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The Effects of Cognitive, Perceptual and Behavioral Factors on Measures of Typing Skills

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THE EFFECTS OF COGNITIVE, PERCEPTUAL AND BEHAVIORAL FACTORS ON MEASURES OF TYPING SKILL

by

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PROBLEM:

This study examined the feasibility of predicting typing skill acquisition from data available in student records. Specifically, the purpose of the study was to see if a correlation exists between the Woodcock-Johnson Psycho-Educational Battery, the Behavior Evaluation Scale, and student personal characteristics with measures of typing skill.

PROCEDURE:

The subjects were 30 students who were residents at the St. Cloud Children's Home. Typing measures, Gross Words a Minute and Rate of Acquisition, were tabulated over a nine-week period. These measures were compared to student demographic data, scores on the Behavior Evaluation Scale and the Woodcock-Johnson Psycho-Educational Battery by using the Pearson Product Moment Correlation and a Stepwise Multiple Regression Equation.

FINDINGS:

There was a high correlation between Visual-Perceptual Speed (age) and Gross Words a Minute while Written Language Aptitude (grade) had the highest relationship with Rate of Acquisition. Five independent variables show an 81% common variance with Gross Words a Minute. A 67% common variance was shared by three independent variables and Rate of Acquisition. A Multiple Regression Analysis was implemented and found to be a possible valid instrument for predicting Gross Words a Minute and Rate of Acquisition. This may prove valid on a cross-validation.

Another study should be done on the next round of students at the St. Cloud Children's Home. Results from another study would show if

the correlations are consistent. A cross-validation procedure should be done to see if the initial Multiple Regression Equation was the result of chance relationships.

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Joan Bigler Chairperson

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STATEMENT OF THE PROBLEM

Background for the Study

Beginning typewriting has been an elective course offered mainly to secondary students. The use of the typewriter as an instructional aid and the recent advent of the computer has exposed more students to the keyboard. These students have exhibited a wide range of abilities in a wide range of educational settings. Typing has been offered to lower age groups and in alternative and special education classes.

Special educators have used the typewriter to develop fine motor skills, improve legibility of written expression, supplement reading programs, and build self-esteem. It also has facilitated programming for the visually impaired and physically handicapped. The importance of learning the keyboard in the "Computer Age" and the potential personal/vocational skill has been of value to many students.

Need for the Study

There are many students who have difficulty learning to type by the touch method. They may have physical problems, behavior problems, a learning disability, or have not developed the appropriate readiness

skills presumed necessary in typing acquisition. Typing is a perceptual/motor skill (Russon & Wanous, 1973) and involves memory, reasoning, reading, and fine motor skills. When a teacher has detected a weakness in one or more of these areas, an alternative typing curriculum or method of instruction could be used to adapt to a student's individual need.

The problem for those who teach the handicapped has been to determine appropriate methods and materials to provide handicapped students with the most effective typing program (Ober & Heller, 1978). There has been a need to expand the typing curriculum for students who are not successful with traditional methods or materials. The special education student taught with a traditional typing test, is doomed to failure (McCabe, 1981).

Statement of the Problem

The Woodcock-Johnson Psycho-Educational Battery (WJPEB) has been widely used in special education to compare scholastic aptitude with achievement. Part One, Tests of Cognitive Ability, taps some of the skills presumed necessary in typing acquisition. The Behavior Evaluation Scale (BES) has been used to identify those students who may have behavior problems which warrant further diagnostic evaluation and possible special services.

The purpose of this study was to see if a correlation exists between the WJPEB, BES, and student personal characteristics with measures of typing skill. The measures of typing skill used were typing speed (GWAM) and rate of acquisition.

Definition of Terms

WJPEB. Woodcock-Johnson Psycho-Educational Battery.

BES. Behavior Evaluation Scale.

Alternative typing curriculum. Typing materials that contain lower reading levels, larger print, and introduction to new keys at a slower rate.

Readiness skills. Basic skills necessary to gain achievement in typing.

GWAM. Gross words a minute. The number of words a student can type in one minute including errors. One word was equal to five spaces.

Rate of acquisition. The number of weeks, during a nine-week period, it took a student to reach their maximum typing speed.

Touch method. The process of using eight fingers for striking specific keys on the keyboard. The thumb is used for the space bar.

Chapter 2

REVIEW OF THE LITERATURE

The review of the literature included information on the different processes involved when typing, the acquisition of typing skill using the touch method, and the usefulness of the typewriter in education. The literature search was conducted primarily on publications from the seventies and eighties. Literature from the mid-nineteen hundreds was also used because of its significance to this study and since the majority of the studies in typewriting were reported before that time.

Processes Pertaining to Typing

The skills students used when learning the typewriter keyboard by the touch method involve a complex interaction of perceptual, motor, behavioral, and cognitive processes. Typewriting has been classified as a psychomotor skill as it involves manipulative responses requiring perceptual inputs, mental processes and finely coordinated muscular movements (Singer, 1972). Gentner (1985) found evidence of mental processing in typewriting when there was insufficient time for serial processing of the letters, the eye fixations were one second ahead of typing and the typists were responsive to text structure above the letter level.

Perceptuo-cognitive theory (Lerch, 1974) stated that the way individuals move, perceive their environment, and exhibit learning ability are interrelated and interdependent. They found children who were not learning effectively may have difficulties in perceptuo-cognitive areas and develop emotional and behavior patterns in an attempt to compensate for, or avoid their difficulties.

The importance of affective behavior in typewriting was found to be "conditioned" to a considerable degree by the educational history of the learner, by the effects prior home and school experiences have had on the learner's attitude toward learning and schooling, interest and desire to learn, and self-concept as a learner (Robinson & Ownby, 1979).

Theories/Models of Typing Acquisition

West's stages of acquisition. West (1982) stated that typewriting skill acquisition consisted of three stages. The cognitive stage consisted of perception of each letter in the copy and is the stimulus for each keystroke. At this time, the learner pronounces each letter to himself as he strikes its key. Motions were found to be awkward and erratic with much verbal mediation preceding each response. The associative stage existed when some letters become chained and the typist perceived and vocalized familiar words even before typing at the letter-by-letter stroking and some sequencing of short, easy, high frequency words or letters. During the third stage, or autonomous stage, typists are typing at a rate of 30 words per minute and over. The perception and subvocalization of individual

letters and familiar words chain more noticeably as the gap between the typists reading and typing speeds get smaller.

