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ABSTRACT

The role of decision making and keystroking in the psychomotor activity of office typing tasks was assessed for second-semester, fourth-semester, and terminal college students under three different work conditions: (1) pre-arranged, (2) unarranged without erasing errors, and (3) unarranged with erasing errors. All differences for main effects for speed and errors were significant (probability less than .01). When office tasks were done under wholly realistic conditions, planning and decision making were one-half, keystroking was three-eighths, and erasing comprised one-eighth of the task. Mean completion time for one letter, one table, and one rough draft for 60 students was: prearranged without erasing, 8.94 minutes; unarranged without erasing, 20.89 minutes; and unarranged with erasing, 23.93 minutes. At low levels of skill, time consumed for keystroking was nearly as salient in contributing toward completion of product as time consumed for decision making. As psychomotor skill increased, the perceptual skill of decision making played an increasingly dominant role. The amount of time needed for decision making took on increasing salience in producing office communications as difficulty of the task and amount of training were increased. (Author)

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MEASURING EMPIRICAL PROPERTIES OF PSYCHOMOTOR SKILLS IN DIFFERENT PSYCHOLOGICAL ENVIRONMENTS[1]

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Summary.—The role of decision-making and keystroking in the psychomotor activity of office typing tasks was assessed for 2nd-semester, 4th-semester, and terminal college students under three different work conditions: (1) prearranged, (2) unarranged without erasing errors, and (3) unarranged with erasing errors. All differences for main effects for speed and errors were significant ($p < .01$). When office tasks were done under wholly realistic conditions, planning and decision-making were one-half, keystroking was three-eighths, and erasing comprised one-eighth of the task. Mean completion time for one letter, one table, and one rough draft for 60 students was: prearranged without erasing, 8.94 min.; unarranged without erasing, 20.89 min.; and unarranged with erasing, 23.93 min. At low levels of skill, time consumed for keystroking was nearly as salient in contributing toward completion of product as time consumed for decision-making. As psychomotor skill increased, the perceptual skill of decision-making played an increasingly dominant role. The amount of time needed for decision-making took on increasing salience in producing office communications as difficulty of the task and amount of training were increased.

The typewriting of office communications is a psychomotor activity which involves the interaction of a mental process with an aggregate of symbols mediated by proprioceptive reactions (Fleishman & Rich, 1963; West, 1967) which culminate in typewriting motions. The mental process is a representation of a pattern of stimulation which is a sign of an object evoking in an organism proprioceptive feedback containing both sensory and perceptual fractional components (Hull, 1952; Staats, 1961). The nondetachable components are the ordered sequences in a behavioral chain. The detachable specific components are the new stimulus-response associations formed. The detachable common component is the fractional operant that is common to all members in a class, having an anticipatory reaction possessing (1) cue function (to the extent that it is distinctive), (2) drive function (to the extent that it is intense), and (3) reinforcing function (to the extent that its intensity is reduced or eliminated). When reinforced in a number of specific chains, fractional operants possess

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more increments of response strength, e.g., the complexity of the nature of typewriting skill needed in the execution of office work requires a multiplicity of sensory, perceptual, and motoric subskills inherent in the nature of such activities as organizing content, planning form and arrangement, proofreading and correcting errors, and keystroking and machine manipulations—all fractional operants.

With novel tasks, the mental process that takes place is an active one: the interaction of the new learning activity with existing cognitive structure exemplifies meaningful learning (Ausubel, 1963). The learner's transaction of the task is highly diminished when the novel component of the task is removed and no decisions are required on part of the learner. The task is often reduced to a one-step process: Set margin at 65 (stimulus), followed by appropriate machine manipulation (response). The task is thus one of following directions. Primarily, decision-making and, secondarily, error-correction are the predominant responses in office communications. Much more instructional focus is needed on the decision-making and error-correction aspects of typewriting in the processing of information as the concepts involved are complex in nature, covering all aspects in the Bloom (1956) and Krathwohl, Bloom, and Masia (1964) taxonomy of objectives, transformational chains (Berlyne, 1965), and evaluative abilities (Guilford, 1959, 1966).

