. R. (2001). *Selection accuracy with a new pen-based selection device* (Tech. Report 29.3396). West Palm Beach, FL: International Business Machines Corp.

Appendix A. Data Collection Forms

Introduction and Data Collection (Version 1)

We are evaluating two designs for a page selector for the next version of the ThinkScribe.

One design lets you select up to page 55 with the slider, then you tap the page up or page down buttons to adjust your selection or to go to higher pages (up to page 99).

Please use the page selector on this 55-page slider ThinkScribe to try to select the following target pages:

- 25 _____
- 50 _____
- 75 _____
- 95 _____

The other design puts all 99 pages in the slider. You can tap the page up or page down buttons to adjust your selection.

Please use the page selector on this 99-page slider ThinkScribe to try to select the same target pages.

- 25 _____
- 50 _____
- 75 _____
- 95 _____

Which version do you prefer? 55 99

Why?

Introduction and Data Collection (Version 2)

We are evaluating two designs for a page selector for the next version of the ThinkScribe.

One design puts all 99 pages in the slider. You can tap these page up or page down buttons to adjust your selection.

Please use the page selector on this 99-page slider ThinkScribe to try to select these target pages.

- 25 _____
- 50 _____
- 75 _____
- 95 _____

The other design lets you select up to page 55 with the slider, then you tap the page up or page down buttons to adjust your selection or to go to higher pages (up to page 99).

Please use the page selector on this 55-page slider ThinkScribe to try to select the same target pages:

- 25 _____
- 50 _____
- 75 _____
- 95 _____

Which version do you prefer? 55 99

Why?

Appendix B. Raw Data

Person	Gender	Age	Order	P25-55	P50-55	P75-55	P95-55	P25-99	P50-99	P75-99	P95-99	Acc55	Acc99	Diff	Pref
1	*M*	*<40*	*55-99*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
2	*M*	*<40*	*99-55*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
3	*M*	*<40*	*55-99*	0	1	0	0	0	0	1	4	*0.25*	*1.25*	*-1*	99
4	*M*	*<40*	*99-55*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
5	*M*	*>40*	*55-99*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
6	*M*	*>40*	*99-55*	0	0	0	0	1	0	0	0	*0*	*0.25*	*-0.25*	99
7	*M*	*>40*	*55-99*	0	0	0	0	0	0	1	1	*0*	*0.5*	*-0.5*	99
8	*M*	*>40*	*99-55*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
9	*F*	*<40*	*55-99*	1	1	0	0	1	0	0	0	*0.5*	*0.25*	*0.25*	99
10	*F*	*<40*	*99-55*	1	1	0	0	1	1	0	0	*0.5*	*0.5*	*0*	99
11	*F*	*<40*	*55-99*	0	0	0	0	0	0	0	0	*0*	*0*	*0*	99
12	*F*	*<40*	*99-55*	3	1	0	0	5	1	2	1	*1*	*2.25*	*-1.25*	99
13	*F*	*>40*	*55-99*	0	0	0	0	0	0	0	1	*0*	*0.25*	*-0.25*	99
14	*F*	*>40*	*99-55*	1	0	0	0	0	0	0	1	*0.25*	*0.25*	*0*	99
15	*F*	*>40*	*55-99*	0	2	0	0	0	1	0	0	*0.5*	*0.25*	*0.25*	99
16	*F*	*>40*	*99-55*	0	0	0	0	0	0	2	2	*0*	*1*	*-1*	99