Activation triggered schema system. Rumelhart and Norman (1981) developed an Activation Triggered Schema System. The schema has an activation value that reflected the total amount of excitation it received. When appropriate conditions had been satisfied, a schema was triggered at which time its procedure became operative, and controlled whatever operations they specified. Different schemata were often interconnected, and one schema could call upon other schemata to perform specific tasks. When one schema called upon another, the initiating schema was called the "parent schema" and the called schema was the "child schema." The schema for typing the word (the) would be initiated by the triggering of its parent schemata which then controls the activation and triggering of the child schemata for the letters t, h, and e, which activated the child schemata that controlled the actual finger, hand, and arm movements. According to the model, people type quickly because they are carrying out many actions at once. When successive strokes are made on different hands, the interstroke intervals are shorter than when both strokes are made with the same hand. Keystroke times were affected by the distance between keys. Skilled typists moved their hands toward the keys in parallel and type units of typing at word level or smaller. The model assumed there are word schemata for every string of letters bound by spaces. Random letter strings are poorly

perceived and poorly remembered. Certain amounts of slow down in typing random letter strings comes from the perceptual and memory processes. The preparation time was longer for those strings involving strokes on both hands than for those involving only a single hand.

Schmidt's theory of motor behavior. Schmidt (1975) referred to his schema theory of how skills were learned, and stated people develop certain rules about their individual motor behavior. The theory predicted the rules people develop about their motor behavior would be more effective in action if the events leading to the development of the rules were varied rather than constant. McCraken and Stelmach (1977) tested Schmidt's theory in a motor learning study and found variable practice more effective. Mach (1972) found beginning typists who learned to type through non-repetitive practice were able to type significantly faster and more accurate on straight copy material than were students who learned to type through repetitive practice. A study by Long and Hayes (1983) found neither the variable nor the specific practice drills proved to be more effective in improving response times to specific letters in two-letter combinations than using no drills at all. The study further found drill work at the intermediate level of skill acquisition did not appear to be helpful to the typist in increasing speed or decreasing errors.

Operant/classical conditioning models. Stimulus-response conditioning models were used to explain acquisition of psychomotor skills. The Skinnerian (operant conditioning) model, relying on reinforcement, was used in the early stages of keystroking, while the Pavlovian (classical conditioning) model, relying on close association between stimulus and response, took over at higher stroking skills (McLean, 1978).

Knowledge of Results in Skill Acquisition

Knowledge of results has been found necessary for the simulus-response association to develop. Students must know when they have made a correct response to increase the probability the response would be repeated consistently in the future (McLean, 1978). Schmidt (1975) studied movement-produced feedback and found feedback was received through various sensory systems, including the visual, auditory, and kinesthetic senses.

Visual Feedback. A study by Hayes and Reeves (1980) found visual feedback as such a strong mediator of performance in typewriting that subjects attended to visual movement cues at the expense of cues provided by other sensory systems. They investigated the use of visual feedback by typists at various ability levels and found typists performed best when visual feedback was available and used for response guidance. Vision contributed heavily to the learning and performance of most motor skills, especially in the early stages of practice. Students could not tell from the feel of the motion

whether they had made the right motion. Early methodology in the teaching of typewriting (West, 1984) required the student to direct vision to the materials being copied and not to use the visual feedback for directing the keystroking response. Typewriters used in typewriting classrooms during the first half of the 20th Century had blank keyboards where letters, numbers, and symbols were not visible to the student. As the role of visual feedback during motor learning became evident, open keyboards with the letters, numbers, and symbols on the key surface began to appear in classrooms.

Vocalization. An experimental class (Herbert & Scalamogna, 1981) used vocalization between the stimulus and response in typing and achieved a higher degree of accuracy on a five-minute timing. They found there are intervening events that take place between the time the stimulus was perceived and the required response. These events were vocalizing, key location, finger selection and vocalizing again. Bernstein (1982) recommended frequent overt vocalization sessions as an integral part of learning and found it a natural response for students when reading language materials. The pronouncing aloud assured the intensity necessary to achieve the formation of associations in keyboard learning. Vocalization began to disappear when students reached 15-20 words per minute (McLean, 1978).

Kinesthetic Feedback. McLean (1978) studied kinesthetic feedback and found it did not exist automatically in each person but must be learned. It would be necessary to develop automaticity (Bloom, 1986) in the many sub-skills required to reach top-level performance in a motor skill. When touch typists reach the automaticity level, they use fingers and hands which require a minimum amount of effort. Research has shown very little dependability of muscular sensations among novices. Typists at skill levels of 10, 20, and 30 words per minute knew (from their muscular sensations alone) when they had struck the wrong key only 20, 30, and 40% of the time.

Personal Characteristics Pertaining to Typewriting

Age. Kaser (1984) taught K-3 and 4-6 graders a summer school keyboarding course and found 75% of the third graders could type without looking at their hands. Their speed was 15-25 words per minute. Kaser concluded that K-2 graders were too young to start, as their attention span was too short, and their finger dexterity and hand size were drawbacks for proper learning of the keyboard. Eighty percent of the 4-6 graders typed between 20-40 words per minute without looking at their hands. Headley (1983) worked with fifth graders and concluded that the motor skills, reading skills, and general interest and motivation were good at that age. She found students at this age enjoyed competition and could race with themselves to improve their skill levels.