The office as a processor of information is involved with human communication, a dynamic process purposive in nature, one which originates stimuli in symbolic form (verbal, written, or expressly implied) intended to modify or otherwise alter the mental and/or physical behavior of those receiving the stimuli (Goyer, 1964). As a fundamental social process, communication is systematic in nature, the result of directed thinking, a cognitive process which selects, adapts, and predicts sequential patterns of responses (Bruner, Goodnow, & Austin, 1956; Ausubel, 1963; Berlyne, 1965; Muhich, 1972). If any two items of information do not fit together psychologically or are in dissonant relationship to each other, the person usually does something to resolve the dissonance, such as (1) increase the importance of the elements involved in the dissonant relation, (2) add new cognitive elements that are consonant with already existing cognition, or (3) change one or more of the elements in the dissonant relation (Festinger, 1962). In this process of change, the modification of behavior can be facilitated through the decision-making process, e.g., processors of information can be aided in (1) constructing alternative behaviors, (2) seeking relevant information about each alternative, (3) weighing the possible consequences of each alternative, and (4) formulating tentative plans of action (Krumboltz & Schroeder, 1965).

The attainment of a concept of a letter, table, manuscript or other office communication implies that one can distinguish the attributes and the relationship between constituent parts specific to each (Smoke, 1932) as well as those attributes which are shared in common (Hull, 1920). An attribute is any feature of an event that is discriminable from event to event. A concept may be thought of as a network of significant inferences—going beyond a set of observed criterial properties in an object or event to the class identity of the object or event (Bruner, Goodnow, & Austin, 1956). The working definition of a concept is the network of inferences that are, or may be, set into play by an act of categorization. The criterial values from which class identity is inferred and the inferences that are then made from class identity to other properties need not be of common-element type nor need they be relationally connected. They may be conjunctive and psychologically defined by the conjoint presence of several attribute values; when and only when such values are present may an event be considered as an exemplar of the category.

Cognition is the process of achieving, retaining, and transforming information about the environment so that it may be selectively applied in subsequent, novel situations. Directed thinking (Berlyne, 1965) is marked by the order in which thoughts succeed each other. The thought process leads the subject step by step nearer to the predicted goal. Once the problem is solved, a solution chain exists—a series of representations consisting of initial, intermediate, and terminal behaviors (Berlyne, 1965; Lanham, Herschelman, Weber, & Cook, 1970). Each situation is joined to the last by an implicit step, derived from an overt response that, in part, regularly replaced one kind of stimulus situation with another kind.

The transformational thought (ϕ) constitutes the legitimate step that links each situational thought with the next. Alternating situational and transformational thoughts make up a transformational chain. Each situational thought, although directly determined by the situational and transformational thought that precedes it, is therefore indirectly determined by the whole of the previous course or train of thoughts.

The illustration that follows outlines the component parts of a transformational chain (Berlyne, 1965) for the activity of typing a simple table from longhand after gathering data: (Clearing margins and tabular stops may be considered as a preliminary step to the transformational chain.)

S_0 represents a 3-column, longhand table with column headings, main heading, and 6 lines in body.

ϕ_1 represents visual overview of the task and thinking processes involving hypotheses as to strategy, which results in decisions as to spatial relationships between component parts, which culminates in initiating Step 1 (for vertical placement), counting number of lines to determine first line of typing if table is to be centered on the page, or an estimation.

u_1 represents execution of above situational thought and spacing down to first line of typing to center position, backspacing for main heading, and typing in main heading.

ϕ_2 represents the process of determining the longest line in each column and number of intercolumn spaces, which leads to determining left margin and tabular stops.

u₃ represents execution of above situational thought in a sequential pattern, resulting in a finished product.

The component parts of each situational thought are bits of information which can be put in sequential order for computer programming.

