RESEARCH SECTION

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EFFECT OF STIMULUS TYPE AND INPUT METHOD ON CRT USER's SPEED AND ACCURACY OF ENTERING AND PROOFREADING STATISTICAL DATA

The use of CRT terminals in organizations has increased dramatically as computer terminals are being used for accounting, automation, statistical research, word processing, and data base management. Because of this increased use, it is important to understand the human factors which affect optimal performance with computer terminals.

Previous studies have investigated several different problems involving the interaction between humans and computer terminals. In a study by Delvolve and Queinnec (1983), the duration of computer work time, operator posture, and automanipulative gestures were found to be important for good performance by CRT operators. In 1963, Isensee and Bennett found that good video luminance was important for optimal performance by CRT operators and that flicker and glare on CRT displays caused discomfort. Miller and Suther (1983), investigated the preferred height and angle settings of CRT terminals and keyboards, and found that the preference seemed to depend on the seat height of the operator.

The studies mentioned above all focused on human factors and ergonomic aspects of computer terminals. While human factors and ergonomics are certainly important, the present study investigated a different angle, that being the effect of stimulus type and input method on performance by CRT users.

When using canned statistical packages such as SAS or SPSS, a researcher can code and enter research data into a computer terminal in one of two ways. The first method is to code and enter the data in a serial method in which there are no spaces between the variables. An example of this method would be:

24367941657987365982 84

The second option would be to enter the data with spaces between the variables. An example of this would be:

23 367 92 4165 798 736 59 82 84

The hypothesized advantage to the serial method is that it saves line space and input time since there are no unnecessary spaces. The hypothesized advantage to the space method is that it is more accurate because it is easier to keep ones place on a line. At present, there is no research evidence that indicates which method is superior. Thus, the purpose of this study was to investigate which method, serial or spaced, is superior in terms of speed and accuracy of data input.

Experiment 1

Method

Subjects. Sixty male and female freshmen from Radford University served as participants. The participants were volunteers from general psychology classes from the 1984 academic year.

Independent Variable. The participants were placed into one of four experimental conditions created through a 2 (stimulus condition - serial or spaced) factorial design. For the stimulus conditions, students were given a data coding sheet with 24 lines of data with each line consisting of 30 numbers. In the serial condition, the number's were listed consecutively without any spaces. In the spaced condition, the 30 numbers were listed with 10 blank columns separating strings of numbers. For the input conditions, students were asked to enter the numbers from the data sheet into a Kaypro computer terminal using either spaces (spaced condition) or without spaces (serial condition) to separate the data variables.

Dependent Variable. A BASIC computer program recorded the number of correctly input lines, a subjective rating of the amount of frustration experienced by the subject, and the time taken to input the 24 data lines.

Results and Discussion.

The data were analyzed in three separate 2 by 2 ANOVA's. As shown in Table 1, the results indicate that regardless of the stimulus type, it was faster to input data using the serial method than it was using the spaced method, $F(1, 56) = 6.69$ $p < .01$.

As shown in Table 2, when subjects were presented

data in the serial fashion and asked to input the data using the serial method, the fewest number of errors were obtained, $F(1, 56) = 4.49$, $p < .038$.

As shown in Table 3, there was no significant effect for either the stimulus method or the input method as to the amount of frustration experienced by the subjects in completing the data input task.

The results of this first experiment seem to indicate that data should be both coded and input in a serial fashion. However, even though the serial method might be best for inputing data into a CRT, it may not be the best method in terms of proofreading. That is, it might be easier and more accurate to proofread data if it has been input using spaces between the variables. In order to address this issue, a second experiment was conducted.

Experiment 2

Method

Subjects. Fifty-six male and female students from Radford University served as participants. The subjects were volunteers enrolled in general psychology courses during the 1984 academic year.

Independent Variable. The participants were placed into one of four experimental conditions through a 2 (data sheet condition - serial or spaced) by 2 (computer printout condition - serial or spaced) factorial design. For the data sheet conditions, students were given a data coding sheet with 24 lines of data with each line consisting of 30 numbers. In the serial condition, the numbers were listed without any spaces. In the spaced condition, the 30 numbers were listed with 10 blank columns separating strings of numbers. For the computer printout conditions, students were asked to compare the numbers from the computer printout with the numbers on the data coding sheets.

Dependent Variable. The time taken to proofread the 24 lines, the number of errors found, and a subjective rating of frustration, served as the variables of interest.

Results and Discussion

The data were analyzed through three separate 2 by 2 ANOVA's. As shown in Table 4, overall it took less time to proofread when the data on the computer had spaces between the variables, $F(1, 52) = 21.34$, $p < .001$.

Furthermore, there was a significant interaction indicating that it took less time to proofread when both the data on the computer printout and the data on the coding sheets had spaces between variables, $F(1, 52) = 21.34$, $p < .001$.

As shown in Tables 5 and 6, there were no significant effects for either the accuracy of the proofreading task nor the amount of frustration that resulted from the proofreading task.

The results of the first study point out that when a researcher inputs data serially he/she saves time and has fewer errors. The results of the second study indicate that when a researcher proofreads data, it is quicker to proofread data entered spaced rather than data that is entered serially.

Therefore, the best method of coding and inputing statistical data is a function of the situation. That is, if CRT time is limited, it might be best to input data serially even though it would take longer to proofread. However, if proofreading time is more important or expensive, then it might be best to input data in a serial fashion.

REFERENCES

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Isensee, S.H., & Bennett, C. A. (1983). The perception of flicker and glare on computer CRT displays. **Human Factors,** 25, 177-184.

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Table 1

Number of Seconds Taken to Input Data

Stimulus Condition	Input Condition: Serial	Input Condition: Spaced
Serial	910.07 (194.61)	1182.47 (299.90)
Spaced	782.60 (136.78)	980.07 (312.23)

Note: Standard deviations are in parentheses

Table 2

Number of Lines Input Correctly

Stimulus Condition	Input Condition: Serial	Input Condition: Spaced
Serial	17.47 (4.79)	12.07 (6.11)
Spaced	13.00 (8.16)	14.60 (6.04)

Note: Standard deviations are in parentheses

Table 3

Mean Ratings of Self-reported Frustration

	Input Condition	
Stimulus Condition	Serial	Spaced
Serial	4.77	5.07
	(1.79)	(1.71)
Spaced	5.07	4.36
	(2.02)	(2.02)

Note: Standard deviations are in parentheses

Table 4

Mean Number of Seconds Taken to Proofread Data

	Computer Printout Condition	
Data Sheet Condition	Serial	Spaced
Serial	608.00	496.14
	(249.90)	(175.91)
Spaced	631.00	313.57
	(150.45)	(91.09)

Note: Standard deviations are in parentheses

Table 5

Mean Number of Errors found during Proofreading

	Computer Printout Condition	
Data Sheet Condition	Serial	Spaced
Serial	7.14	6.07
	(1.75)	(2.37)
Spaced	6.43	7.36
	(2.37)	(1.08)

Note: Standard deviations are in parentheses

Table 6

Mean Rating of Self-reported Frustration During Proofreading

	Computer Printout Condition	
Data Sheet Condition	Serial	Spaced
Serial	4.00	3.57
	(1.41)	(2.34)
Spaced	3.78	3.28
	(1.93)	(1.94)

Note: Standard deviations are in parentheses

AUTHOR'S NOTES

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2. Requests for reprints should be sent to: Michael G. Aamodt, Department of Psychology, Radford University, Radford, Virginia 24142.