Children between the ages of five and eight mastered typing skills during a study (Cowles, 1984) designed to examine the relationship between typing skill development and motor proficiency. A sample of 24 children were administered the Bruininks-Oseretsky Test of Motor Proficiency to measure their gross and fine motor skills. The students were placed in a 30-minute touch typing class for ten days. Results indicated young children could learn to type correctly without frustration. Seven- and eight-year-olds experienced success with words and sentences and stayed with the task; five- and six-year-olds progressed to words only. Gross and fine motor proficiency were highly related to the success of the older children. An experimental class (Kaake, 1983) of 26 normal and learning disabled elementary students enrolled in an 11 week course in touch typing. The program was based on the game principles set down in "Typing Fun" (Switzer, 1977). The games were designed to give incentives to type each set of letters, words, or phrases with actual playing of a sport from start to goal. By the fifth week, six students had learned the letters by touch, and by the end of the course, all students mastered the keyboard. Informal reading and spelling pre-tests and post-tests were given to each child with favorable results.

Reaction time. A personal motor trait which has been measured in numerous skill studies and which has been viewed as a component of skill performance was reaction time. Clarke (1975) stated the ability to react quickly to a stimulus was, in part, due to the intrinsic

speed with which a given muscle can contract. A significant correlation existed between typewriting rate and the difference between the reaction time of the hands (Hayes, Wilson, & Schafer, 1977). The skilled typists in this study had significantly faster times for the right hand than for the left. Reaction times on each of the eight fingers were obtained and found from the slowest to the fastest fingers were L4, L3, L1, L2, R1, R2, R3, R4. (L4 = left little finger, R4 = right little finger).

Handedness. A large number of left-handed students use materials and equipment prepared for right-handed students (White, 1986). Many typewriting desks were built with a drawer or shelf on the right side of the desk. Typewriters were put on the left side of the desks while students were told to position the copy materials on the right. A particular hand or finger used to operate certain parts of the typewriter originated from the location of the specific mechanism on the manual typewriter. Electric typewriters are free of obstructive parts on both the left and right sides of the machine, and studies indicate (Wanous, 1980) no significance in the preference to which hand to use to put the paper in, or which thumb to use on the space bar. Ross (1982) concluded that recent research conducted at the Center for Occupational Education in Newark, New Jersey, produced evidence that the position of material to be typed was an important variable in the skills acquisition rate of beginning typing students. The research has shown that changing the position of the copy when

typing can have a significant impact on the typing speeds of certain types of learners. Hunter (1976) stated that individuals may be born with a predisposition to use their right or left brain. A stimulus in the left visual field was sent through the right side of each eye and was processed in the right hemisphere, and a stimulus in the right visual field was sent through the left side of each eye and was processed in the left hemisphere. Speed advantages for words were found much greater for the right visual field than for the left visual field, and subjects responded faster to letters presented in the right visual field because information is relayed directly to the left hemisphere, the center for verbal information (Olson, 1977).

Typewriter vs. Computer

Computers have become an important tool in education since one-half of the labor force hold information-related jobs; and, in 1981, over 75% of all occupations dealt with computers in some way (Molnar, 1981). Computers have become an integral part of the school curriculum and have been used at all levels of education. Students at every age work with the computer in some way and have developed their own system for learning the keyboard. Most students use the "hunt and peck" method when using the keyboard (Headley, 1983). To avoid bad keystroking habits, elementary schools have introduced keyboarding courses to develop touch typing skills. A study (Gades, 1986) to determine the effects of computer use on keyboarding technique and skill concluded that working with a computer prior to

taking a keyboarding course has no adverse effect on keyboarding technique on post-secondary students in a beginning keyboarding course without affecting speed or accuracy.

Ober (1986) studied the differences between keyboarding and typewriting and found keyboarding was the act of placing information into various types of equipment through the use of a typewriter-like keyboard. He described the focus of a keyboarding course was on input rather than output. There were differences in error correction and machine adjustments. Both keyboards are so similar students can develop competent skills on either and make the change. A four-week experimental study (Lindsay, 1983) was conducted with 105 high school students in four introductory typewriting classes of a large urban school in British Columbia during the 1981 spring semester. The purpose of the study was to compare the effectiveness of teaching the skill-building components of typewriting speed and accuracy using either a microcomputer or the electric typewriter. Results indicated the microcomputer was as effective as the electric typewriter in increasing student speed levels and accuracy scores considering factors of sex, age, and class attended. Hinson and Dickey (1984) found that students could learn the keyboard just as thoroughly and just as rapidly with a computer keyboard as with a typewriter keyboard. Students were more flexible and willing to meet the challenges of change than were the teachers.

The Typewriter as an Aid in Education

Elements of language, e.g., spelling, punctuation, capitalization, and the information in the material typed are both learned while typing (Bernstein, 1982). Dawley (1974) worked with a group of 105 beginning typewriting students on a study involving incidental learning. Students learned how to type and automatically absorbed some of the material they were typing. Cooper (1980) examined studies showing the parallel between speech and typing in the kind of motor planning used, indicating the perception of syntactic cognates and the subvocalized rehearsal while typing. The typewriter was used as an aid to ESL instruction (Bernstein, 1982). The use of the typewriter as part of the language learning experience at first appeared to involve only incidental learning; but, in practice, became an integral part of the acquisition process, a motivating force, a feedback link, and a means of improving the intentional learning of language. A pilot study (O'Hara, 1968) in Houston, Texas, was designed to improve reading and language art skills while learning to type. Typing seemed to stimulate a shy student or a slow learner because he/she realized this was a task they could master. Areas of improvement were in work habit, self-confidence, and attitude toward school. In the California Diagnostic Reading Test, both vocabulary and comprehension scores increased from 7 months to 1 year, 7 months.

Ten classes of learning disabled children were selected from the special education population of a suburban public school in Montgomery, Maryland. This study (Campbell, 1973) assessed two reading

instruction aids that required different degrees of eye-hand coordination with regard to their effects on acquisition of early reading skills. Handwriting and typewriting were used to see if psychomotor training was a gain to reading skills more than handwriting. It was concluded that typewriting, by offering more facilitating experiences (more sustained attention, more responsive and less threatening environment), contributed more positive help to learning to read than handwriting.

