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The Digit Symbol Subtest of the Wechsler Adult Intelligence Scale as an Indicator of Learning

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THE DIGIT SYMBOL SUBTEST OF THE WECHSLER ADULT INTELLIGENCE SCALE AS AN INDICATOR OF LEARNING

by

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LIFE

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TABLE OF CONTENTS

Chapter		Page
I	INTRODUCTION	1
	Statement of importance of intelligence tests in evaluating human mental abilities--The widespread use of the Wechsler-Bellevue Intelligence Scale--The 1955 revision of the Wechsler-Bellevue--The necessity of investigating the Wechsler Adult Intelligence Scale--Concern of present study--The Digit Symbol subtest of the Wechsler Adult Intelligence Test--Wechsler's claim about the Digit Symbol Test--Specific purpose of this study--Formal hypotheses.	
II	REVIEW OF RELATED LITERATURE	4
	The question of what the Digit Symbol Test measures--Thorndike's use of the Digit Symbol Test as a measure of learning--The Digit Symbol Test as a measure of intelligence--The Digit Symbol Test as a measure of speed--Digit Symbol Test performance as a perceptual-motor activity--Role of incidental learning in the Digit Symbol Test--Importance of motor factor in Digit Symbol Test--Two comparisons of the Wechsler Adult Intelligence Scale and the Wechsler-Bellevue--Doppelt's Short Form of the WAIS--Validities of abbreviated WAIS Scales--Evaluations of the WAIS--Research concerning factors involved in typing; tests constructed to measure abilities necessary to learn typing.	
III	PROCEDURE	27
	Selection of subjects--Administration of Short Form of WAIS and Digit Symbol Test to each subject--Participation of subjects in formal typing course--Evaluation of typing achievement by means of SRA Typing Skills Test--Correlation of Digit Symbol scores and Typing scores--Statistical methods employed.	

TABLE OF CONTENTS (Continued)

Chapter		Page
IV	RESULTS AND INTERPRETATION	32
	Coefficients of correlation found between tests administered in this study--Partial coefficients of correlation found between Digit Symbol scores and Typing Speed and Typing Accuracy scores.	
V	SUMMARY AND CONCLUSIONS	35
REFERENCES	. . . . .	37
FOOTNOTES	. . . . .	40
APPENDIX I	. . . . .	41
APPENDIX II	. . . . .	44
APPENDIX III	. . . . .	45
APPENDIX IV	. . . . .	46

LIST OF TABLES

Table		Page
I	WECHSLER ADULT INTELLIGENCE SCALE IQs, DIGIT SYMBOL SCORES, SRA TYPING SPEED AND TYPING ACCURACY SCORES FOR 40 SUBJECTS	41
II	RANGE OF SCORES, MEANS, AND STANDARD DEVIATIONS FOR TESTS ADMINISTERED IN THE PRESENT STUDY	32
III	COEFFICIENTS OF CORRELATION BETWEEN SCORES OF TESTS ADMINISTERED IN THE PRESENT STUDY	33

INTRODUCTION

Since the beginning of the twentieth century, mental tests have become increasingly popular as aids in evaluating a person's intelligence. These mental tests, first used in the classroom situation, are now being utilized in many other situations. It is not only the teacher who is interested in obtaining an estimate of his students' mental ability, but it is also the employment counsellor who seeks the aid of mental tests and the clinical psychologist who uses psychological tests as aids in diagnosis and treatment. While the users of intelligence tests are interested in procuring an estimate of general intelligence, they are also interested in obtaining estimates of the relative strength and weakness of those separate abilities which contribute to over-all intelligence. Much research has been carried on in an attempt to discover what those abilities are that designate the intelligent human being and how those abilities may be measured.

One of the most recently published and widely used individual intelligence tests is the Wechsler Adult Intelligence Scale (30).[1] This scale is essentially an extension and modification of the original Wechsler-Bellevue Intelligence Scale, Form I, published in 1939 (28).[2] The latter test was designed specifically for the purpose of measuring adult intelligence. Prior to the publication of this test, most intelligence tests in use at that time had been constructed for the purpose of measuring the intelligence of children. Although the W-B fulfilled a need, many criticisms of its inadequacies

led to the publication of the WAIS in 1955 by the Psychological Corporation. The basic structure of the WAIS remains essentially the same as that of the W-B, except for the inclusion of the Vocabulary subtest as a regular rather than an alternate subtest. The improvements in the WAIS include revision of content in the various subtests, redesigning of some test materials, and more exact and simpler methods of scoring and directions.

Because of the improvements made in the original W-B, the new WAIS will probably meet with greater success than the W-B and therefore, will be used extensively. Because of this probable widespread use, the writer believes it is necessary to study the WAIS and obtain as much information as possible about this scale. It is important to investigate all aspects of the WAIS in order to determine if the scale is what its author purports it to be.

The present study is concerned with one part of the WAIS, the Digit Symbol Subtest (30).[3] A DS was included in the original W-B. This test is frequently used as a test of intellectual ability and, specifically, as a measurement of new learning ability. According to Wechsler, this subtest requires the subject to associate a certain symbol with a given digit (one of the numbers from one to nine) and the "speed and accuracy with which he does it serves as a measure of his intellectual ability"(28, p. 94). Wechsler also suggests that low scores made on this subtest by patients with organic disturbances are chiefly a result of impairment in new learning ability (28, p. 154).

In the WAIS, the 1955 revision of the W-B, a DS is also included. A few changes have been made to improve the subtest, such as, the number of items has been increased from sixty-seven to ninety, the reversed "N" symbol which

resulted in many half scores on the W-B has been replaced by an upside-down "T," half scores are no longer obtainable, one point is received for each symbol drawn correctly, there is better spacing of symbols, each symbol is used the same number of times, and the digit distribution is more equal in order and frequency of appearance in the test series. However, the basic structure and instructions of the DS remain the same. The purpose of the DS also remains the same. Wechsler implies that, as in the W-B, performance on the DS of the WAIS serves as a measure of new learning ability. Wechsler admits the importance of considering the motor speed factor when evaluating performance on this subtest. However, he believes that "speed as well as power should be given weight in the evaluation of intelligence" since the reduction in the DS performance of older persons "is on the whole proportional to the subject's over-all capacity at the time he is tested." (29, p. 81)

The purpose of this study is to attempt to discover if DS performance on the WAIS is indicative of new learning and, more particularly, if it is indicative of learning a manipulative skill, such as, typewriting.

It is hypothesized that if DS performance is indicative of new learning, then higher than average DS scores on the WAIS will be indicative of higher than average skill in learning typing. Also, then, lower than average DS scores on the WAIS will be indicative of lower than average skill in learning typing and average DS scores will be indicative of average skill in learning typing.

Besides the possibility of verifying Wechsler's statement concerning the value of including the DS in the WAIS, this study may also be of value in that it may provide a specific demonstration of the diagnostic usefulness of the DS.

CHAPTER II

REVIEW OF RELATED LITERATURE

A survey of the experimental literature in search of information reveals that the question of what the DS measures has been a subject of disagreement for some time. Thorndike (27) cited the digit symbol test as the only test of learning ability that had been used as a measure of intelligence up until 1926. He believed that the task was one of learning based on the amount of substitutions done correctly in a given time. This amount depended largely on how quickly and accurately the individual learned the key. Of course, a question arises here. Thorndike could be asked, "Are associations being formed?" "Is the amount of substitutions made actually the number of associations learned?" "Couldn't the digit symbol test be more of a motor test than a test of learning?" These are all considerations for debate and study.

Greene (12) also stated that learning takes place in the digit symbol test but it is a slow process. He noted that when the subject tried to learn, he slowed down in substituting symbols. Since the digit symbol test is affected by the speed of learning, this question arises: Does the subject's final score on this test give a measure of actual learning of associations or merely placing of associations, in which in the latter case, no real learning is involved? If shortness of the testing interval makes it an inadequate measure of learning, then if this were increased, learning would manifest itself. Anastasi (1) found that as practice proceeds tests of this kind, the

samples of the aspect of behavior measured becomes more adequate.

In a study in 1928 by Levine and Marks (15) on methods for measuring the cheating type of deceptive behavior in the testing of non-intelligent traits, the digit symbol test was included as one of the oldest psychological "speed" tests together with others, such as, cancellation of a's. If this is merely a speed test and it measures the speed of a subject in a simple motor task, then it cannot also be said to be a test of new learning. The question remains - what does digit symbol test performance measure?

