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Factor analysis of the WAIS-R and selected indices of the WMS-R

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FACTOR ANALYSIS OF THE WAIS-R AND SELECTED INDICES OF THE WMS-R

A Thesis

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Specialist in Education

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An Abstract of a Thesis

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Abstract

This study replicates a study conducted by Harmon, Clausen, and Scott (1993) in which these researchers attempted to define the number of factors present in the cognitive factor structure of adults in a vocational rehabilitation setting. The Wechsler Adult Intelligence Scale-Revised (WAIS-R) and the Verbal Memory and Visual Memory Indices of the Wechsler Memory Scale-Revised (WMS-R) were the instruments used to define the factors in the Harmon et al. (1993) study as well as the current study. A larger sample size was utilized in the present study and went on to define the cognitive factor structure of these individuals by gender.

The results of the current study for the entire sample conformed to those found by Harmon et al. (1993) and supported the uniqueness of a third factor when utilizing the WAIS-R and the Verbal Memory and Visual Memory Indices of the WMS-R. When the sample was broken down by gender the results obtained for males and for females supported a three factor solution and although many similarities were found when comparing these results to the Harmon et al. (1993) study, these solutions did not conform precisely to those results obtained in the Harmon et al. (1993) study. Furthermore, in comparing the results of males and females, many similarities were found, but again these solutions did not conform precisely to each other.

CHAPTER 1

INTRODUCTION

Vocational rehabilitation counselors seek to direct individuals into vocations consistent with their interests and abilities, yet identifying the strengths and weakness of these individuals is frequently difficult to assess. Research has indicated that aptitude and memory profiles are considered appropriate factors in determining vocational and educational goals for individuals (Liebert & Spiegler, 1990; Restak, 1984; Snyderman & Rothman, 1987). Furthermore, the literature has indicated that aptitude and memory profiles are strongly correlated (Waldmann, Dickson, & Kazelskis, 1991).

The Wechsler Adult Intelligence Scale-Revised (WAIS-R) and the Wechsler Memory Scale-Revised (WMS-R) are two tests that have been widely used to assess the aptitude and memory of adults, respectively. By comparing the aptitude and memory profiles of populations, important insight may be gained that will help vocational rehabilitation counselors develop more effective educational and vocational goals and to design better interventions.

To determine similarities and differences among populations and among individuals, a factor analytic viewpoint may be employed. Naglieri and Kaufman (1983) suggested that the number of factors obtained from a factor analysis provides a more specific and diverse number of options for intervention. Thus, the more factors obtained from an individual's aptitude and memory profile, the better clinicians, vocational rehabilitation counselors, and educational

counselors can effectively program educational and vocational goals for individuals.

Surprisingly, in conducting several computer searches of the research literature, only one factor analytical study was found that combined data from the WAIS-R and the WMS-R using a vocational rehabilitation sample. This study, conducted by Harmon, Clausen, and Scott (1993) is explained in detail in chapter two and is the basis for the present study. The literature search began by using the ERIC database to find articles containing the keywords "WAIS," "WAIS-R," "WMS," or "WMS-R" in their titles or abstracts. The search was restricted to articles published after 1974. ERIC contained 24,442 documents with the aforementioned keywords. These keywords were then combined with the additional keywords "vocational rehabilitation." This resulted in the Harmon et al. study (1993). Additional keyword combinations were then attempted including "WAIS" or "WAIS-R" with "vocational rehabilitation," "WMS" or "WMS-R" with "vocational rehabilitation," "WAIS," or "WAIS-R" with "gender" or "sex," and "WMS" or "WMS-R" with "gender" or "sex." This resulted in 46 articles, the abstracts of which were read. Full articles were retrieved if the abstract made reference to gender, the three factor solution, or vocational rehabilitation, in conjunction with the WAIS or WAIS-R or the WMS or the WMS-R. These articles were read and their references were viewed for further potentially relevant material. This process continued until no promising leads remained.

Statement of the Problem

The current study attempts to add to the limited literature pertaining to the cognitive factor structures of individuals who have received vocational rehabilitation services. This study replicates a study by Harmon et al. (1993) in which the cognitive factor structure of individuals who have received vocational rehabilitation services is defined. The current study proceeds to compare the cognitive factor structures of this sample by gender, a comparison not previously reported in the literature.