Predictors of Typing Skill

The majority of studies on the prognosis in typewriting were done in the 1920s and 1930s, with over 70% of the studies reported before 1940 (Robinson, 1968). There were four areas the prognosis of typewriting were classified under. They were (a) mental traits or native capacities, such as intelligence; (b) mental skills, such as reading, spelling, math, and general knowledge; (c) motor abilities, such as eye-hand coordination, tapping speed, and reaction time; and (d) personal factors, such as age, grade, vocational, interests and purpose in learning to type.

Foss (1963) found IQ scores were closely related to individual speed performance and concluded that the higher the reading rate in words-per-minute, the higher the speed performance. Intelligence and reading ability tests (Eckert, 1966) were correlated with typewriting speed and accuracy. The tests were the Otis Quick-Scoring Test of Mental Ability, the California Test of Mental Maturity, the Differential Aptitude Tests, and the Iowa Tests of Educational

Development. There was little relationship between intelligence and reading ability to typing speed. In an experimental program conducted at South Salem Oregon High School (Ivarie, 1963), a moderate relationship was found between spelling ability and typing speed and accuracy. There was a high relationship between improvement in spelling ability and typing speed ability over a one-year period.

The Tapping Test (Flanagan & Fivars, 1963) was given to 1,400 students who used small adhesive-backed felt dots which were pasted to the fingers. The dots were saturated from moisture tablets of water color. The moisture dots were transformed by tapping the finger against a series of circles printed to simulate a keyboard. The results of the test showed a high relationship with typing scores on a five-minute timed test.

A Kinesthetic Sensitivity Test (Olson, 1980) was found to be used on the first day of typewriting class as a prognostic aptitude test for predicting straight-copy typewriting speed during any six-week period of the school year. The instrument could best be used for prediction of stroking errors during the first six-week period.

A study (Cleaver & O'Connor, 1984) evaluated the validity of the use of digital dexterity and reaction time as variables to predict students' gross typing speed. To gather data for the study, researchers tested 120 students from three typing classes at Jefferson Community College in Louisiana and one typing class at the University of Louisville (Kentucky). In the first test, researchers used an electronic stopwatch, hand-held counter, and a digital computer to

measure the digital dexterity of students entering the classes. The second test involved the use of a digital computer to measure the students' reaction time, ability to use their fingers independently, and speed at typing three random characters. Based on the results of the first test, it was concluded that little correlation exists between gross typing speed and digital dexterity. After correlating the results of the second test with students' gross typing speed, after the completion of a one-semester course, the researchers determined that reaction time and the ability to use fingers independently had moderate correlation coefficients with gross typing speed. The ability to type three random characters was moderately correlated with typing speed.

Affective behavior seemed to be "conditioned" with the results of a study (Tucker, 1959) that indicated success in typing correlated positively and significantly with the qualities of restraint and good personal relations and negatively and significantly with aggressiveness.

Chapter 3

PROCEDURES AND METHODS

The purpose of this study was to examine the relationship between the WJPEB, BES and a student's personal characteristics with measures of typing skill.

Subjects

The subjects of this study were students who have been placed at the St. Cloud Children's Home. The Children's Home, located in St. Cloud, Minnesota, has been licensed through the Department of Welfare as a residential treatment facility for emotionally disturbed youth. The Children's Home and the school, part of the Special Education Department of District 742, have a unique and dependent relationship. It was felt neither the "home" nor the "school" could do an adequate job of meeting students' needs if both were not involved in follow-through of treatment and educational needs.

The teaching staff consisted of 13 full-time teachers, one school social worker, one diagnostician, a special education coordinator and a part-time psychologist. All school staff are licensed in content teaching areas as well as learning disabilities (LD) and/or emotional behavioral disorders (EBD).

There are 84 children, ages 8 through 18 residing at the Children's Home when at capacity. Each of the seven cottages has 12

students in residence. There are two adolescent boys' cottages, two adolescent girls' cottages, two adolescent co-educational cottages and one pre-adolescent co-educational cottage. All the elementary-aged students (grades 3-6) live in the pre-adolescent co-educational cottage and attend school at South Elementary School. These students are initially placed in a self-contained resource room at South Elementary School with teachers from the Children's Home, and mainstreamed into regular classes as soon as possible. The on-grounds curriculum covers all secondary (7-12) grade levels and include course offerings in English, social studies, mathematics, science, industrial arts, home economics, business education, career education, art, remedial reading, and driver's training.

This alternative educational program's the main focus was on recognizing and providing for the unique needs of each student. The main objective has been to return students to a public school setting while still in residence. All students are given a full-time school schedule and receive credit for work completed. Class sizes range from one to six students. Small classes provide an opportunity for teachers to focus on behavioral issues as well as instructional objectives. Individualization and small group instruction were used to adapt functional levels, course content, and teaching methods as students vary in skills, abilities, and needs.

The 30 subjects in this study were students in three sections of beginning typing class. Each 45-minute class was co-ed and made up of students in grades 7-11 who had no previous typing instruction. These

students were in typing for at least a nine-week period between the beginning of the 1985-86 school year and the first semester of the 1986-87 school year.

Description of the Instruments

Three measuring instruments were used in this study. The Woodcock-Johnson Psycho-Educational Battery (WJPEB), the Behavior Evaluation Scale (BES), and a series of one-minute typing speed tests, obtained from Century 21 Beginning Typewriting Textbook.

The Woodcock-Johnson Psycho-Educational Battery. The WJPEB was utilized as a data-gathering instrument. It has been used as an individually administered, wide-age-range, comprehensive set of standardized tests measuring cognitive abilities, scholastic aptitudes, academic achievement, and scholastic and non-scholastic interests. It was normed from age 3-80 (Hessler, 1982). It has been used at the St. Cloud Children's Home to compare a student's scholastic aptitude and actual achievement.

The Battery has three parts. Part I, Tests of Cognitive Ability, measures a student's performance in perceptual speed, memory, reasoning and verbal skills.

The perceptual speed test required visual processing and visual discrimination ability. The student must note essential details in an automatic and fluent manner in visual scanning. Speed is essential. The spatial relations and visual matching sub-tests are used to determine perceptual speed.

The memory skills test reflect the ability to sequence, process and retain the information they hear by demonstrating mental alertness, attention and concentration. The memory for sentences and numbers reversed sub-tests are used for this test.