McGeoch (20) relates that digit symbol test performance is determined by set and implicit instructions, and incidental learning may be the function of set. Therefore, incidental learning may be motivated although it more often seems not to be. McGeoch calls digit symbol test performance a perceptual-motor activity since it involves the learning of association between stimulating conditions and overt motor responses which are not primarily verbal. Something might be said in favor of McGeoch's stand. It seems likely that a substitution test is not entirely a learning test but more of a motor test, involving facility in eye-hand movements, eye-hand coordination with the possibility of incidental learning, especially if no significant relationships of a positive nature could be found between those who are performing with the greatest speed on the digit symbol test and those who are learning the associations the fastest. Is the one who is performing with greater speed on the digit symbol test also learning equally fast? The answer to this question would seem to solve the problem regarding what the substitution test measures.

In support of McGeoch's conclusion, Willoughby (31) states that

incidental learning takes place in the digit symbol test. In his experiment, three-hundred subjects were asked to recall symbols in the DS of the W-B, Form I, at which they had been working for 2.5 minutes with the key before them, but without the instructions to connect the symbol with the digit for the purpose of immediate recall. It was found that those subjects in their late teens recalled the most symbols and the amount of recall decreased with subjects of increasing age. Without implicit instructions to learn the substitutions, it appears then that the digit symbol test is more of a test of motor speed with incidental learning rather than a test of new learning of the associative type. However, it should be noted that Willoughby's experiment did not show what his subjects could do under motivation.

Contrary to McGeoch and Willoughby, Rosenweig (25, p. 25), in evaluating the W-B, accepts Wechsler's conclusions regarding the DS and states that "the speed and accuracy with which an individual does the test items of the Digit Symbol Subtest of the Wechsler-Bellevue, Form I Scale measures new learning of the associative type." It should be noted that Rosenweig merely makes a statement of agreement with Wechsler without offering any proof or justification for such agreement.

On the other hand, Rapaport (24) advocates the use of the digit symbol test as a test of psychomotor speed. To check to see if learning has taken place, he recommends that subjects be asked whether they tried to learn the digits and corresponding symbols, or tried to learn to look at the correct place to find the symbol, or whether they did not do either. Rapaport noted that organic injury which impaired motor ability also impaired digit symbol test performance. He also observed that increasing severity of depression

usual directions. Another group was told that they were required to do as many test items correctly as possible as well as learn the code. Another group was told not to learn the code but only do as many items as they could. The fourth group was told to concentrate on learning the code without being concerned about how many test items were completed. In the second part of the experiment, four other college groups (sophomores and juniors in a general psychology course) were used as speed groups. The "speed atmosphere" was intensified and one of the four sets of instructions was used with each group. Remarks aimed at stressing speed were introduced while the groups worked on the digit symbol test. In the third part of the experiment, all groups received the code test consisting of the code key with symbols absent. They were to recall as many symbols as possible in thirty seconds. Then the groups were retested, but the difference was that the code key was absent and no assistance was given in the completion of the first eight squares. The retest directions were the usual DS directions. Luchins and Luchins based their predictions on the following hypothesis: The nature of the assigned task and the introducing of speed factors would influence test scores and learning performance. It was found that, in the group of college students used, intergroup and intragroup differences, many significant at the one per cent level of confidence, tended to be in accordance with the authors' expectations. The experiment verified that what the subject thinks is required of him and his reactions to the need for speed determine his performance. The trend of the test results, as well as the correlation coefficients between various phases of the experimental session, indicated that

the initial test score could not serve as a reliable index of new learning. The experimenters recommended the use of a code test and retest to obtain insight into a subject's performance since they observed their subjects differed in the manner in which they set about to learn the DS code. They also advised the tester to obtain the subject's interpretation of the directions and the manner in which he sets about learning the code since these factors influence his performance level and the test directions can be ambiguous in the sense that they lend themselves to various interpretations by the subject.

Luchins and Luchins designed their experiment carefully. Their procedures are well organized and constructed. Their statistical methods appear adequate. The experimenters have made valid conclusions on the basis of their findings. For the population represented in their study, value may be given to Luchins' and Luchins' statement that an initial digit symbol test score cannot serve as a reliable index of new learning.

When one summarizes the findings regarding what DS measures, one sees that previous experimenters have correlated motor, recall, and learning tests with DS scores and have arrived at conflicting conclusions. However, some of the more reliable experiments seem to indicate that the DS is not a good measure of new learning ability.

In the present experiment, this writer proposes to determine the indicative value of the WAIS DS score with regard to learning a manipulative skill, namely, typewriting. This study will aim to discover the correlation between performance on the DS and the acquisition of typing skill. Since establishing an accurate correlation between DS scores and typing scores will require

partialling out of intelligence (which is assuming intelligence influences the ability to learn to type), it will be necessary to administer an individual intelligence test to obtain an estimate of each subject's intellectual ability. The decision to administer the WAIS and then finally, the selection of a specific short form of the WAIS for administration was based on the following research.

The WAIS, as was mentioned previously, is not a new scale but a modification of the W-B that was developed in order to meet certain limitations of its predecessor. The WAIS has been considered the best intelligence test for adults today. Therefore, a comparison between the two tests seems in order to determine their differences, and to discover the advantages and value of the WAIS. Two such comparisons are cited here.

Cole and Webela (6) administered the W-B and the WAIS to forty-six college students ranging in age from nineteen to twenty-nine years. Although most tests were staggered they report that the WAIS was more often administered as the second test. The IQ's ranged from 105 to 143. Mean IQ's for the first administration were: Verbal Scale 125, Performance Scale 123, and Full Scale 127; mean IQ's for the second administration were: Verbal Scale 127, Performance Scale 130, and Full Scale 130. The greater practice effect was noted on the mean Performance IQ of the second administration. Practice effects, significant beyond the one per cent level, however, were evidenced on all three IQ's of the second test. Practice effects were notably evident on the Picture Arrangement, Object Assembly, and Digit Symbol subtests. One would assume from these findings that the WAIS or W-B should not be used as a retest when either scale has been administered first.

The authors report that the weighted scores on Comprehension and Vocabulary, independent of practice effects, were significantly higher on the WAIS. They presume that this was true of the Vocabulary subtest because the words at the higher end of the WAIS list appeared consistently more familiar to their subjects than those at the higher end of the W-B list. It should be noted, however, that the IQ's of the subjects used in this study appear to tend toward the upper range of intelligence. This factor could be responsible here, although the authors do not specifically state whether the words on the WAIS list simply appeared more familiar or whether the subjects actually obtained more correct answers.

A comparison study using psychiatric patients is that of Goolishian and Ramsey (10). In this study the WAIS and W-B were administered to two different groups rather than to the same individuals. The WAIS was administered to 154 white patients. A second group of 392 white patients was administered the W-B. There was no significant difference in either age or education between the groups.

Significant differences, beyond the one per cent level, were found on five subtests. Arithmetic and Digit Span were higher on the WAIS; Picture Completion, Digit Symbol, and Block Design were significantly higher on the W-B. The Performance and Full Scale IQ's, as a result of the higher scores of the three performance subtests, were significantly higher on the W-B. Difference between Performance Scales were significant beyond the one per cent level, while differences between Full Scales were significant at the one per cent level. Mean Verbal IQ was 103.42 for the W-B and 100.68 for the WAIS; mean Performance IQ was 101.82 for the W-B and 94.99 for the WAIS;

and mean Full Scale IQ was 102.94 for the W-B and 98.53 for the WAIS.

The significant differences on the five subtests appear to be the result of differences between the subtests of each scale. The higher mean scores obtained on the Arithmetic and Digit Span subtests seem to result for changes in subtest content and scoring. The Arithmetic subtest of the WAIS appears to be easier, according to the writers, than that of the W-B, thus accounting for higher scores. The higher scores on the Digit Span subtest of the WAIS, which is identical in content to that of the W-B, appeared to be caused by higher weighted scores being given to performances on the WAIS subtest which were identical to performances on the W-B. The mean scores of these two subtests more closely approximate the mean scores of other Verbal subtests of the WAIS. This was not true, state the writers, with the W-B. They expect that the changes in scoring and content of these two WAIS subtests, which has resulted in greater comparability between Verbal subtests scores of the WAIS, will tend to reduce the drop in scores with anxious and inattentive testees which was so frequently true of the W-B.

Lower scores were obtained on the Digit Symbol, Picture Completion, and Block Design subtests of the WAIS than were obtained on the W-B. According to the writers, this is because the weighted norms have been shifted upward on the WAIS making it difficult for a subject to get a high score. For example, on the Digit Symbol subtest an identical performance receives a higher score on the W-B than it does on the WAIS. On the Block Design subtest of the WAIS no time credits are permitted until the more difficult items are reached, whereas on the W-B, time credits are given throughout.