Evaluative abilities are among the least of the investigated abilities and involve decisions as to the accuracy, goodness, suitability, or workability of information (Guilford, 1959). The eight evaluative abilities in the Guilford (1959) system that apply to the nature of office tasks are: (1) some kind of criterion or standard of judgment is involved, e.g., standards for effective communication and marketability of product; (2) ability to judge the identity of a unit (Is this unit identical to that unit?); (3) ability to judge the identity of symbolic units in the form of series of letters or numbers or of names of individuals, e.g., the proofreading required to judge identity of symbolic units that are typical of clerical skills; (4) ability to decide whether two ideas are identical or different, e.g., grouping of a disarray of units or symbols into columns and assigning each column heading an appropriate name; (5) the criterion of logical consistency in the relationship of parts to whole, e.g., the relationship of one column to another in setting up tabulations and of column headings and boxheads in relationship to the columns; (6) evaluation of systems is concerned with the internal consistency of those systems, e.g., self-evaluation of the parts to the whole within the task after execution or organizational consistency within correspondence or a manuscript; (7) semantic ability for evaluating transformation (e.g., Which of several solutions is the best to use? What layout, format, style or procedure to use?); and (8) sensitivity to problems and needed improvements, e.g., workable suggestions for effective and constructive change, the sum of which equals cognitive development and perceptual integration, or the ability to fuse sensory impressions into meaningful entities.

> Intellectual or cognitive development pertains to the use of information acquired. Thus comes the ability to integrate, associate, correlate, store, and assess information effectively to form judgments and to develop new thought—the creative dimensions . . . (Carmichael, 1969, p. 20).

Very little dependable feedback (West, 1967) was found when typists' vision was obstructed in the detection of errors meaning that, at most times, typists did not know when a misstroke error occurred and had to depend upon proofreading the copy in order to detect and eventually correct errors. Errors of omission or placement which disturbed the logical internal consistency of the communication were more serious and required much more time, effort, and expense to correct (Muhich, 1967; McLean, 1971; West, 1971).

If keystroking skill is the most important contributor to production-proficiency, then focusing on the development of high straight-copy stroking skill, to the exclusion of other skills, is appropriate. If, on the other hand, the planning processes that lead to acceptable arrangement of materials are found to predominate in production skill, then substituting an earlier and heavier focus on the perceptual and organizational processes that lead to proficiency at office-tasks would be indicated, thus placing the instructional emphasis of keystroking skill in an appropriate context along with the more difficult components. This study therefore proposes that psychological environments that emphasize the perceptual processes vs motor aspects in typewriting tasks are much more salient in simulating real life (decision-making) work conditions vs unrealistic (nondecision-making) work conditions and become increasingly more salient in affording greater opportunity to make serious errors as task-difficulty increases.

The purpose of the present study was to assess the relative roles of keystroking skill and of decision-making ability in the typing of office tasks, the goal being a mailable product produced in a reasonable period of time. These office tasks required two major clas of behavior: (1) physical manipulations of the typewriter, mainly keystroking and machine manipulations; and (2) execution of decisions as to placement and arrangement of work on the page: margins, vertical and horizontal placement, spacing between elements, division of words, and identifying, erasing, and correcting errors.

The operational hypotheses were expressed in the form of questions to be answered from performance scores of typists at three levels of training on straight-copy work and on simple letters, tables, and drafts (manuscripts) typed under each of three working conditions: from arranged copy without erasing, from unarranged copy without erasing, and from unarranged copy with erasing errors. The questions were as follows: (1) Are there significant differences in performance (speed and errors) between straight copy and office tasks under each of the three working conditions and among the three training levels? (2) What relationships (correlations) exist among performance scores (and do they differ significantly) between straight-copy and office-task performance under various office-task work conditions and among the three training levels? (3) Is the keystroking involved in straight copy substantially the same as the keystroking in office tasks? (4) Is accuracy of keystroking under straight copy (nondecision-making conditions) the same as accuracy of keystroking on office-typing tasks (decision-making conditions)? (5) What are the speed-error relationships for the various tasks? (6) What are the relationships between test performance and teachers' ratings and general scholastic ability?

METHOD

To answer these questions, 60 students distributed among three training levels [18 completing 2nd-semester typing in one high school (HS 2); 23 completing 4th-semester typing in another high school (HS 4); and 19 in an advanced college class (2¼ to 2½ yr. of high school plus college typing training) (Coll.)] were tested for their proficiency at straight-copy work and at simple

(1) business correspondence, (2) tables, and (3) rough drafts (manuscripts) administered under each of three working conditions to all *S*s.