Significance of the Study

Increased attention concerning individuals who have received vocational rehabilitation services is necessary to provide better and more appropriate educational and vocational services in which to help these individuals realize their potential. Factor analytical research employing the use of the WAIS-R and the WMS-R to better define the cognitive structure, specifically the intellectual and memory functions of individuals who have received vocational rehabilitation services, is scarce. Information comparing the cognitive factor structure of this population by gender is minimal, as well.

Research pertaining to the understanding of this population's cognitive factor structure, as well as the similarities and differences among groups in this population will serve to assist those who provide services for this population design more appropriate educational and vocational goals. It must be remembered,

however, that individuals are complex and unique beings and that broad generalizations cannot be made without first appraising the cognitive profiles of the individual.

Assumptions

1. The Wechsler Adult Intelligence Scale-Revised is a valid measure of intelligence.

2. The Wechsler Memory Scale-Revised is a valid measure of memory.

3. The intelligence and memory instruments were properly administered.

4. The sample is reasonably representative of that of the vocational rehabilitation population.

Limitations

1. The sample size was relatively small and therefore subject to large sampling errors and limited generalizability.

2. Subjects were administered one measure of intelligence (WAIS-R) and one measure of memory (WMS-R) which may not measure other important variables that make up the intellectual and memory constructs of an individual.

CHAPTER 2

REVIEW OF LITERATURE

Finding a match between employees strengths and weaknesses and their vocation is of interest to both business people and vocational rehabilitation counselors (Rhodes, Sandow, Mand, & Buckley, & Albin, J., 1991). Analyzing an individual's aptitude and memory capabilities is an approach utilized to find a better match between an individual's strengths and weaknesses and their vocation. By analyzing differences among subsets of this population, such as by gender, important insight may be gained in which to provide more appropriate services for these populations.

Research has indicated that aptitude and memory profiles are considered appropriate factors in determining vocational and educational goals for individuals (Liebert & Spiegler, 1990; Restak, 1984; Snyderman & Rothman, 1987) and that they are strongly correlated (Waldmann et al., 1991). The Wechsler Adult Intelligence Scale-Revised (WAIS-R) and the Wechsler Memory Scale-Revised (WMS-R) are instruments used to assess aptitude and memory in adults, respectively.

The WAIS-R is an individually administered test given to assess the intellectual capabilities of adults aged 16 years, 0 months to 74 years, 11 months. It is comprised of six Verbal Scale subtests and five Performance Scale subtests. A detailed description of the WAIS-R is provided in Appendix A. To assess memory in adults the Wechsler Memory Scale-Revised provides a rapid, simple and practical

memory examination (Prigatano, 1978). It is comprised of thirteen subtests designed to measure specific aspects of memory. A detailed description of these subtests is provided in Appendix B.

Research concerning the reliability and validity of the WMS-R is limited. Most studies conducted have been on its predecessor, the Wechsler Memory Scale (WMS) and this research is dated. Prigatano (1978) summarizes the literature of the WMS noting that Wechsler indicated that he developed it over 10 years of "intermittent experimentation;" however no empirical data were presented. However, evidence concerning alternate-form reliability of the WMS was provided by Stone, Girdner, and Albrecht (1946). They designed an alternate form of the WMS used to compare the intellectual functions of psychiatric patients and normals. In this inquiry, these researchers compared raw scores obtained from 27 subjects (10 hospital patients and 17 student nurses) given Form I followed later by Form II. No significant differences in raw scores were found in either the patients or the student nurses leading the researcher to conclude that their form of the WMS could be used interchangeably with Form I. In the same study, the researchers administered the two forms to 60 college students. Half received Form I followed by Form II, the other half received Form II followed by Form I. The difference in raw scores was 2.15 points for individuals administered Form I first, and 1.55 raw score points for those administered Form II first. These differences were not significant, again providing support for alternate-form reliability.

Evidence for test-retest reliability of the WMS was provided by Stinnett and DiGiancomo (1970) who administered the WMS to a population of clinically depressed patients. These patients were given the WMS before and after undergoing unilateral, non-dominant electro-convulsive therapy (ECT). Patients showed an increase in WMS scores after treatment, however, a t-test was conducted which yielded non-significant differences, thus providing evidence of test-retest reliability of the WMS in a patient population.