Time limits of this subtest have been revised downwards on the WAIS which require the subject to complete the designs very quickly in order to earn a bonus score. The Picture Completion subtest of the WAIS has been lengthened and the inclusion of these items apparently has made this subtest more difficult than its predecessor. Weighted scores have also been changed for this subtest. This is especially true in the middle range where at least two correct responses are required to raise the weighted score one point, whereas on the W-B, one correct response in the middle range raised the weighted score by one point. These various factors, according to the authors, were reasons for the significant difference between means of these subtests on the WAIS and W-B.

One can assume, on the basis of this study, that the WAIS is a more difficult test than the W-B. The Verbal Scales appear comparable, but the Performance and Full Scales appear significantly different.

Following publication of the W-B, several studies appeared in the literature regarding short forms of the scale. These short forms usually consisted of different combinations of scores from certain subtests which were used to estimate Full Scale IQ. A short form of a test, if reliable, is often useful where a quick estimate of intelligence is needed when there is not sufficient time nor need to administer the entire test. Because the time element had to be considered in the present study, it was necessary to choose a reliable short form of the WAIS, since the latter test had been chosen as an essential part of this experiment.

Doppelt (7), one of the psychologists employed in the WAIS standardization, devised a short form of the scale based on information obtained from

the records of the 800 subjects of Wechsler's three standardization groups: ages 18-19, 25-34, 45-54. He selected the two best predictors of the total Verbal score (total of scores on six tests of the Verbal Scale) by correlating all combinations of two Verbal subtests with total Verbal score. He found the highest correlation between Arithmetic and Vocabulary subtests and total Verbal score (ages 18-19, .938; ages 25-34, .934; ages 45-54, .948). Following the same procedure with the Performance subtests, the highest correlation was found between Block Design and Picture Arrangement subtests and total Performance score (ages 18-19, .939; ages 25-34, .917; ages 45-54, .926).

The correlation between sum of scaled scores on these four subtests and the Full Scale score was then found for the seven age groups comprising the standardization sample and also for the four old-age groups (60-64, 65-69, 70-74, 75 and over) used in standardization of the WAIS on older persons. The coefficients ranged between .95 and .96. The standard deviation of Full Scale scores was approximately 25; the resulting standard error of estimate was about seven scaled score points, or 4.2 IQ points. Thus, one could expect a Full Scale score estimated by this method to be within seven scaled points of the actual score about two-thirds of the time. Regression equations, based on all age groups, were computed for use in predicting Full Scale score from the four subtest scores. It was found that the predicting variable was similar throughout the age groups and that the constant term of the regression equation varied according to the age of the individual. The predicting variable was set at 2.5 and the constant term

ranged from four to ten, depending upon age.

In order to use the short form, an examiner makes use of a simplified regression equation presented by Doppelt (7, p. 65): Estimated Full Scale Score is equal to 2.5 times the sum of scaled scores on the four subtests plus the constant according to age. For example, the constant added for 16 and 17 year olds is 10.

Doppelt applied his predictive equations to two groups of subjects not used in the original statistical analysis and found that in 71 per cent of his cases the differences between obtained and estimated Full Scale Scores were within one standard error (-7 scaled points); two standard errors (-14 scaled points) contained 96 per cent of the cases.

This short method appears to obtain a relatively stable estimate of the IQ. Doppelt used a presumably normal population. His results can therefore be valuable for the present study.

A short form is also valuable in testing the mentally ill. Olin and Resnikoff (23) and Himelstein (13) have both evaluated the reliability of the short form when used with psychiatric patients.

The first study utilized fifty-four men and forty-nine women patients who had varied schizophrenic and neurotic diagnoses. Mean age of the subjects was 36.5 years. The range of IQ's for the complete WAIS was from 78 to 135, with a mean of 108. Correlation of .925 was found between IQ's obtained from administration of the complete WAIS and IQ's obtained by the short form method. Standard error of estimate was 7.9 scale points which is comparable to that found by Doppelt.

Himelstein's sample consisted of fifty male patients, thirty-five whites and fifteen Negroes, tested upon hospital admission. Mean age of the group was 25.1 years, with a range of twenty-two to sixty-three years. Mean educational level was 8.3 years, with a range of from two to sixteen years. Mean IQ, based on the complete WAIS, was 87.2; mean IQ, based on the short form method, was 85.6. Correlation between IQ's of completed WAIS and those estimated from the short form method was .956; standard error of estimate was 3.5 scale points.

These results from psychiatric samples agree favorably with those obtained from a normal population and suggest that the Doppelt Short Form yields reasonably accurate predictions of IQ. Therefore, on the basis of the above research, Doppelt's Short Form was chosen for administration in this study.

In a study Maxwell (19) attempted to establish the validities of abbreviated WAIS Scales. The validities of all possible abbreviated WAIS Scales of two, three, four, and five subtests were determined in her investigation. Coefficients of correlation between the full WAIS and the sum of the particular subtest scores were computed by a variation of McNemar's formula for validity coefficients by using intercorrelations of the subtests. This r was considered a measure of the validity of the abbreviated scale. The reference group for the study was three-hundred men and women in the 25-34 year age group used in the WAIS standardization. Maxwell concluded from this study that the accuracy of the abbreviated scale in estimating the Full Scale Score increases as the number of subtests in the Scale increases. An optimum point is reached however, at which an increase in scale length brings

about but a slight increase in accuracy. She also found that combinations composed of verbal tests or of performance tests have lower correlations than do abbreviated scales with both types of subtests. However, short verbal scales are superior to performance scales in estimating mental level as measured by whole scales. Maxwell reported too, that abbreviated WAIS Scales have higher correlations with the Full Scale than do the W-B Scales and the best abbreviated WAIS Scales differ in composition from the best abbreviated W-B Scales. Maxwell indicates that the content changes within the subtests, their increased reliabilities and intercorrelations, and the addition of Vocabulary as a formal part of the WAIS Scale are factors operant in these changes. Although Maxwell acknowledges the usefulness of short forms, she warns against the loss of qualitative observations which the administration of a complete scale affords, as well as the decreasing accuracy of the mental level.

Maxwell's study is comprehensive and informative. She reports the twelve best tetrads found and reveals that the range in reliability for these three-hundred and thirty possible combinations extends from .96-.90. Maxwell also shows relative agreement with Doppelt's record of correlation for the scale - Arithmetic, Vocabulary, Block Design, and Picture Arrangement. Doppelt recorded a r of .954 for the scale and Maxwell determined a r of .959 for the scale.

Two evaluations of the WAIS will be cited in this review of the literature. One is by Shafer (26) and the other by McNemar (21).

Shafer thinks that the outstanding improvement of the WAIS is the "all-new Vocabulary list containing mostly verbs, adjectives, and abstract

or 'literary' nouns" (26, p. 157). He regards the W-B Vocabulary as containing many items, such as "guillotine," which overlap Information items, while the WAIS list more directly obtains an idea of the subject's verbal self-expression and defines his verbal organization and communication of experience. On the other hand, he notes that the Information subtest of the WAIS now contains two items overlapping Comprehension ("Why are dark clothes warmer than light-colored clothes? and "How does yeast cause dough to rise?"); and the Comprehension subtest contains three items (proverbs) which overlap concept formation or the Similarities subtest. Thus, he believes, all changes in the WAIS have not been toward achieving greater homogeneity within subtests.

Shafer is critical of the fact that the Digit Span and Arithmetic subtests remain a part of the Verbal Scale. It has been his experience that both subtests are very vulnerable to psychopathology. Often, he states, a much better clinical estimate of the patient's verbal level can be obtained by omitting these two scores and intrapolating. He regrets that the new scale does not include a subtest for the purpose of measuring mental deterioration, such as a measure of immediate memory for meaningful material. He regards neither the Digit Span nor Digit Symbol subtests as being satisfactory in this regard.

McNemar (21), a competent statistician, evaluates the standardization sample of the WAIS as being excellent and believes it a marked improvement over that of the W-B. He accepts the split-half reliabilities presented by Wechsler of the eleven subtests but is somewhat skeptical of the reliability coefficients for Verbal (.96), Performance (.93), reliabilities which may

not be as high on the IQ scales.

McNemar says the author of the WAIS shows no recognition of the vast factor-analysis literature which, if anything, has consistently indicated that a "test constructor should strive for a pure measure of whatever he hopes to quantify. That is, a score should represent a point on a unidimensional scale rather than a hodgepodge of different dimensions" (21, p. 159).

McNemar criticizes the inclusion of the Digit Span and Arithmetic subtests in the Verbal Scale of the WAIS on the basis that these two subtests are not true measures of verbal ability, or, they are not pure measures on a unidimensional scale.

McNemar believes that Wechsler undertook an impossible task in attempting to construct a scale to measure general or, as Wechsler named it, global intelligence which will also provide differences among subtests that will be of diagnostic value. He states that the diversity of content within the eleven subtests is too great and that the intercorrelations between them are too low to satisfy the requirements for a reliable measure of general intelligence. On the other hand, the diversity of the subtests is not great enough, in the factor-analysis sense, to yield the low intercorrelations necessary for reliable difference scores that will be of diagnostic value.