In Condition 1 wholly prearranged copy was presented, with all margin and machine settings made in advance and without erasing errors (nondecision-making work conditions). In Condition 2 wholly unarranged copy was provided, with all placement and other decisions made by the typist, but without erasing (decision-making work conditions holding erasing time constant). In Condition 3 wholly unarranged copy was given, with all placement and other decisions to be made by the typist, but with identifying, erasing, and correcting errors (decision-making work conditions duplicating real life). Condition 1 removed decision-making and erasing from the work, in effect, converting the work into an ordinary copying task. Comparison of performance under this condition with straight-copy performance indicated the extent to which straight-copy keystroking skill differed from office-task keystroking skill. Condition 2 introduced decision-making and, as contrasted with performance under Condition 1, provided an estimate of the role of decision-making in office-task typing, unconfounded by the effects of erasing. Condition 3, as contrasted with Condition 2, provided an estimate of the effects of erasing, holding constant both stroking-skill and decision-making.

All *S*s worked under all conditions and parallel forms of the test materials were used for each of the three working conditions in counterbalanced order. The data arising from these tests were speed and error scores for ordinary straight-copy work and for the three office tasks under each of the three working conditions for persons at each of three levels of training. For details in scoring, see Muhich (1967).

Technically, the analysis of variance design used was a treatments × *S*s × levels design in which each *S* acted as his own control (in effect 9 replications within the experiment).

Alpha levels were .05 and .01. Variance analyses (conditions, tasks, levels, and interactions) were followed by tests, through critical ratio, for differences between means (conditions, tasks, and levels). Product-moment coefficients of correlation were tested for statistical significance from zero and differences between correlations.

RESULTS AND DISCUSSION

The means and standard deviations for all levels combined ($N = 60$) for each of the three conditions, three tasks, total production, and straight copy are shown in Table 1.

Differences Among Conditions

As shown in Table 2, the significant *F*s indicate that conditions needed for planning form and arrangement were present in the two unarranged working conditions and, presumably, differences in completion time were a measure of

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR SPEED AND ERRORS (*N* = 60)

Condition	Speed[a]			Errors[b]	
	gwpm	*M*	*SD*	*M*	*SD*
		Letter			
C-1	34.4	11.63	3.38	3.65	2.82
C-2	17.9	22.33	6.45	3.68	2.76
C-3	15.5	25.78	7.03	2.33	1.81
		Table			
C-1	16.2	12.37	4.97	2.87	2.52
C-2	5.7	34.98	11.66	4.65	2.36
C-3	5.2	38.85	13.21	3.40	1.87
		Manuscript			
C-1	27.2	11.75	3.45	4.31	2.87
C-2	12.2	26.27	7.47	5.20	2.68
C-3	10.3	31.10	10.70	3.22	2.17
		Total Production			
C-1	25.7	35.75	10.99	10.83	6.69
C-2	11.0	83.58	23.59	13.53	6.22
C-3	9.6	95.73	26.54	8.95	4.63
		Straight Copy			
All Ss	94.42		12.91	14.27	8.12

[a]Mean speed is in total number of quarter minutes.
[b]Errors are in total number of errors.

the time spent identifying and correcting errors to the extent that errors were not overlooked, which were then considered errors of omission.

Differences Among Tasks

Speed.—Significant differences in completion time in quarter minutes were obtained between all comparisons for tasks (Table 3): draft and letter, table and draft, and table and letter. The order of difficulty, relative to time, was table, draft, and letter as inferred from the means of means (38.85, 31.10, and 25.78, respectively, an average of three training levels, under decision-making conditions).

Errors.—Significant task differences in total errors for all conditions combined were found between draft and table and between draft and letter (Table 4). No significant difference was found in total number of errors between the table and letter. Relative to quality of work, the 80-word rough draft copy was more difficult than the 50-word table or the 100-word letter, and the 50-word table was more difficult than the 100-word letter. Difficulty of the task (as measured by quality of work) was, in descending order, rough draft, table, and letter.