Prigatano (1978), in his review of the literature on the WMS, cited several studies concerning the test-retest reliability of the WMS. He cites Krawieicki et al. (1957) and Walton (1958) who both reported variable Mental Quotient (MQ) scores in psychotic patients while Caldwell and Watson (1954), as cited in Prigatano (1978), showed stable scores using a normal sample of aged women. Prigatano concluded the test-retest reliability of the WMS seemed to depend on the clinical condition of the patients studied.

Correlational research of the WMS and the WAIS was limited as well. One study, by Libb and Coleman (1971) conducted a correlational analysis of the WAIS and the WMS using a vocational rehabilitation sample. Subjects with psychiatric, mental, or physical disabilities were administered the WAIS and the WMS resulting in the following Pearson product-moment correlations. The WMS-Verbal IQ correlation was $r = .83$, the WMS-Performance IQ correlation was $r = .68$, and the WMS-Full Scale IQ was $r = .80$. This

concluded, the authors stated, that the WMS correlates highly with the WAIS.

Prigatano (1978), in reviewing the literature on the WMS, cited the following correlational studies of the WAIS and the WMS. Fields (1971) reported a correlation coefficient of $\underline{r}$ = .83 in brain damaged adults, Kear-Colwell (1973) found a .82 correlation in psychiatric patients, and Black (1973) reported a correlation coefficient of .75 in head injured and normal adults. Prigatano thus concluded that while MQ and Full Scale IQ are highly correlated in some individuals they do not appear to be measuring the same constructs since there is some variability in performance on the WMS that cannot be attributed to intelligence.

An area of interest pertaining to the current study concerns gender differences on the WAIS-R and the WMS-R. Most research has been devoted to differences in subject performance on the WMS and the WAIS, rather than on differences in factor structures. One study, however, examined the factor solution of the WMS by gender (Arbit & Zagar, 1979). These researchers administered the WMS to individuals referred for psychological evaluation and compared cognitive factor structures among three age groups: 13-39, 40-59, and 60-88. For males and females aged 13-39 and 40-59 years, the same two factor solution emerged. This two factor structure did not occur for subjects aged 60-88. The researchers suggested that the two factor solution did not occur in this age group due to a generational change

which affected memory. Nevertheless, it appeared that no significant differences in factor structure were due to gender.

Studies examined pertaining to the WAIS were limited to differences in subject performance. For example, Boor (1975) analyzed the scaled scores of the WAIS subtests for all psychiatric patients referred to the Milwaukee County Mental Health facility between 1960 and 1971. Data indicated that male patients had significantly higher Verbal Scale, Performance Scale, and Full Scale IQ scores than did females. Furthermore, males outperformed females on the Information, Comprehension, Arithmetic, Picture Completion, and Block Design subtests. No significant differences in subject performance were found on the Digit Span, Picture Arrangement, or Object Assembly subtests. Females outperformed males on only one subtest, Digit Symbol. Boor concluded that these sex differences can be interpreted as special characteristics of a psychiatric population since Wechsler reported no significant sex differences in his standardization sample.

In reviewing the literature of the WAIS performance of non-brain damaged men and women, Snow and Weinstock (1990) found no major gender differences to emerge. Males outperformed females on the Arithmetic and Information subtests while females outperformed males on the Digit Symbol subtest. Thus, while Boor (1957) found subject performance differences in a psychiatric population, a review of the literature in a non-brain damaged population found no significant gender differences. This literature therefore suggests

that in special populations differences in performance may result by gender on the WAIS, while the research does not indicate differences in performance by gender on the WMS.

Another area of interest pertaining to the current study is the number of factors the WAIS-R defines. It is traditionally accepted that the WAIS-R measures two factors, the Verbal Comprehension factor, made up of Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similaritites, and the Perceptual Organization factor comprised of Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol (Kaufman, 1975). Ryan, Rosenberg, and DeWolfe (1984) found results supporting that two factor solution in their research. They administered the WAIS-R to 85 psychiatric and medical patients receiving vocational rehabilitation services. A factor analysis specifying two factors was conducted in which the authors found strong results supporting the two factor solution. The Verbal Scale subtests loaded more substantially on Factor 1 than on Factor 2 while the opposite held true for the Performance Scale subtests, providing justification for the two factor solution in a vocational rehabilitation sample.