Since this study is concerned with the relationship between DS scores of the WAIS and scores obtained on a standardized typing test, some information will be cited here in relation to typing: research done with regard to factors involved in typing, and tests constructed to measure typing and the abilities presumably necessary to learn typing.

In a study by Flanagan, Fivars, and Tuska (8) a test was designed to measure two of the aptitudes required in learning typing. The test illustrated the application of the job element approach to identifying and measuring two important aspects of typing and related tasks. Hypotheses were formulated with regard to the specific nature of the aptitudes involved in typing. These hypotheses were based on a systematic analysis of the activities involved in typing or the operation of other keyboard machines. Two job elements formed the basis for the rationale on which the present Tapping Test was based. The first of these was the ability to tap with one finger at a time by controlling each finger separately and independently. The second was to learn to respond with a particular finger on perceiving a letter, number, or other type of symbol. It was suggested that the first of the job elements could be tested with items involving simple tapping speed in which the subject simply was required to make dots in circles by tapping with each of four fingers in succession. The second could be measured by having the subject make dots in appropriate circles using the correct finger in accordance with a letter symbol. The first two sections of this test were primarily measures of the first job element, and the last seven sections emphasized the second element, which necessarily involved the first.

The subjects for this experiment were obtained from five classes of pupils who either had no training in typing or had only a few hours of training at the time the test was administered and a small group of high school freshmen and seniors with no typing experience of any kind. There were a total of 115 students in the groups which had had one semester of

typing, 68 in the groups which were just beginning to study typing, and 35 not enrolled in typing courses. The Tapping Test was administered to these groups in December, 1956, and in the Fall of 1957, the Tapping Test was administered to a group of 15 persons with one or more years of experience as employed typists, stenographers and secretaries.

Reliability Coefficients were obtained by correlating the scores on separately timed halves of the Tapping Test for nine typing classes from four separate high schools. The average reliability coefficient for the nine classes was .92.

Measures of the predictive value of the Tapping Test were obtained by comparing the scores on the test with numerical equivalents of grades in typing courses and typing tests scored in terms of words per minute. An average validity coefficient of .53 was obtained.

The authors of this study concluded that the combined reliability, validity, and uniqueness data suggested that the Tapping Test should serve as a desirable device for the screening of aptitudes where training facilities are limited. It was also suggested that it should be useful as a supplement to shorter typing tests for hiring purposes. It would be especially appropriate in cases where the test had to be taken on a machine unfamiliar to the individual, where the person had not been recently employed as a typist, and where various applicants had widely differing backgrounds in terms of training and experience.

As early as 1927, tests for tapping and dotting were used as parts of mechanical aptitude tests. MacQuarrie (18) devised a typing test that consisted of seven rows of circles and an individual was required to place

three dots in each circle as fast as he could. The dotting test required the subject to move his hand from right to left while placing one dot in each of a number of rows of unequally spaced circles.

Klugman (14) studied the relation between scores on tests and graduation from a commercial course in high school. He administered tests to 124 girls entering a commercial high school and found that the 37 who graduated had superior performance on MacQuarrie's tapping tests but did not show significant difference on his dotting test.

In 1946 Barrett (3) employed the same Tapping and Dotting Tests, along with a number of other general clerical tests, to predict achievement in typewriting among liberal arts college students. She administered the tests to 96 students who had registered for typing and used their final grades as the criterion of success. She reported that the Dotting Test differentiated between students with good and poor grades in typing but the Tapping Test did not.

Gottsdanker (11) used dotting test items which were very similar to the MacQuarrie Test but had much shorter time limits. In his "Choice Dotting" test, the subject was instructed to dot certain circles within a given cluster of circles according to a plan which depended on a letter in a previous cluster. The test was designed to measure the functions needed for performing quickly the correct movement at the moment when several movements are possible. Gottsdanker considered it a kind of "memory for details." He reported testing 51 women students in a business college, using examinations in work with machine calculations as his criteria of success. He found that the tapping test had a validity of .25 and the dotting test had a

validity of .21. Neither of these coefficients were statistically significant.

A number of other studies are reported in the literature regarding the effectiveness of these and other types of tests in predicting speed and accuracy in using keyboard machines. However, the results are not very consistent. To summarize previous studies, it appears that tests of the type developed by MacQuarrie in tapping and dotting have only a very small amount of validity for predicting this kind of activity.

With regard to research concerning the SRA Typing Test, which is used as a criterion of typing achievement in this study, little could be found. In fact, a search of the literature revealed nothing. The only information available regarding the test was that on file with Science Research Associates (see Appendix IV). This information was collected by a private company and it wishes to remain anonymous (2).

CHAPTER III

PROCEDURE

The director of Jones Commercial High School was contacted to obtain permission to conduct this project in his school. This school was chosen because its program stresses business education and training of a secretarial nature. Learning to type is therefore an essential part of the training program. After the project was explained to the director and permission was granted to carry out the experiment, the author selected the subjects to participate in the study. Forty, white, female students were chosen from the school record file. The students selected were then asked to volunteer their services for a special project. The students were informed that this was a scientific study and that the results of their performances would in no way influence their school grades. In fact, the names of the persons participating would not be used. All forty students willingly agreed to participate in the project. Each student selected had passed her sixteenth birthday but had not reached her eighteenth birthday. Also, each subject had never had any previous training or formal instruction in typing and did not know how to type by any method, including those methods sometimes devised by a person to teach himself the skill. Each girl was not only beginning a first course in typing, but was also well motivated to learn to type, as was indicated by her voluntary participation in the Jones Commercial

High School program that stresses the learning of this skill. In a separate interview with each subject, individual motivation to learn typing was verified and the factual data mentioned above was confirmed. In order to procur full cooperation and to dispel any fears the subjects might have about participating in this study, the nature of the project, its purpose and procedures were explained to each subject in the private interview. Finally, every girl was encouraged to perform to the best of her ability when taking the tests involved in the project. None of the subjects were known personally by the examiner.

The procedure was as follows:

1. In a small but adequate, seldom-used, quiet, well-lit room in the basement of Jones Commercial High School, the Short Form of the WAIS (for information regarding the specific short form utilized, see previous chapter) was administered to each of the 40 subjects individually in order to estimate intellectual ability, since this is an important factor when any learning is considered. The short form used consisted of the following subtests: Arithmetic, Vocabulary, Picture Arrangement, and Block Design.[4]
2. The second step of the project consisted in administering the DS of the WAIS to obtain a DS score for each subject.
3. The first and second steps were alternated and the tests were administered before the subjects were given an opportunity to learn typing.

The administration of the tests took place over a period of five

consecutive days. The examiner (this author) was experienced in administering the WAIS and followed the instructions exactly.

Most of the questions the subjects had about the tests or the project in general had been answered in the private interview before testing, but if there happened to be further questions, they were answered either before or after the test session. A few of the questions were concerned with what the tests told about a person. A typical answer to a question such as, "Are these tests going to tell you all about me?" was: "The tests measure certain intellectual abilities; they have nothing to do with personality." Some subjects seemed concerned that the tests might show some personality inadequacy. However, they seemed reassured to learn the tests were simply measures of certain mental abilities.

There was no difficulty scheduling a test time for each subject. It was arranged by checking her program card and finding the best possible class period for her to be excused.[5] All that was needed was a written note from the examiner excusing the subject from the one particular class period. The faculty had been informed of the project by the director of the school, so no administrative difficulties were encountered. One class period was forty minutes long, making adequate time for testing.

Following administration of the Short Form of the WAIS and the DS, the 40 subjects began their formal typing course. The course was approximately ten weeks long (one school semester) and it consisted of one forty minute typing class per day. A qualified typing instructor taught, directed, and trained the students in typing. Emphasis was placed on learning the keyboard, copy work, and drill. The manual used by each girl in learning to

type was Modern Typing Practice. The students were requested by their teacher to confine their typing to the forty minute class session per day. The teacher stressed the importance that there be no extracurricular typing practice since she desired the students to master the keyboard in their first typing course before they began practicing on their own.

Upon completion of the typing course, which included instruction, training, and practice in the formal classroom situation, an evaluation of each subject's typing skill was made. Typing achievement was evaluated in terms of speed and accuracy. The SRA Typing Skills Test, Form A, was administered in a group session to the 40 subjects. The subjects assembled in the typing classroom to which they were accustomed and were told this was the final stage of the project they had agreed to participate in ten weeks before. They were reminded that the results of this typing test would in no way influence their typing grades, but they were encouraged to perform as well as they could. Instructions for the SRA Typing Skills Test (see manual in Appendix) were given and the subjects proceeded to take the test.