The reasoning skills score reflects the student's intellectual foresight for "thinking through" the present problem by using mental processing. There are four sub-tests used in determining this score. They are the antonyms-synonyms, analysis-synthesis, concept formation and anologies sub-tests.

The verbal skills section suggest general vocabulary and understanding of word meanings. The sub-tests used were picture vocabulary, antonyms-synonyms and analysis-synthesis.

Part II assesses five areas of academic achievement. They include reading, math, written language, knowledge and skills. Part III measures scholastic interest and non-scholastic interest.

The test has been administered to students during their first month of placement. It has a reliability coefficient of .93.

The Behavior Evaluation Scale. The Behavior Evaluation Scale was developed in 1983 in response to numerous requests for such an instrument from school personnel who were experiencing difficulty in reaching and documenting decisions regarding diagnosis, placement, and programming for children and adolescents with behavior disorders/emotional disturbances. It was designed to be used as a general behavior rating scale with any regular class or special

education student who has exhibited behavior problems which warrant assessment and intervention (McCarney, Leigh, & Cornbleet, 1983).

The standardization sample consisted of 1,018 students across all grade levels from ten different states representing each of the four major geographical regions in the United States. The test was made up of 52 items which represent specific observable and measurable behaviors. The items were rated using a scale ranging from 1 (Never or Not Observed) to 7 (Continuously Throughout the Day). Each item was associated with one of five subscales:

1. An ability to learn which cannot be explained by intellectual, sensory, or health factors.
2. An inability to build or maintain satisfactory interpersonal relationships with peers and teachers.
3. Inappropriate types of behavior or feelings under normal circumstances.
4. A general pervasive mood of unhappiness or depression.
5. A tendency to develop physical symptoms or fears associated with personal or school problems.

A standard score was obtained from each subscale and recorded on a student's profile. The amount of time necessary to administer the test was between 10-20 minutes. The coefficient reflecting the reliability of this test was .96.

Typing speed tests. A series of typing speed tests were given in paragraph form and contained all the alphabetic letters the student had learned. The Gross Words a Minute (GWAM) method with a five-error

limit was used for determining speed. Five spaces, including letters, punctuation and space, equaled one word per minute. Each speed test was one minute in length. The speed tests were taken from the Century 21 Beginning Typewriting Textbook published by Southwestern Publishing Company.

Collection of Data

The WJPEB standard scores were taken from student files. All cognitive sub-tests were administered by licensed educational psychologists. The achievement battery was administered by our school diagnostician. The age of this data varied from one to six months.

The BES scores were obtained from two teachers, typing and math. Each teacher had the student in their class for at least a nine-week period. Personal characteristics on each student were taken from student files. The characteristics included age, grade, sex, handedness, and medication status. The medication included drugs prescribed for all behavior disorders, seizure control and depression.

The scores on typing speed tests were recorded on a bar graph. The graph included their typing speed (GWAM) and the current date of the test. Each student began taking speed tests when they had learned most of the alphabetic keyboard, and continued taking them until the end of the ninth week of class. During the nine-week period, students worked through the same curriculum at an individual pace. The class hour was structured to maintain optimum "on task" behavior. The speed tests were administered three times a week (Monday, Wednesday and Friday) during the last ten minutes of a forty-five minute class

period. The highest speed during the nine-week period was the score used for determining the GWAM. The week, during the nine-week period, a student reached their highest speed (GWAM) was the score used for Rate of Acquisition.

All scores were placed on a master data sheet and included 45 independent variables and two dependent variables. The analysis of the data was done in the Computer Center at St. Cloud State University. The descriptive statistics for all variables included mean scores and their subsequent standard deviation.

The relationship between the independent variables to each of the two dependent variables were analyzed by using the Pearson Product Moment Correlation. Since the major objective of the study was to see if a relationship exists between the WJPEB, BES, and personal characteristics with typing speed (GWAM) and rate of acquisition, step-wise multiple regression was used. A multiple regression equation was developed to obtain predicted GWAM and Rate of Acquisition scores.

Chapter 4

RESULTS

This study examined the prediction of typing skill acquisition from data available in student records. The data gathered from the scores of 30 students, in grades 7-11, who were in beginning typewriting class for their first nine weeks of typewriting instruction. The data were divided into three sections: population descriptors, intercorrelates between the descriptors, and multiple correlates.

Population Descriptors

This section describes the population in terms of demographic facts, mean and standard deviations of the Behavior Evaluation Scale, Woodcock-Johnson Psycho-Educational Battery and measures of typing skill.

The percentages of demographic facts are presented in Table 1. They include the areas of age, grade, sex, handedness and medication status. The highest percentage of students (34%) were 15 years old. Thirty-seven percent were in the ninth grade. There were an equal number of males and females in this study. Right-handed students made up 93% of the population and 53% were on medication.

Table 1

Student Characteristics

Total N = 30	N	%
Age		
13 years old	4	13%
14 years old	4	13%
15 years old	10	34%
16 years old	9	30%
17 years old	3	10%
Grade		
7th grade	5	17%
8th grade	4	13%
9th grade	11	37%
10th grade	6	20%
11th grade	4	13%
Sex		
Male	15	50%
Female	15	50%
Handedness		
Right	28	93%
Left	2	7%
Medication		
On medication	16	53%
Off medication	14	47%

A summary of the descriptive statistics of mean scores and their relative standard deviations for student scores on the Behavior Evaluation Scale in typing and math class are shown in Table 2. It can be seen that there is little difference in scores when a student was evaluated in typing and math class.

Table 2

Means and Standard Deviations of the Behavior Evaluation Scale in Typing Class and Math Class

Behavior Evaluation Scale N = 30	Typing		Math	
	Mean	SD	Mean	SD
Subscale				
1. Learning Problems	7.2	2.4	6.7	2.8
2. Interpersonal Difficulties	4.0	2.7	5.2	2.8
3. Inappropriate Behaviors	5.2	2.4	5.4	2.4
4. Unhappiness/Depression	4.4	2.7	5.0	2.7
5. Physical Symptoms/Fears	4.0	3.0	4.9	2.4
Behavior Quotient	63.7	20.2	67.0	20.6

A summary of the descriptive statistics of mean scores and their relative standard deviations for student scores on the Woodcock-Johnson Psycho-Educational Battery can be seen in Table 3. These scores were divided into age and grade levels. The standard deviations in grade scores were higher than age scores.