Differences Among Levels

Speed.—College typists were significantly faster under straight-copy, or

TABLE 2

ANALYSIS OF VARIANCE FOR SPEED AND ERROR SCORES

Source	df	Completion Time[a] MS	Completion Time[a] F	Total[b] Errors MS	Total[b] Errors F	Major[c] Errors MS	Major[c] Errors F	Minor[d] Errors MS	Minor[d] Errors F
Among Subjects	59								
Among Levels	2	6674.03	[illegible]	234.09	13.16*	50.29	11.83*	77.50	10.22*
Errors Among	57	121.84		17.78		4.25		7.58	
Within Subjects (S)	480								
Among Conditions (C)	2	20112.18	629.46*	106.15	28.93*	99.58	71.95*	231.06	97.07*
Among Tasks (T)	2	3597.26	112.58*	47.56	12.96*	35.36	25.54*	.92	.39
C × T	4	758.72	23.74*	19.47	5.31*	2.42	1.75	13.18	5.54*
C × L	4	270.90	8.48*	21.74	5.92*	7.40	5.35*	30.47	12.80*
T × L	4	205.17	6.42*	5.63	1.53	1.15	.83	8.38	3.52*
C × L × T	8	53.92	1.69	.46	.13	.21	.15	.81	.34
Error Within	456	31.95		3.67		1.38		2.38	
Total	539								

[a] In number of quarter minutes.

[b] Unit weight given to major and minor errors.

[c] Form-and-arrangement and proofreading errors under decision-making work conditions.

[d] Typographical errors under nondecision-making work conditions.

* $p_{.01}$ = 5.18 for 2/40 *df*; 4.79 for 2/120 *df*; 3.48 for 4/120 *df*; and 2.66 for 8/120 *df*.

TABLE 3

DIFFERENCE IN COMPLETION TIME MEANS BETWEEN CONDITIONS AND BETWEEN TASKS (FOR ALL Ss) AND BETWEEN LEVELS (BY CONDITIONS)

Interaction	Diff.	p
Between Conditions		
Unarranged with Erasing — Unarranged without Erasing	4.05	<.01
Unarranged without Erasing — Prearranged without Erasing	15.94	<.01
Unarranged with Erasing — Prearranged without Erasing	19.99	<.01
Between Tasks (All Conditions)		
Draft — Letter	3.13	<.01
Table — Draft	5.69	<.01
Table — Letter	8.82	<.01
Arranged without Erasing		
Draft — Letter	.12	
Table — Draft	.62	
Table — Letter	.74	
Unarranged without Erasing		
Draft — Letter	3.94	<.01
Table — Draft	8.71	<.01
Table — Letter	12.65	<.01
Unarranged with Erasing		
Draft — Letter	5.32	<.01
Table — Draft	7.75	<.01
Table — Letter	13.07	<.01
Between Levels		
Arranged without Erasing		
College — High School 4	3.08	
High School 4 — High School 2	5.10	
College — High School 2	8.18	
Unarranged without Erasing		
College — High School 4	3.70	
High School 4 — High School 2	8.95	<.01
College — High School 2	12.65	<.01
Unarranged with Erasing		
College — High School 4	7.06	<.01
High School 4 — High School 2	9.71	<.01
College — High School 2	16.77	<.01

Note.—Differences are in the direction shown; for example, "Table — Letter" means "Table minus Letter." In all instances, differences are based on a mean of means, or an average for three conditions or three tasks or three levels.

nondecision-making, working conditions than High School 2 level; but High School Level 4 and college people did not differ.

When decision-making was added to the working condition, High School Level 2 was significantly slower than High School Level 4 and college, but no difference was found between High School 4 and College levels.

When identifying and correcting errors were added to the work condition, the High School Level 2 typists were significantly slower than High School Level 4 and the latter were, in turn, significantly slower than College level. This finding was, of course, in accordance with expectations.