The SRA Typing Test is a standardized typing test which provides scores in terms of the International Speed Score and an Accuracy Ratio. The test allows for a practice test before the ten minute typing test. Having completed the test, the students were thanked for their cooperation and dismissed. A few students were asked if they had engaged in extracurricular typing practice. Those questioned said they had not, so it was assumed that the teacher's request that there be no extra typing practice had been complied with.

The tests administered were scored and reviewed by this examiner. The Short Form of the WAIS and the DS were scored after their administration and the SRA Typing Test was scored following its administration. The scoring concepts outlined in the test manuals were strictly adhered to, as was the procedure outlined by Doppelt (7)[6] for scoring the Short Form of the WAIS.

The typing scores of each subject were correlated with her DS score, using the partial correlation technique to control the influence of the IQ, in order to determine what, if any, significant relationships existed between the acquisition of typing skill and scores on the WAIS DS. The formulae for finding the partial coefficients of correlation between the DS scores and Typing Speed scores, holding the WAIS IQ constant, and between the DS scores and the Typing Accuracy scores, holding the WAIS IQ constant, are as follows:[7]

1. Correlation of DS scores and Speed scores
   (1 = WAIS IQ, 2 = DS score, 3 = Speed score)

$$r_{23.1} = \frac{r_{23} - r_{12}r_{13}}{\sqrt{1 - r^2_{12}}\sqrt{1 - r^2_{13}}}$$

2. Correlation of DS scores and Accuracy scores
   (1 = WAIS IQ, 2 = DS score, 3^1 = Accuracy score)

$$r_{23^1.1} = \frac{r_{23^1} - r_{12}r_{13^1}}{\sqrt{1 - r^2_{12}}\sqrt{1 - r^2_{13^1}}}$$

CHAPTER IV

RESULTS AND INTERPRETATION

The WAIS IQs, the DS scores, and the SRA Typing Speed and Accuracy scores for each of the 40 subjects are presented in Table I (see Appendix). Table II shows the range of scores on the WAIS, DS, and SRA Typing Test, as well as the means and standard deviations of the WAIS, DS, and Typing Speed and Typing Accuracy scores.

TABLE II

RANGE OF SCORES, MEANS, AND STANDARD DEVIATIONS

FOR TESTS ADMINISTERED IN THE PRESENT STUDY

Test	Number	Range of Scores	Mean	SD
WAIS SHORT FORM	40	75-125	95	10.69
DS	40	36-76	59.58	9.51
TYP. SPEED	40	0-47	14.15	11.46
TYP. ACCUR.	40	0-87	46.85	29.58

In Table III there are listed the coefficients of correlation between DS and Typing Speed, IQ and DS, IQ and Typing Accuracy, IQ and Typing Speed, and DS and Typing Accuracy that were found in this study. The Pearson

Product-Moment method was used in obtaining the coefficients of correlation.

TABLE III

COEFFICIENTS OF CORRELATION BETWEEN SCORES

OF TESTS ADMINISTERED IN THE PRESENT STUDY

Test	Typ. Speed	Typ. Accur.	DS
WAIS SHORT FORM	.29	.32	-.33
DS	.39	.24	

The r between the WAIS Short Form and Typing Speed with df = 38 is not significant. The r between the WAIS Short Form and Typing Accuracy with df = 38 is significant at the .05 level of confidence. The r between DS and Typing Accuracy with df = 38 is not significant. The r between DS and Typing Speed with df = 38 is significant at the .05 level of confidence. The negative r between the WAIS Short Form and DS with df = 38 is significant at the .05 level of confidence. This latter coefficient of correlation is interesting. Here there is indication of negative relationship between an individual's IQ and her ability to perform on the DS. Could this be some indication of a negation of Wechsler's claim that the DS is an indicator of a person's new learning ability? Further pursuit and investigation of this question might prove to be revealing.

The partial coefficient of correlation found between the DS scores and the SRA Typing Speed scores was .55. With df = 37, this r is significant

at the .01 level of confidence. The partial coefficient of correlation found between the DS scores and the SRA Typing Accuracy scores was .38. With df = 37, this r is significant at the .05 level of confidence.

It has been the purpose of this study to determine if DS performance is indicative of learning typing. Positive, significant relationships have been found. Therefore, even though the partial coefficients of correlation found are not high, they nonetheless indicate that DS performance is indicative of learning to type. It is interesting to note that there is a higher relationship between DS performance and Typing Speed than there is between DS performance and Typing Accuracy. Thus, for this population, DS scores are more indicative of success in terms of Typing Speed than they are indicative of success in terms of Typing Accuracy.

CHAPTER V

SUMMARY AND CONCLUSIONS

It has been the purpose of this study to discover if DS performance on the WAIS is indicative of learning a manipulative skill, namely, typing. It was hypothesized that if DS performance was a good indicator of learning to type, then higher than average DS scores on the WAIS would be indicative of higher than average skill in learning typing, lower than average DS scores would be indicative of lower than average skill in learning typing, and average DS scores would be indicative of average skill in learning typing. The results of this study did verify the hypotheses, in general.

In order to achieve the proposed purpose, the DS of the WAIS and the SRA Typing Skills Test were administered to 40 female 16 and 17 year old students participating in a high school program that stressed business training of a secretarial nature. A Short Form of the WAIS was administered to each of the 40 subjects to obtain an estimate of intellectual ability. The DS was administered to each of the subjects before they began their formal course in learning to type. Upon completion of the typing course for beginners, the 40 subjects' typing achievement was evaluated using the SRA Typing Skills Test. The typing scores of each subject were correlated with her initial DS score, using the partial correlation technique to control the influence of the IQ, as was estimated on the Short Form of the WAIS.

The partial coefficient of correlation found between the DS scores and the SRA Typing Speed scores was .55 with df = 37. This r is significant at the .01 level of confidence. The coefficient of correlation found between the DS scores and the SRA Typing Accuracy scores was .38 with df = 37. This r is significant at the .05 level of confidence.

On the basis of this study, it may be concluded that for 40 female high school students beginning a first course in typing, there is indication that their DS performance is indicative of learning typing. However, when considering the results of this study, they must be qualified. Even though there is some common variance explained by the coefficients of correlation found in this study, the amount of covariance is so small that it would not warrant the use of the DS as a predictor of success in typing or as a means of selecting those students for typing courses who would achieve superior typing skill.

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FOOTNOTES

[1]The abbreviation, WAIS, will be used throughout to indicate the Wechsler Adult Intelligence Scale.

[2]The abbreviation, W-B, will be used throughout to indicate the Wechsler-Bellevue Intelligence Scale, Form I.

[3]The abbreviation, DS, will be used throughout to indicate the Digit Symbol Subtest.

[4]This abbreviated form of the WAIS was chosen on the basis of the experimentation done by Doppelt (7), who found that this combination of subtests was the best predictor of an estimate of the Full Scale score.

[5]The cooperation of the faculty was greatly appreciated in this effort.

[6]Doppelt predicted the Full Scale score by multiplying the sum of the scaled scores on four selected subtests of the WAIS by 2.5 and then adding a constant which depended on the subject's age. The constant added for 16 and 17 year olds is 10 and therefore, the one added in this study.

[7]For statistical procedures used, see Garrett (9, p. 380-384).

APPENDIX I

TABLE I

THE WAIS IQs, DS SCORES, SRA TYPING SPEED AND TYPING ACCURACY SCORES FOR 40 SUBJECTS

Subject	WAIS IQ	DS	Typ. Spd.	Typ. Acc.
1	85	48	5	17
2	102.5	70	0	0
3	95	47	0	0
4	97.5	69	15	47
5	85	57	11	34
6	95	56	20	57
7	100	60	12	34
8	87.5	57	0	0
9	90	70	27	87
10	107.5	56	16	73
11	102.5	66	23	69
12	102.5	57	15	72
13	95	62	5	37
14	110	52	0	0
15	95	56	20	77

Continued...