Table 3

Mean and Standard Deviations of Student Scores on the Woodcock-Johnson Psycho-Educational Battery Including Age and Grade Levels (Standard Deviation = 15)

	Age		Grade	
	Mean	SD	Mean	SD
Full Scale	86.2	14.6	85.0	16.3
Verbal Ability	87.2	17.0	86.2	17.7
Reasoning	87.3	12.8	86.9	13.4
Visual-Perceptual Speed	90.6	17.9	89.9	19.1
Memory	88.2	12.7	86.2	19.6
Reading Aptitude	88.3	14.5	95.4	43.4
Math Aptitude	85.0	14.7	88.9	27.9
Written Language Aptitude	85.7	13.8	97.7	79.0
Knowledge Aptitude	85.0	15.1	81.7	21.2
Reading	86.7	13.1	88.2	15.0
Mathematics	84.9	13.7	88.0	27.4
Written Language	84.3	12.9	93.9	61.2
Knowledge	80.7	15.8	80.4	19.9
Skills	84.9	12.9	84.0	13.3

A summary of the descriptive statistics of mean scores and their relative standard deviations for student scores on Gross Words a Minute

and Rate of Acquisition are presented in Table 4. It can be seen that the mean typing speed is 21.3 Gross Words a Minute and the mean Rate of Acquisition is 7.9 weeks.

Table 4

Means and Standard Deviations for Measures of Typing Skill

	N	Mean	SD
Gross Words a Minute (GWAM)	30	21.3	8.5
Rate of Acquisition	30	7.9	1.1

Intercorrelates Between the Descriptors

This section presents the linear correlates between student demographic facts, Behavior Evaluation Scale, and Woodcock-Johnson Psycho-Educational Battery scores with measures of typing skill.

The relationships between scores on Personal Characteristics with measures of typing skill can be seen in Table 5. These scores were analyzed by using the Pearson Product Moment Correlation. A student's sex had the highest positive correlation ($r = .217$) with Gross Words a Minute, and it also had the highest negative correlation ($r = -.366$) with Rate of Acquisition. Weak correlation coefficients are seen in all areas of this table.

Table 5

Relationships Between Scores on Personal Characteristics and Measures of Typing Skill (Gross Words a Minute and Rate of Acquisition)

	Correlation Coefficient	
N = 30	GWAM	RATE OF ACQ.
Age	.085	-.047
Grade	.108	-.295
Sex	.217	-.366
Handedness	.006	.261
Medication	.093	-.187

The relationships between scores on the Behavior Evaluation Scale in typing and math class with measures of typing skill analyzed by the Pearson Product Moment Correlation, are shown in Table 6. The subscales of the Behavior Evaluation Scale have moderate positive relationships with Gross Words a Minute. Learning Problems (math) has the highest positive relationship with r = .528. The Learning Problems (typing) subscale has the highest negative relationship (r = -.457) with Rate of Acquisition.

Table 6

Relationships Between Scores on the Behavior Evaluation Scale and Measures of Typing Skill

N = 30	Correlation Coefficient GWAM	RATE OF ACQ.
Subscale (Typing)		
1. Learning Problems	.317	-.457
2. Interpersonal Difficulties	.354	-.227
3. Inappropriate Behavior	.222	-.390
4. Unhappiness/Depression	.220	-.322
5. Physical Symptoms/Fears	.173	-.405
Behavior Quotient	.355	-.380
Subscale (Math)		
1. Learning Problems	.528	-.290
2. Interpersonal Difficulties	.363	-.160
3. Inappropriate Behavior	.365	-.450
4. Unhappiness/Depression	.371	-.240
5. Physical Symptoms/Fears	.264	-.425
Behavior Quotient	.462	-.343

The relationships between scores on the Woodcock-Johnson Psycho-Educational Battery (age and grade levels) with measures of typing skill analyzed by the Pearson Product Moment Correlation, are presented in Table 7. When one examines the Visual-Perceptual Speed scores on the Woodcock-Johnson Psycho-Educational Battery in both age and grade, it can be seen that there is significant correlation of .737 (age) and .724 (grade) with Gross Words a Minute. High positive relationships with Gross Words a Minute can also be seen in the areas of Written Language Aptitude (age) $r = .616$, Math Aptitude (age) $r = .603$, Memory (age) $r = .594$, and Mathematics Achievement (age) $r = .580$.

When observing the Rate of Acquisition correlation coefficients, there are very few moderate positive relationships. Memory (grade) has the highest correlation with $r = .427$, followed by Knowledge (grade) $r = .348$, and Knowledge Aptitude (grade) $r = .317$. It can be seen that most of the independent variables have moderate negative relationships with Rate of Acquisition. The highest negative relationships are Written Language Aptitude (grade) $r = -.686$, Reading (grade) $r = -.684$, Written Language (grade) $r = -.671$ and Reading Aptitude (grade) $r = -.655$. A high score in one of these areas seem to have a negative correlation with Rate of Acquisition. Students with high scores in these areas achieve their highest typing speed in fewer weeks.