There is evidence in the literature to suggest that a third factor exists, referred to as Freedom from Distractibility. This factor is said to be comprised of the Arithmetic, Digit Span, and Digit Symbol subtests of the WAIS-R (Kaufman, 1975). In a study employing a hierarchical cluster analysis, Silverstein (1985) found evidence for the Freedom from Distractibility factor, however it was

defined only by Digit Span and Arithmetic. This researcher conducted inter-correlations among the 11 subtests of the WAIS-R for each of the nine age groups that comprised the WAIS-R standardization sample, resulting in three major clusters.

The first cluster, Verbal Comprehension, was comprised of Information, Comprehension, Vocabulary, and Similarities appeared for all nine age groups. In only four age groups in the standardization sample did all six Verbal Scale subtests of the WAIS-R form a cluster. The second cluster, Perceptual Organization, was less defined. Only one age group had all five Performance Scale subtests forming a cluster. Furthermore, although Block Design and Object Assembly appeared as a cluster for eight of the nine age groups, they were joined by Picture Completion for only four groups, and again by Picture Arrangement for only two groups. The third cluster, Freedom for Distractibility, consisted of Digit Span and Arithmetic for seven of the nine age groups, and were joined by Digit Symbol for only one group. Silverstein did not report which age groups made up these aforementioned clusters and subsequently they were not reported here.

In another study using a vocational rehabilitation sample, Fraboni, Saltstone, Baines, and Cooper (1988) found support for the Freedom from Distractibility factor, but like Silverstein (1985) it did not conform precisely to the three factor interpretation. WAIS-R subtest scores from 121 adults seeking vocational rehabilitation services were obtained. Two separate factor analyses were conducted, one employing the three factor solution and one employing the two

factor solution. Factor loadings were determined by using the arbitrarily adopted value of .30.

In accordance with the three factor interpretation the Verbal Scale subtests of the WAIS-R are expected to load on the Verbal Comprehension factor while the Performance Scale subtests are expected to load on the Perceptual Organization factor, with the exception of Arithmetic, Digit Span, and Digit Symbol; these three subtests load on the third factor, Freedom from Distractibility (Harmon et al., 1993; Kaufman, 1975). In this study the third factor was defined only by Digit Symbol and Digit Span. The third subtest, Arithmetic, loaded on the Verbal Comprehension factor rather than on the Freedom from Distractibility factor.

In specifying the two factor solution, the first two factors conformed well to the Verbal Comprehension and Perceptual Organization distinction found by Ryan et al. (1984) mentioned earlier, although Picture Completion and Similarities loaded on both factors. Nevertheless, Fraboni et al. (1988) felt that both solutions may represent different dimensions of intelligence for this vocational rehabilitation population and that more studies should be conducted examining the two and three factor solutions in special populations.

Kaufman, McLean, and Reynolds (1991) also reported support for the third factor yet again it was not comprised of all three subtests (Digit Span, Arithmetic, and Digit Symbol). These researchers factor analyzed the standardization sample of the WAIS-R by sex and race

(Black-White). The three factor solution yielded robust Verbal Comprehension and Perceptual Organization dimensions. The third factor, Freedom from Distractibility, was defined by only two tasks, Digit Span and Arithmetic for all samples. Furthermore, the factor loading were very similar across the sample, by race and by gender. Thus, while the research cited does provide evidence for a third factor, there is some disagreement as to what subtests comprise the Freedom from Distractibilty factor.

In a unique study employing the use of the WMS-R in conjunction with the WAIS-R, Harmon, Clausen, and Scott (1993) further defined the Freedom from Distractibility factor using a vocational rehabilitation sample. Harmon et al. (1993) examined the aptitude and memory profiles of 54 adults who had received vocational rehabilitation services by factor analyzing the responses obtained on the WAIS-R and the WMS-R. Factor 1 contained the Information, Comprehension, Vocabluary, and Similarities subtests of the WAIS-R and was consistent with the Verbal Comprehension factor commonly reported in the literature (Fraboni et al., 1988; Kaufman, 1975; Ryan et al., 1984) Factor 2 was comprised of the Picture Completion, Picture Arrangement, Block Design, and Object Assembly subtests of the WAIS-R, representing the commonly reported Perceptual Organization factor (Fraboni et al., 1988; Kaufman, 1975; Ryan et al., 1984). Factor 3 included the Digit Span, Arithmetic, and Digit Symbol subtests of the WAIS-R, and also the Verbal Memory and Visual Memory Indices of the WMS-R. Furthermore, Verbal Memory did not load