TABLE I (Continued)

Subject	WAIS IQ	DS	Typ. Spd.	Typ. Acc.
16	95	66	20	57
17	105	44	2	11
18	82.5	75	8	39
19	122.5	62	10	50
20	80	62	8	29
21	105	37	13	81
22	125	63	47	87
23	87.5	36	18	66
24	87.5	74	21	63
25	87.5	60	0	0
26	80	64	16	46
27	110	65	22	79
28	100	58	20	87
29	92.5	65	31	74
30	87.5	59	10	37
31	90	64	11	42
32	90	76	44	86
33	95	62	12	79
34	92.5	55	19	62
35	90	52	6	32
36	105	75	36	80

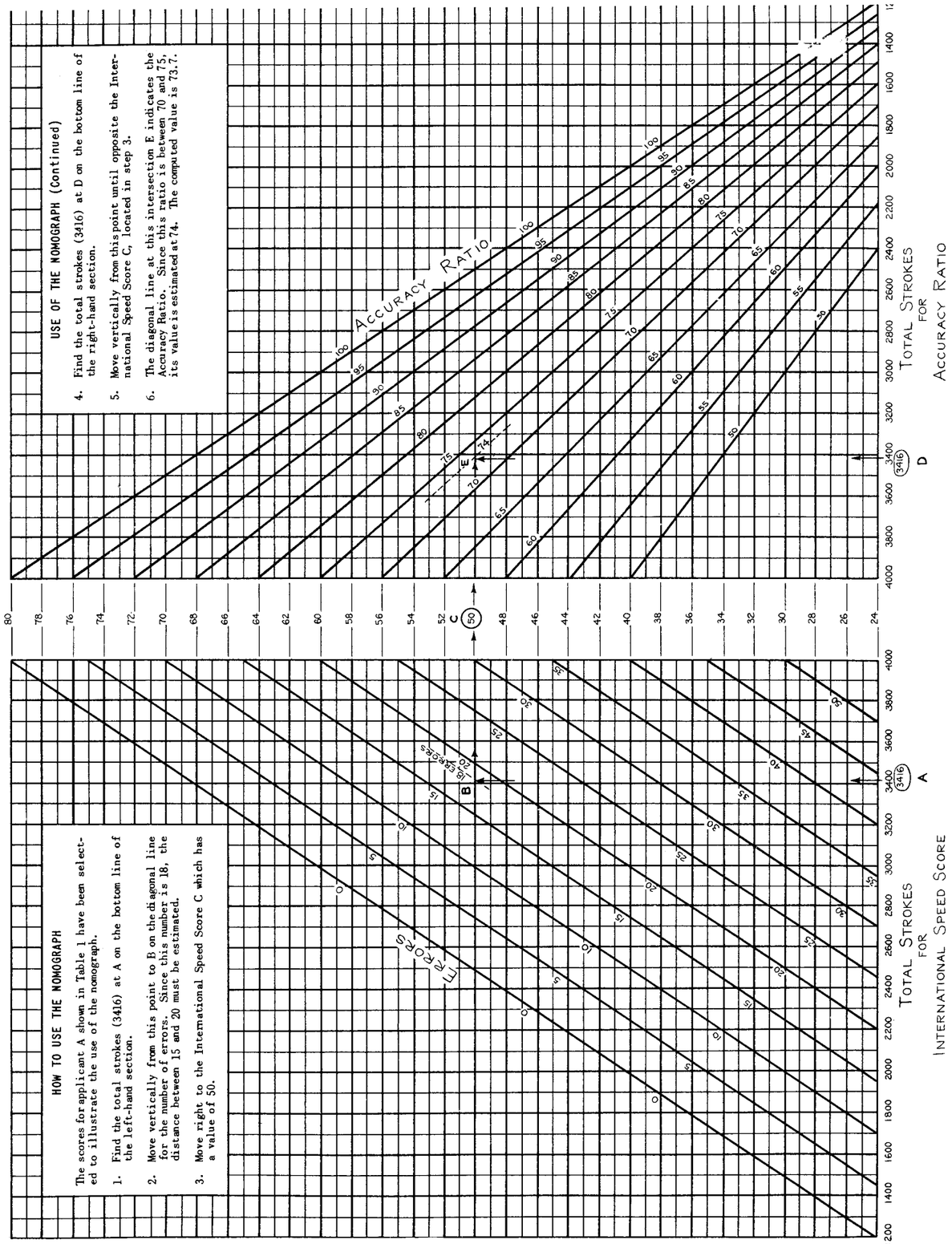
Continued...

TABLE I (Continued)

Subject	WAIS IQ	DS	Typ. Spd.	Typ. Acc.
37	82.5	43	7	19
38	75	67	0	0
39	92.5	55	0	0
40	90	61	14	64

APPENDIX II

SRA TYPING SKILLS MANUAL



EXAMINER MANUAL

for the

SRA TYPING SKILLS

THE AUTHORS

Dr. Marion W. Richardson has been a leader in test construction theory and practice for many years. His career has been marked with outstanding success in the fields of psychological quantitative theory, research, and personnel selection. His long list of honors and positions includes: Editor, *Psychometrika;* Director and Past President, Psychometric Society; Supervisor of Selection Research, Proctor and Gamble Company; Chief, Test Development, U.S. Civil Service Commission; Associate Director, Chicago office, Psychological Corporation; Chief, Personnel Research, The Adjutant General's Office, War Department. At present, he is Chairman of the Board of Directors and Director of Research, Richardson, Bellows, Henry and Company, Inc.

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Richardson, Bellows, Henry and Company, Inc. is a firm of personnel consultants composed of the key men from the largest personnel research and procedures office in the armed services, together with others from industry, education, and government. The staff represents a variety of background and interest, including test construction and theory, that is especially useful in providing tests designed to meet the needs of industry and vocational guidance.

PURPOSE AND GENERAL DESCRIPTION

The *SRA Typing Skills* consists of a business letter, approximately 225 words long, which is copied by the examinee as often as possible in a ten-minute period. The test is scored by the International Typewriting Contest Rules to obtain the conventional score in terms of net words per minute; this is called the *International Speed Score.* Scoring also provides an *Accuracy Ratio* to indicate the proportion of words typed without error.

This type of test was selected for inclusion in the SRA PROGRAM OF STENOGRAPHIC SKILLS because it is short, easy to administer, and simple to score. It yields results which are closely related to those obtained on mutilated copy, tabular materials, hand-written drafts, etc., without requiring long testing periods, complicated scoring processes, and prolonged use of typewriters.

The *SRA Typing Skills* is a part of the SRA PROGRAM OF STENOGRAPHIC SKILLS which is designed to provide a coordinated battery of tests for the proper selection and placement of stenographic personnel. The other tests in the program are:

SRA Language Skills, a 20-minute test of English language fundamentals, covering vocabulary, spelling, word division, and punctuation. This examination requires very little time on the part of the personnel office for either administering or scoring. It is primarily intended for use as a screening device.

SRA Dictation Skills, two series of test letters, administered by means of phonograph records. The Speed Series is designed to measure the speed at which the stenographer can take dictation of average difficulty. The Accuracy Series measures the level of difficulty of dictated material the stenographer can take successfully. Letters need not be transcribed on the typewriter. Instead, the examinee is asked to supply key words which are omitted in copies of the letter.

FORMAT

The test is contained in a long folded booklet, including introductory comments and instructions on the front sheet. On the opposite side, there is a typical business letter to be copied by the examinee. The subjects are given an opportunity to become accustomed to their machines by copying a typewritten section from the front sheet. For the actual test a work sheet which may be detached from the rest of the booklet is provided. This sheet contains vertical lines indicating the marginal setting for either Pica or Elite type. In addition, boxes for the salutation are supplied to insure the correct starting place for the letters. There is ample space for three letters on one side of the sheet. It is highly improbable that an examinee could type more than three letters in the time allowed. However, if anyone should exceed this number, the opposite side of the work sheet may be used for the additional typing. The accumulated number of strokes is recorded for each line, thus facilitating scoring.

The test is available in two equated forms. If desired, one form may be used for hiring; the other for upgrading.

ADMINISTRATION

The administration of the test is extremely simple. Only one time limit and a minimum of oral directions are required. A few points need to be considered to achieve satisfactory, controlled administration of the test.

The examiner. Administration of the test should be supervised by a person thoroughly familiar with the test, testing procedures in gen-

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eral, and the administration of group tests.

Testing room. The testing room should rule out any variables which might influence the scores. Such distractions as unnecessary noises, interruptions, uncomfortable furniture, and poor lighting should be avoided. The size of the testing room and the number of typewriters available determine the size of the group to be tested; with satisfactory physical facilities the *SRA Typing Skills* may be administered to a fairly large group.

Materials needed. In administering the *SRA Typing Skills*, each examinee should have a typewriter that is in good condition, a sheet of letter size scratch paper, and a copy of the folded booklet. An *SRA Interval Timer*, a stop watch, or a watch with a sweep-second hand must be available for accurate timing of the test period.

Instructions and timing. In testing a group of persons, the examiner distributes the booklets and instructs the examinees not to begin work until told to do so. As soon as everyone is ready, the examiner should say:

"The directions for this test are printed on the first page of the folded booklet. Be sure to follow them carefully. Now begin reading the directions and working the practice exercise."