Table 7

Relationships Between Scores on the Woodcock-Johnson Psycho-Educational Battery (Age and Grade Levels) and Measures of Typing Skill (Gross Words a Minute and Rate of Acquisition)

N = 30	Correlation Coefficient			
	Gross Words a Minute		Rate of Acquisition	
	Age	Grade	Age	Grade
Full Scale	.563	.536	-.248	-.162
Verbal Ability	.211	.204	-.245	-.194
Reasoning	.409	.388	.007	.092
Visual-Perceptual Speed	.737	.724	-.297	-.227
Memory	.594	.513	-.259	.427
Reading Aptitude	.319	-.048	-.257	-.655
Math Aptitude	.603	.212	-.264	-.601
Written Language Aptitude	.616	-.066	-.304	-.686
Knowledge Aptitude	.471	.463	-.263	.317
Reading	.386	-.121	-.265	-.684
Mathematics	.580	.204	-.149	-.567
Written Language	.482	-.065	-.259	-.671
Knowledge	.343	.381	-.253	.348
Skills	.494	.483	-.303	-.360

Multiple Correlates

This section presents the coefficients of multiple correlation and multiple determination of demographic facts, Behavior Evaluation Scale and Woodcock-Johnson Psycho-Educational Battery scores with measures of typing skill. A Multiple Regression Equation was then found and implemented to determine the predicted typing acquisition scores. An efficiency table was set up to determine how efficient the Multiple Regression Equation was.

As shown on Table 8, a stepwise multiple regression was employed to find the percent of common variance between the scores of five independent variables and typing speed (GWAM). Visual-Perceptual Speed (Age) was the most significant with a r = .737 and a 54% common variance with Gross Words a Minute. A moderate, yet consistent, increase in percent was observed when adding Reading Aptitude (grade), Learning Problems (BES--Math), Knowledge (age) and Physical Symptoms/Fears (BES--Typing). An 81% common variance was seen when adding these variables to Visual-Perceptual Speed (age).

The percent of common variance shared between the scores of three independent variables and Rate of Acquisition was 67% as seen in Table 9. Written Language Aptitude (grade) had the highest correlation with a r = -.686 and a 47% common variance. When adding medication and a student's sex, the percent substantially increased.

Table 8

Coefficients of Multiple Correlation and Multiple Determination of Personal Characteristics, BES, WJPEB Scores with Typing Speed (GWAM)

Step	Variable Entered	N	Multiple R	Multiple R^2
1	Visual--Perceptual Speed (age)	30	.737	.542
2	Reading Aptitude (grade)	30	.818	.670
3	Learning Problems (BES--Math)	30	.850	.722
4	Knowledge (age)	30	.880	.775
5	Physical Symptoms/Fears (BES--Typing)	30	.903	.815

Table 9

Coefficients of Multiple Correlation with Multiple Determination of Personal Characteristics, BES, WJPEB Scores with Rate of Acquisition

Step	Variable Entered	N	Multiple R	Multiple R^2
1	Written Language Aptitude (grade)	30	.686	.470
2	Medication	30	.755	.570
3	Sex	30	.823	.678

The contribution of independent variables to the Multiple Regression Equation for Gross Words a Minute are shown in Table 10. Five independent variables were added to the equation. Visual-Perceptual Speed (age) had the highest simple correlation ($r = .737$) with Gross Words a Minute, so it was added first. It had a 54% common variance and a F ratio (ratio of explained mean scores to unexplained mean scores) of 33.251. Reading Aptitude (grade) was then added to the equation increasing the common variance to 67% and decreasing the F ratio to 27.446. When adding Learning Problems (BES--Math), Knowledge (age), and Physical Symptoms/Fears (BES--Typing) to the equation, the F ratio decreased minimally. No other variables met the .05 significance level for entry into the equation.

The contributions of three independent variables to the Multiple Regression Equation for Rate of Acquisition were presented in Table 11. Written Language Aptitude (grade) had the strongest negative correlation with $r = -.686$ so was listed first. There was a 47% common variance with an F ratio to 24.913. When adding Medication to the equation, the F ratio decreased to 17.960. A student's Sex was added to the equation and showed a 67% common variance, but the F ratio increased to 18.304. No other variables met the .05 significance level for entry into the equation.

Table 10

Contributions of Independent Variables to the Multiple Regression Equation for Gross Words a Minute

Step	Variable Entered	*Equation	R^2	F Ratio
1	Visual-Perceptual Speed (age)	$y' = -10.69885 + b_1 (.35293)$	.542	33.251
2	Reading Aptitude (grade)	$y' = -9.84721 + b_1 (.42380) + b_2 (-.07626)$	.670	27.446
3	Learning Problems (BES--Math)	$y' = -10.5856 + b_1 (.37224) + b_2 (-.07302) + b_3 (.758)$	.722	22.589
4	Knowledge (age)	$y' = -17.68446 + b_1 (.31457) + b_2 (-.08756) + b_3 (1.00255) + b_4 (.14943)$	.775	21.530
5	Physical Symptoms/Fears) (BES--Typing)	$y' = -18.53667 + b_1 (.28213) + b_2 (-.07883) + b_3 (1.78098) + b_4 (.16716) + b_5 (-.87019)$	.815	21.274

(.05 significance level reached)

*Equation $y' = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$

y' = Predicted Gross Words a Minute
a = constant
$b_1 - b_5$ = independent variables
x = beta scores

(b_1 = Visual-Perceptual Speed)
(b_2 = Reading Aptitude)
(b_3 = Learning Problems)
(b_4 = Knowledge)
(b_5 = Physical Symptoms/Fears)

Table 11

Contributions of Independent Variables to the Multiple Regression Equation for Rate of Acquisition

Step	Variable Entered	*Equation	R^2	F Ratio
1	Written Language Aptitude (grade)	$y' = 8.87633 + b_1\ (.00965199)$	.470	24.913
2	Medication	$y' = 9.98980 + b_1\ (-.01047) + b_2\ (-.70484)$	.570	17.960
3	Sex	$y' = 11.31906 + b_1\ (.00977511) + b_2\ (-.88710) + b_3\ (-.75308)$	.678	18.304

(.05 significance level reached)

*Equation $y' = a + b_1x_1 + b_2x_2 + b_3x_3$

y' = Predicted Rate of Acquisition
a = constant
b_1 - $b3$ = independent variables
x = beta scores

(b_1 = Written Language Aptitude (grade)
(b_2 = Medication)
(b_3 = Sex)

The observed Gross Words a Minute and their predicted scores by using the Multiple Regression Equation are presented in Table 12. The efficiency of each score was tabulated by showing how much higher or lower the predicted score was from the observed score. Gross Words a Minute was divided into four levels (30-38, 20-29, 10-19, and 7-9) with the highest speed observed in each level recorded first.