Errors.—Under the nondecision-making work conditions there were no significant differences in total errors between College and High School 4 while

TABLE 4

DIFFERENCE IN TOTAL ERROR MEANS BETWEEN CONDITIONS AND TASKS (ALL Ss) AND BETWEEN LEVELS (BY CONDITION)

Interaction	Diff.	p
Between Conditions		
Prearranged without Erasing — Unarranged with Erasing	.63	<.05
Unarranged without Erasing — Prearranged without Erasing	.90	<.01
Unarranged without Erasing — Unarranged with Erasing	1.53	<.01
Between Tasks (All Conditions)		
Table — Letter	.42	
Draft — Table	.61	<.05
Draft — Letter	1.03	<.01
Between Levels		
Prearranged without Erasing		
College — High School 4	.25	
High School 2 — College	2.69	<.05
High School 2 — High School 4	2.94	<.05
Unarranged without Erasing		
High School 2 — High School 4	1.13	
High School 4 — College	1.25	
High School 2 — College	2.38	<.05
Unarranged with Erasing		
High School 2 — High School 4	.86	
High School 4 — College	.96	
High School 2 — College	1.82	

significant differences were obtained with High School Level 2 and College and High School Levels 2 and 4; the high and advanced ability levels were similar in accuracy of keystroking under straight-copy work conditions, and both were significantly more accurate than the High School 2 level.

When decision-making was added to the work condition, no significant differences in total errors were obtained between High School Levels 2 and 4 and between High School Level 4 and College, while a significant difference was obtained between High School Level 2 and College. Significant differences in quality of work for three tasks existed only between the beginning and advanced levels of ability.

When identifying, erasing, and correcting errors were added to provide a duplicate of real-life work conditions, no significant differences in total errors were found between levels. The real-life work condition was equally demanding for the three ability levels as the observed differences were not significantly different from zero.

The null hypotheses of no time difference and of no error difference due to work conditions were rejected.

Correlational Data

Intercondition *r*s for speed and for errors across all tasks and levels showed that the faster and more accurate typists under decision-making work conditions were also the faster and more accurate typists under nondecision-making work

TABLE 5

INTERCONDITION CORRELATIONS FOR SPEED AND FOR ERRORS ($N = 60$)

Condition	Speed	Errors
Unarranged with Erasing — Unarranged without Erasing	.64*	.70*
Unarranged with Erasing — Prearranged without Erasing	.83*	.46*
Unarranged without Erasing — Prearranged without Erasing	.73*	.59*

*$p < .01$.

conditions. With few exceptions, the same can be said for each of the tasks (Table 5).

Straight-copy vs office-typing tasks.—To determine if the keystroking involved in straight copy was substantially the same as keystroking in office tasks, correlations for speed and for errors were computed between straight-copy and office tasks with findings as shown in Table 6.

TABLE 6

INTERCORRELATIONS FOR SPEED[a] AND ERROR[b] IN STRAIGHT COPY AND IN OFFICE TASKS (BY WORK CONDITION AND LEVEL)

Variable	HS 2 1	HS 4 2	Coll. 3	All 4
Ns	18	23	19	60
Between Straight-copy Speed and Speed on Office Tasks				
1 Arranged without Erasure	−.49*	−.41*	−.85†	−.84†
2 Unarranged without Erasure	−.25	−.21	−.32	−.61†
3 Unarranged with Erasure	−.62	−.31	−.23	−.75†
Between Straight-copy Errors and Errors on Office Tasks				
4 Arranged without Erasure	−.04	.24	.63†	.33*
5 Unarranged without Erasure	−.04	.23	.73†	.35†
6 Unarranged with Erasure	.18	−.11	.44*	.22
Between Straight-copy Misstrokes[a] and Misstroke Errors on Office Tasks				
7 Arranged without Erasure	−.08	.18	.59†	.29*
8 Unarranged without Erasure	.09	.14	.68†	.41†
Between Speed and Total Errors				
9 in Straight Copy	−.06	−.18	.01	−.19
in Office Typing				
10 Arranged without Erasure	−.02	−.12	.40	.48†
11 Unarranged without Erasure	−.05	−.19	.31	.27†
12 Unarranged with Erasure	.52	.36	.17	.59†
Between Straight-copy Speed and Misstroke Errors in Office Typing[c]				
13 Arranged without Erasure	−.09	.01	.22	.42†
14 Unarranged without Erasure	.16	−.13	.11	.37†

[a]Straight-copy speed is in gross wpm for six minutes of typing, and office tasks are in quarter minutes of completion time.
[b]Each keystroking error within a word is counted one misstroke with the exception of transposition errors, which are counted as one misstroke.
[c]Keystroking errors under the condition, Unarranged without Erasure.
*$p < .05$. †$p < .01$.