All necessary information has been included on the front page of the booklet. While the testees are reading the directions and typing the practice paragraphs, the examiner should make certain that all typists are following the instructions correctly. Experience has indicated that two points should be watched carefully:

1. The entire first section of the directions — from "The *SRA Typing Skills* measures . . . ." through "Do not unfold the booklet until you have finished typing the practice exercise" — must be typed for warm-up and practice.
2. The test letter must be kept folded under at all times during the preliminary period except when the work sheet is being detached from the booklet. DO NOT ALLOW ANY READING OF THE TEST LETTER BEFORE BEGINNING THE TEST.

The examiner should allow as much time as is needed on this practice exercise. Five to seven minutes is usually sufficient. It is important that each individual knows exactly what to do on the test. If an examinee asks questions regarding the operation of the typewriter, the examiner may answer them, but he should not set the typewriter correctly for the test. Moreover, he should *NOT* answer questions relevant to the nature of the test. After everyone is ready to begin the test, the administrator should say:

"Are you ready? Be sure to follow the directions you have read. Work carefully and accurately. You will have EXACTLY TEN MINUTES. Ready. Begin."

The examiner must time the test carefully. Deviation of even one minute can increase a score by 10% or more. A score on an incorrectly timed test is worthless. The *SRA Interval Timer* may be set to ring at the end of the ten-minute period. If an interval timer or a stop watch is not available, the starting time should be recorded in minutes and seconds. The addition of ten minutes to the starting time will give the stopping time, which should be written down and kept in front of the examiner continuously. At the end of exactly ten minutes, time must be called and all papers collected immediately.

SCORING

Compare the typed material with the copy and encircle each error. Count as errors cases of striking incorrect letters or punctuation marks, incorrect spacing, strike-overs, repetition of words, transposition of letters or words (only one error for each transposition), and improper shifting (letter off the line, capital for small letter, or vice-versa). In case the examinee gets off the "home keys," it is counted as one error per line. If the subject retypes a word, phrase, or whole line, one error is counted for each word retyped. In addition, no credit is given for the strokes required to type the repeated material. Also count one error for each of the following violations of instructions:

1. Single-spaced copy.
2. Incorrect indentation due to improperly set machine.
3. Variation of paragraph indentation (all paragraphs must be indented 5 spaces).

Do not count more than one error per word.

Record the number of errors per line in the boxes provided near the left-hand margin. Total the errors and record in the Total Error Box.

To obtain scores, first determine the number of strokes. The accumulated number of strokes is printed in the left-hand margin for each line of the test. If the last typed line is incomplete, add the number of strokes typed in this line to the accumulated frequency for the preceding line.

The International Speed Score and Accuracy Ratio may be obtained easily by means of the nomograph on the last page. Detailed instructions illustrating the use of the nomograph are included on the same page.

CONSTRUCTION OF NOMOGRAPH

The International Speed Score is obtained by dividing the total number of strokes by 5, to determine the gross number of words per minute. From this, 10 times the number of errors is subtracted. The difference is then divided by the number of minutes. For this test the formula may be written: $\frac{S - 50E}{10}$ where S is the total number of strokes and E, the total number of errors. This formula has been used to prepare the left-hand section of the nomograph.

The Accuracy Ratio is defined as the total number of strokes minus 50 times the number of errors, divided by total strokes. It can be written as: $\frac{S - 50E}{S}$.

This formula was used to construct the right-hand section of the nomograph.

INTERPRETATION OF SCORES

The International Speed Score is the conventional net words per minute score used in the International Speed Competitions and in the grading of most student typists. It was designed to indicate the typing speed, corrected for errors. The Accuracy Ratio represents an estimate of the proportion of errorless words typed.

The value of this index is readily apparent from an examination of the following illustrations; the first is graphically represented on the nomograph.

TABLE 1

Applicant	Total Strokes	Errors	Errors × 50	Net Speed	Accuracy Ratio
A	3416	18	900	50	74
B	2773	5	250	50	91

In both cases the net speed of typing is 50 words per minute. Using only the conventional type of score, here called the Speed Score, both applicants A and B would appear equally desirable as employees. However, the Accuracy Ratio of 74 for applicant A suggests that she is apt to make a large number of errors, while that of 91 for applicant B indicates a much more satisfactory degree of accuracy. Considering the time required for correcting errors and retyping inaccurate copy, B would be the more desirable typist, provided other qualifications are equal. In general, Accuracy Ratios below 85 indicate unsatisfactory performance; ratios above 90 are desirable.

The standards set for typing competence vary considerably. For the most part, they are set arbitrarily for each organization. Thus, a large department store requires a net rate[1] of 35 words per minute for beginning typists; a publishing company requires 50 words per minute; and a manufacturing concern requires 40 words per minute. Standards vary with the locality and the labor market. H. A. Tonne (4) points out that the requirement for graduation from a business course for most high schools is 50 words per minute net, with not more than 5 errors in a ten minute test.[2] However, this is often based on practiced material, and many employers find it difficult to locate beginning typists who are able to attain this standard when tested with new material.

[1] Net rate is the same as the International Speed Score.

[2] This corresponds to an Accuracy Ratio of 91.

RESEARCH

Much research needs to be done in this field, particularly in determining standards on tests given for actual employment purposes. The cooperation of persons using these tests will be greatly appreciated by the authors. All communications should be addressed either to the publishers, Science Research Associates, 57 West Grand Avenue, Chicago 10, Illinois, or to the authors, in care of Richardson, Bellows, Henry and Co., Inc., 1 West 57th Street, New York 19, New York.

PRACTICE EFFECT

A valid criticism of many typing tests is that the examinee is allowed practice, thus improving her score far beyond her actual ability. This should be avoided. If, for any reason, a retest is needed, the alternate form should be used. One form should not be administered more than three times to any one individual, and should not be readministered unless there is at least one month interval between testings.

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APPENDIX III

FORM FOR SRA TYPING SKILLS TEST

SRA TYPING SKILLS

FORM A

Prepared by Marion W. Richardson, Ph. D. *and* Ruth A. Pedersen, B. A.

Richardson, Bellows, Henry and Company, Inc.

The SRA Typing Skills measures your speed and accuracy in typing. It is one of the three tests in the SRA PROGRAM OF STENOGRAPHIC SKILLS. The other two tests are the SRA Language Skills and the SRA Dictation Skills. The purpose of the PROGRAM is to reveal your present skills for such occupations as typist, secretary, and stenographer.

This test consists of a letter which should be reproduced exactly on the special Work Sheet that is attached. Follow the directions carefully; work as rapidly and accurately as you can. Before starting to type, adjust your machine as follows:

a. Set the marginal tabs for 65 spaces.

b. Set the tabulator for a 5-space paragraph indentation.

c. Set the machine for double spacing.

In order to become accustomed to your machine, insert a sheet of scratch paper and copy this typewritten section beginning: "The SRA Typing Skills measures." Do not unfold the booklet until you have finished typing the practice exercise.

* * *

After you have finished the practice exercise:

1. Unfold this sheet into one long strip and tear along the perforations that divide the letter from the *Work Sheet*. Keep the letter folded under until you are told to begin.
2. Insert the *Work Sheet* in your typewriter and type your name, age, group, and the date in the spaces provided.
3. Roll up the *Work Sheet* until the arrows labeled "ELITE TYPE" and "PICA TYPE" appear. The vertical lines at the ends of the arrow for your size of type indicate the position of the margins. Check that your marginal tabs are set to agree.
4. Move up the work sheet so that the box near the left hand margin of the paper appears. The salutation for each letter must be typed in the box exactly like this: | 15 | Dear Mr. Jones:
   Adjust the work sheet so that you are ready to type the salutation of the letter in the first box.

   DO NOT START TYPING THE LETTER UNTIL YOU ARE GIVEN THE SIGNAL TO DO SO.

You may be able to type the letter more than once in the time allowed. If you complete the letter, begin retyping it immediately, using the second box for the salutation. Space has been provided for three letters on this side of the *Work Sheet*. If you finish all three and still have time, turn the *Work Sheet* over and begin typing the letter on the opposite side.

The letter must be copied line for line. If for any reason one of your lines does not fit between the marginal settings, allow it to extend into the margin.

If you make an error, do not stop to correct it. Go right ahead with the rest of the letter.

Wait for the signal before beginning the letter.

Published by SCIENCE RESEARCH ASSOCIATES, INC., 57 West Grand Avenue, Chicago 10, Illinois

To Reorder Use Code Number 7-401

MET 18546 2-59

Dear Mr. Jones:

The Committee on Sales Programs has carefully reviewed your memorandum. Before outlining the reactions of the Committee in detail, I should like to say that everyone considers your contribution excellent, and is aware that it required much constructive thinking, as well as detailed analysis of the relevant material.