The observed Rate of Acquisition and their predicted scores are recorded in Table 13. The Rate of Acquisition was divided into the four weeks that were observed. They were recorded at a weekly interval from six weeks to nine weeks. The weekly intervals represented how long it took a student to reach their highest typing speed (GWAM). A predicted week was tabulated by using the Multiple Regression Equation. The efficiency of each predicted score was recorded. This score showed how much higher or lower the predicted score was from the observed score.

Table 12

Observed Gross Words a Minute and Their Predicted Scores by Using the Multiple Regression Equation*

Gross Words a Minute (N=30) (Levels)	Observed (GWAM)	Predicted (GWAM)	Efficiency (Dif. of Pred. to Obs. Scores)
30-38	38	38	--
	38	33	-5
	34	29	-5
	34	30	-4
	30	28	-2
20-29	29	21	-8
	29	25	-4
	29	32	+3
	29	25	-4
	26	28	+2
	26	25	-1
	26	27	+1
	26	24	-2
	24	27	+3
	22	16	-6
	20	21	+1
	20	25	+5
10-19	19	20	+1
	19	21	+2
	18	15	-3
	17	21	+4
	16	17	+1
	16	15	-1
	15	18	+3
	13	19	+6
	12	18	+6
	12	6	-6
7-9	8	12	+4
	8	8	--
	7	8	+1

* Equation $y' = -18.53667 + b_1 (.28213) + b_2 (-.07883) + b_3 (1.78098) + b_4 (.16716) + b_5 (-.87019)$

Table 13

Observed Rate of Acquisition and Their Predicted Scores by Using the Multiple Regression Equation*

Rate of Acquisition (Weeks) (N=30)	Rate of Acquisition Observed	Rate of Acquisition Predicted	Efficiency (Dif. of Pred. to Obs. Scores)
6 Weeks	6	8	+2
7 Weeks	7	8	+1
	7	7	--
	7	8	+1
	7	7	--
	7	8	+1
	7	8	+1
	7	8	+1
	7	7	--
	7	7	--
8 Weeks	8	8	--
	8	7	-1
	8	8	--
	8	8	--
	8	8	--
	8	8	--
	8	8	--
	8	8	--
	8	9	+1
9 Weeks	9	8	-1
	9	9	--
	9	9	--
	9	9	--
	9	8	-1
	9	8	-1
	9	8	-1
	9	8	-1
	9	9	--
	9	9	--
	9	9	--

* Equation $y' = 11.31906 + b_1 (.00977511) + b_2 (-.88710) + b_3 (-.75308)$

Chapter 5

DISCUSSIONS

Summary and Conclusions

This study was the result of inadequate teaching methods and materials for students who have difficulty acquiring typing skill. There are also no tangible instruments for proper student diagnosis which can be used to prescribe correct typing materials and set more accurate expectations of beginning typing students in a special education setting. After reviewing the literature, there were no clear methods or instruments evident for teaching students with a variety of different needs.

This study examined the prediction of typing skill acquisition from data available in student records. Student data was collected in the areas of population descriptors, Behavior Evaluation Scale scores and Woodcock-Johnson Psycho-Educational Battery scores. These were correlated with the measures of acquisition of typing skill. A multiple regression was then conducted.

Correlation coefficients using the Pearson Product Moment Correlation are presented in Tables 5, 6, and 7. Moderate to high positive relationships were seen in a variety of scores obtained from the WJPEB and BES with a student's typing speed (GWAM). Visual-Perceptual Speed (age) had the highest positive relationship

with a r = .737. Most of the variables had low to moderate negative relationships with Rate of Acquisition. Written Language Aptitude (grade) and Reading Achievement (grade) had the highest negative relationships with a r = -.686, and r = -.684, respectively. Memory (grade), Knowledge (grade) and Knowledge Aptitude (grade) all had moderate positive relationships.

Stepwise multiple regression determined the percent of common variance between variables and measures of typing skill. An 81% common variance could be shared with five selected variables and typing speed (GWAM). A 67% common variance was found when combining Written Language Aptitude (grade), medication, and a student's sex with Rate of Acquisition.

A Multiple Regression Equation was implemented to determine the contributions the selected independent variables had on each measure of typing skill. An equation was formulated to enter the five independent variable scores to predict a student's Gross Words a Minute. Three independent variables were used to set up an equation to predict Rate of Acquisition.

When using the Multiple Regression Equation for Gross Words a Minute, scores were predicted from two to five Gross Words a Minute lower at the 30-38 speed level. Predicted scores varied at the 20-29 speed level but came close to observed scores. At the 10-19 and 7-9 speed levels, the equation predicted higher scores. This prediction reflects the regression to the mean.

The Multiple Regression Equation was very accurate in predicting a student's Rate of Acquisition. The most accurate predicted week was the eighth week, with seven of the nine scores predicted correctly. The seventh-week period was predicted high and the ninth-week period predicted low. The predicted scores that were incorrect were only one week off in most areas. The exception was the sixth week with a predicted score of eight weeks.

A student's selected test scores and personal characteristics can be used upon entering beginning typing class at the Children's Home. By using the Multiple Regression Equation, a presumed proper diagnosis and a predicted level of typing acquisition can be obtained for each student. Appropriate methods and materials can then be adapted to meet each of the student's individual needs.

Suggestions

Another study should be done using the Multiple Regression Equation in the next round of students at the Children's Home. This will help determine if the predicted scores from the Multiple Regression Equation were obtained by chance. A cross-validation procedure should be used and variables that are no longer related to the criterion measure be taken out.

Other measures of typing skill besides Gross Words a Minute and Rate of Acquisition could be used. Recording the typing errors as a

separate dependent variable should be studied. Longer speed tests, three minute and five minute, could be given to get a more accurate measure of Gross Words a Minute.

Limitations

Because the sample was taken from an elective course in a residential treatment center, only 30 students could be used. The high turnover rate, low enrollment and small classes all attribute to the small sample. A larger sample size should be used in future studies.

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