Keystroking speed.—Relationships significantly different from zero were obtained between straight-copy speed and speed on office tasks at the .01 level for each of the working conditions (Rows 1, 2, and 3, Table 6). The negative correlations were an artifact of measurement—high gross words per minute with low completion time in quarter minutes (fast typists in both instances); therefore, those who ranked high in keystroking speed on straight copy also ranked high in keystroking speed on office tasks.

Keystroking errors.—No significant relationship was found between errors in straight copy and errors for working conditions which duplicate real life for all levels combined (Row 6, Table 6); but a moderate relationship was obtained for the college level. Accuracy of typing office tasks under real-life work condition was, for most part, entirely different from accuracy for straight-copy timings for all levels and showed only a moderate relationship at advanced levels of skill. Significant, but low, correlations were obtained between straight-copy errors and errors under each of the two working conditions without erasing errors. There was a slight tendency for some relationship between accuracy of typing office tasks without erasing errors and accuracy of typing straight copy when comparing across three levels of ability (a difference of 1½-yr. training). Advanced college typists showed a marked relationship between straight-copy errors and errors in office tasks under the two no-erasing conditions. Over-all, as training advanced, the relationship between the two became more pronounced (Rows 4, 5, and 6; Table 6).

There was little tendency for speed and errors to go together in straight-copy work; but in office-task typing, the faster typists were more accurate with respect to total number of errors (Rows 10, 11, and 12; Table 6). The *r*s between speed and misstroke errors were also significant (Rows 13 and 14, Table 6), indicating that the fastest typists also made the fewest keystroking errors.

Misstrokes.—As shown in Rows 7 and 8 (Table 6), there was only a mild tendency for straight-copy misstrokes to be related to misstroke errors in office tasks. Office-task typing produced less than twice the misstroke errors produced in straight-copy typing. Possibly, student awareness of task differences caused the student to adopt a different "set" that resulted in fewer misstroke errors in office tasks. Again, straight-copy accuracy had no relationship to production accuracy as measured by misstroke errors.

Speed-error relationships.—Speed-error relationships for straight-copy typing (Row 9, Table 6) were not significantly different from zero. The factors underlying the two variables were completely different. The factors that contributed to speed in typing straight copy were not the same as the factors that contributed to accuracy in typing straight copy. Therefore, each of these factors ought to receive a different type of training.

Test performance, teachers' numerical ratings, and scholastic aptitude.—Except for the High School 4 group, there was little apparent relationship between scholastic aptitude and straight-copy skill, and the results for this group were probably accidental. There was nothing about straight-copy work that made more than modest demands on general intelligence. Relationships between teachers' numerical ratings and test performance on straight copy (Table 7) were: (1) High School Level 2 students with high numerical ratings tended to be the faster straight-copy typists; (2) High School Level 4 students showed no relationship between numerical ratings and speed or errors on straight copy; (3) college students with high numerical ratings tended to be faster straight-copy typists.

Relationships between scholastic aptitude and test performance on office tasks done under real-life work conditions (Table 7) were: (1) High School Level 2 students with high IQs tended to make fewer errors and to type office tasks faster (low completion time in quarter minutes); (2) High School Level

TABLE 7

CORRELATIONS BETWEEN TEST PERFORMANCE AND TEACHERS' RATINGS AND SCHOLASTIC APTITUDE

Condition	Speed				Errors			
	HS 2	HS 4	Coll.	All	HS 2	HS 4	Coll.	All
			Scholastic Aptitude					
N	14	23	13	50	14	23	13	50
Straight Copy	.30	.48*	–.06	.24	–.22	.23	–.23	–.23
Unarranged with Erasing	–.63*	–.3[illegible]	.12	–.34*	–.61*	–.47*	–.36	–.48†
			Teachers' Ratings					
Straight Copy	.78†	.24	.59†	.66†	–.13	.13	–.39	.22
Unarranged with Erasing	–.61	–.38	–.33	.45†	–.81†	–.52†	–.59†	.66†

*$p = .05$. †$p = .01$.