While your memorandum was being circulated, a major change in the organization of the home office was announced. This shift, as you no doubt realize, will result not only in a complete realignment of the District Manager's duties, but also in some adjustments in the size of the territories to be covered. Whenever the size of a sales district is expanded, the greater demand on the regional office increases the supervisory load. Your plan did not provide for such an increase, but I am certain modifications can easily be made to handle that situation.

Furthermore, it will probably be necessary to select and train additional personnel to take care of the three new products which we are introducing next fall. Since our personnel turnover is steadily decreasing, we may encounter less difficulty than we previously anticipated in our plans for the current year.

We always welcome your ideas on subjects of interest to our company in this general area or any other.

Sincerely yours,

APPENDIX IV

RESEARCH DONE BY PRIVATE COMPANY ON

THE SRA TYPING SKILLS TEST

NET WORDS PER MINUTE SCORE RANGES FOR SPECIFIED PERCENTAGE INTERVALS

Secretaries

	Applicants	Hires	Employees
Top 5%	70-77	71-76	[illegible]
Next 5%	65-69	67-70	73-77
Next 15%	57-64	61-66	66-72
Next 25%	49-56	55-60	60-65
Next 25%	41-48	49-54	53-59
Next 15%	31-40	42-48	44-52
Next 5%	23-30	39-41	38-43
Low 5%	0-22	23-38	18-37
N	416	76	106

General Clerks

	Applicants	Hires	Employees
Top 5%	54-70	58-89	66-89
Next 5%	50-53	55-57	62-65
Next 15%	41-49	50-54	55-61
Next 25%	31-40	44-49	45-54
Next 25%	20-30	34-43	32-44
Next 15%	10-19	23-33	23-31
Next 5%	4-9	17-22	17-22
Low 5%	0-3	2-16	8-16
N	786	100	99

Statistical Clerks

	Applicants	Hires	Employees
Top 10%	47-54	48-54	56-67
Next 15%	41-46	46-47	50-55
Next 25%	33-40	40-45	43-49
Next 25%	23-32	32-39	30-42
Next 15%	12-22	24-31	20-29
Low 10%	1-11	22-23	7-19
N	34	22	33

Clerk-Stenographers

	Applicants	Hires	Employees
Top 5%	58-89	66-67	71-75
Next 5%	55-57	64-65	67-70
Next 15%	50-54	57-63	62-66
Next 25%	43-49	50-56	53-61
Next 25%	34-42	43-49	49-52
Next 15%	25-33	36-42	45-48
Next 5%	20-24	31-35	41-44
Low 5%	6-19	12-30	36-40
N	159	54	50

Distribution Clerks

	Applicants	Hires	Employees
Top 10%	41-51	40-44	46-49
Next 15%	35-40	36-39	39-45
Next 25%	26-34	33-35	31-38
Next 25%	14-25	27-32	16-30
Next 15%	3-13	23-26	2-15
Low 10%	0-2	0-22	0-1
N	45	24	33

Administrative Clerks

	Employees
Top 10%	60-64
Next 15%	53-59
Next 25%	47-52
Next 25%	38-46
Next 15%	24-37
Low 10%	0-23
N	26

GROSS WORDS PER MINUTE SCORE RANGES FOR SPECIFIED PERCENTAGE INTERVALS

Secretaries

	Applicants	Hires	Employees
Top 5%	77-99	79-99	82-93
Next 5%	74-76	76-78	79-81
Next 15%	66-73	70-75	75-78
Next 25%	60-65	64-69	70-74
Next 25%	54-59	58-63	65-69
Next 15%	49-53	53-57	60-64
Next 5%	47-48	51-52	56-59
Low 5%	20-46	45-50	42-55
N	416	76	106

General Clerks

	Applicants	Hires	Employees
Top 5%	65-81	68-71	80-90
Next 5%	60-64	64-67	75-79
Next 15%	53-59	58-63	67-74
Next 25%	47-52	52-57	60-66
Next 25%	38-46	46-51	53-59
Next 15%	31-37	38-45	45-52
Next 5%	28-30	32-37	40-44
Low 5%	14-27	15-31	23-39
N	786	100	99

Statistical Clerks

	Applicants	Hires	Employees
Top 10%	59-70	61-70	68-72
Next 15%	52-58	55-60	60-67
Next 25%	44-51	52-54	55-59
Next 25%	36-43	47-51	51-54
Next 15%	25-35	37-46	41-50
Low 10%	15-24	33-36	30-40
N	34	22	33

Clerk-Stenographers

	Applicants	Hires	Employees
Top 5%	71-81	73-76	80-81
Next 5%	66-70	70-72	77-79
Next 15%	59-65	63-69	70-76
Next 25%	52-58	58-62	66-69
Next 25%	49-52	53-57	62-65
Next 15%	44-48	49-52	56-61
Next 5%	42-43	47-48	54-55
Low 5%	31-41	40-46	50-53
N	159	54	50

Distribution Clerks

	Applicants	Hires	Employees
Top 10%	50-55	52-57	57-63
Next 15%	45-49	48-51	52-56
Next 25%	39-44	44-47	47-51
Next 25%	30-38	40-43	39-46
Next 15%	22-29	35-39	33-38
Low 10%	17-21	32-34	29-32
N	45	24	33

Administrative Clerks

	Employees
Top 10%	73-77
Next 15%	66-72
Next 25%	59-65
Next 25%	52-58
Next 15%	40-51
Low 10%	27-39
N	26

... RANGES FOR

PERCENTAGE INTERVALS

			Employees
		[illegible]-99	97-99
		96-97	94-96
		93-95	92-93
	[illegible]-90	88-92	87-91
	74-84	81-87	82-86
	58-73	75-80	69-81
	46-57	71-74	60-68
Low 5%	0-45	53-70	33-59
N	416	76	106

General Clerks

	Applicants	Hires	Employees
Top 5%	93-100	96-98	95-99
Next 5%	90-92	94-95	91-94
Next 15%	82-89	90-93	86-90
Next 25%	69-81	82-89	75-85
Next 25%	50-68	72-81	58-74
Next 15%	27-49	54-71	43-57
Next 5%	11-26	39-53	36-42
Low 5%	0-10	5-38	20-35
N	786	100	99

Statistical Clerks

	Applicants	Hires	Employees
Top 10%	87-92	86-88	91-94
Next 15%	80-86	82-85	86-90
Next 25%	72-79	77-81	75-85
Next 25%	64-71	68-76	62-74
Next 15%	37-63	60-67	41-61
Low 10%	3-36	41-59	13-40
N	34	22	33

Clerk-Stenographers

	Applicants	Hires	Employees
Top 5%	95-97	98-99	96-99
Next 5%	92-94	97	94-95
Next 15%	87-91	94-96	90-93
Next 25%	80-86	89-93	85-89
Next 25%	68-79	80-88	78-84
Next 15%	52-67	69-79	71-77
Next 5%	41-51	63-68	64-70
Low 5%	19-40	21-62	58-63
N	159	54	50

Distribution Clerks

	Applicants	Hires	Employees
Top 10%	89-95	90-98	85-90
Next 15%	82-88	85-89	80-84
Next 25%	68-81	77-84	67-79
Next 25%	45-67	64-76	40-66
Next 15%	8-44	51-63	7-39
Low 10%	0-7	0-50	0-6
N	45	24	33

Administrative Clerks

	Employees
Top 10%	90-94
Next 15%	85-89
Next 25%	77-84
Next 25%	70-76
Next 15%	60-69
Low 10%	0-59
N	26

PERCENTAGES OF GROUPS FALLING BELOW CERTAIN NET WORDS PER MINUTE SCORES

Secretaries

	N	NWPM 40	45	50	60
Applicants	415	21	35	52	81
Hires	76	6	16	30	74
Employees	106	6	11	19	50

General Clerks

	N	NWPM 25	30	35	40
Applicants	786	36	47	59	73
Hires	100	12	19	27	38
Employees	99	12	21	30	39

Statistical Clerks

	N	NWPM 25	30	35	40
Applicants	34	29	41	58	73
Hires	22	11	20	35	49
Employees	33	16	24	32	44

Clerk-Stenographers

	N	NWPM 40	45	50	60
Applicants	159	40	59	76	97
Hires	54	16	31	51	83
Employees	50	3	10	30	71

Distribution Clerks

	N	NWPM 25	30	35	40
Applicants	45	47	62	76	88
Hires	24	16	35	66	90
Employees	33	39	48	63	77

Administrative Clerks

	N	NWPM 25	30	35	40
Employees	26	11	15	20	30

APPROVAL SHEET

The thesis submitted by Marilyn Lindahl Luotto has been read and approved by three members of the Department of Psychology.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form, and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Arts.

July 1, 1963
Date

Frank J. Kobler
Signature of Adviser