4 students with high IQs tended to make fewer errors on office tasks, while speed of work showed no apparent relationship; (3) no relationship between speed or errors for College Level. Over-all, simple office tasks were easy to type for students at all IQ levels represented. Relationships between teachers' numerical ratings and test performance on office tasks (Table 7) were: (1) High School Level 2 students with high numerical ratings were faster typists (low quarter minutes) and made fewer errors on office tasks; and (2) high numerical ratings were received by High School Level 4 and college students with fewer errors on office tasks duplicating real-life working conditions while there was no relationship between the two for speed of work. It was apparent that some teachers' grades do include other factors besides skill at keystroking alone on these particular types of tasks.

Implications for Training

The findings of the present investigation make it apparent that decision-making was by far the most salient component of production skill by making more demands on the typists' time and ingenuity when compared with the psychological environment in which no decisions were required. When office tasks were done under wholly realistic conditions, the perceptual activity of planning and decision-making was half the job, keystroking was three-eighths of the job while erasing comprised one-eighth of the task. Mean completion time for one letter, one table, and one draft for 60 students was 8.94 min. when copy was prearranged without erasing, 20.89 min. when copy was unarranged without erasing, and 23.93 min. when copy was unarranged with erasing.

At low levels of skill, keystroking was nearly as salient in amount of time demanded of the typist as decision-making. As skill increased, decision-making played an increasingly dominant role.

As task difficulty and amount of training were increased, the decision-making process took on increasing salience in amount of time consumed to complete a product. Relative to speed of work, the 100-word letter was typed faster than the 80-word draft (manuscript) used in this study. Relative to accuracy of work, the 80-word draft produced more errors than the table and letter, in that order.

Proficiency at decision-making was delayed by prolonged training in being repeatedly told margin settings, spacing between columns, line length, and on what line to start typing, resulting in low transfer to the decision-making required in real life.

It appeared that the instructional focus was essentially on straight-copy typing (straight-copy timings and wholly guided work) for at least two-thirds, and as high as 90%. of all classroom time throughout training, whether over a 1- or 2-yr. period of time, based on the typewriting texts examined (see Table 8). Due to the nature of the task itself, sufficient training on straight copy was built into every typing task. The perceptual skill of decision-making required much more practice than the motor skill of keystroking and manipulating the typewriter. Yet, there were far too few unguided tasks in the current typewriting textbooks, thus defeating and delaying learning to make decisions unaided.

An attempt was made to determine the hours of training time spent on business letters, tables, and rough draft copy by sending a questionnaire to a

TABLE 8

NUMBER OF TASKS IN FOUR CURRENTLY USED TEXTBOOKS IN WHICH STUDENTS ARE WHOLLY GUIDED, PARTIALLY GUIDED, AND UNGUIDED IN DECIDING VERTICAL AND HORIZONTAL ARRANGEMENT

Task	Wholly Guided	Partially Guided	Unguided	Total No.
Letters	238	97	123	458
Tables	49	98	78	225
Drafts	56	35	18	109
Totals	343	230	219	792

10% stratified proportional sample of the business teachers in the state of Illinois. For respondents teaching typewriting during the second semester, the amount of training time devoted to letters during Weeks 1 through 6 (approximately 30 hr.), ranged from 0 to 18 hr., with 6 hr. representing the median; 0 to 12 hr. were devoted to tables, with 5.5 hr. the median; and 0 to 10 hr. for rough drafts, with 3 hr. the median. It was evident that there was a wide variation in amounts of training time teachers devoted to each activity.

Keystroking was relatively easy to learn by students at all levels of IQ as demonstrated by the low relationships between scores on straight-copy typing and scholastic ability. The moderate, but significant, relationships between IQ and communications-skills requiring decision-making attested to the fact that the concept of intelligence is more comprehensive in scope.

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