significantly on Factor 1 or Factor 2, while Visual Memory loaded only modestly on Factor 2. The authors believe that further research may affirm the uniqueness of Factor 3 for individuals who have received vocational rehabilitation services. Overall, the review of the literature has mixed results regarding gender differences. Arbit and Zagar (1979), using the WMS found the same factor structure for males and females in two of the three age groups referred for psychological evaluation. Utilizing the WAIS, Boor (1975) found subject performance differences, typically favoring males, on five of the eleven subtests. Females outperformed males on only one subtest. Conversely, Snow and Weinstock (1990) in a review of the literature found no major gender differences on WAIS performance in non-brain damaged adults. Thus, research indicates WAIS performance differences in a patient population for the WAIS but does not indicate gender differences in a non patient population.

Evidence regarding the number of factors defined by the WAIS and/or WAIS-R is mixed as well. All of the factor analytic research of the WAIS and WAIS-R reviewed found strong results for the two factor theory (Fraboni et al., 1988; Harmon et al., 1993; Kaufman et al., 1991; Ryan et al., 1984; Silverstein et al., 1984). Evidence was provided for a third factor but typically it was not defined by all three subtests (Digit Span, Digit Symbol, and Arithmetic). Fraboni et al. (1988) found Digit Span and Digit Symbol to comprise the third factor for his vocational rehabilitation sample while Silverstein et al. (1985) found Digit Span and Arithmetic to load on

the third factor for seven of the nine age groups analyzed with Digit Symbol joining the third factor for one group. Only the Harmon et al. (1993) study resulted in the Freedom from Distractability factor being defined by Digit Span, Digit Symbol, and Arithmetic.

The present study, using an increased sample size, seeks to learn more about the cognitive factor structures of individuals who have received vocational rehabilitation services by replicating the Harmon et al. (1993) study. In addition the sample of the current study was broken down by gender to evaluate any differences in the factor structure of males and females.

CHAPTER THREE

DESIGN OF THE STUDY

Subjects

The subjects included in the present study were part of another study involving individuals who had received vocational rehabilitation services (of which the present researcher was not involved). The subject selection and testing was completed by a certified school psychologist and professor of educational psychology.

The subjects were 113 adults, most of whom resided in a metropolitan area of Iowa. The subjects ranged in age from 24 to 64; the median age equal to 43. The sample was comprised of 74 males (65%) and 39 females (35%). Twelve of the males were black (16%) as were 12 of the females (30%). The rest of the subjects were white. These percentages are reasonably representative of the demographics obtained from the United States General Accounting Office (1994) for the vocational rehabilitation population based on 1993 statistics. This office reported the following demographic percentages for the vocational rehabilitation applicants accepted in 1993; males consisted of 57% of the applicants while females made up the remaining 43%. Pertaining to ethnic groups, Blacks comprised 19% of the accepted applicants and Hispanics 5%. No other ethnic groups were listed and these groups were not broken down by gender.

Instruments

1. The WAIS-R is an intelligence scale consisting of a battery of 11 subtests which when treated individually may be considered as measuring different aspects of intellectual capability. See Appendix A for a more detailed description of the subtests.

2. The WMS-R is a memory scale composed of 13 subtests. Individually, these subtests are purported to measure a specific aspect of memory. Two of the four indices were utilized in this study, the Verbal Memory Index, comprised of Logical Memory I and Verbal Paired Associates I, and the Visual Memory Index, composed of Figural Memory, Visual Paired Associates I, and Visual Reproduction I. See Appendix B for a more detailed description of the subtests.

Procedure

Males and females in a vocational rehabilitation setting were administered the WAIS-R and the WMS-R. Scaled scores on the 11 WAIS-R subtests and the Standard Scores of the Verbal Memory and Visual Memory Indices of the WMS-R were obtained separately for the 74 males, 39 females, and the entire sample of 113 individuals. A principal factor analysis was conducted, employing the varimax rotation for extraction of the Kaiser normalization using the computer program SPSS 4.1. An eigenvalue of approximately 1.00 was used to determine the significance of a factor. Subtest factor loadings equal to or above .40 were considered substantial (Sattler, 1988). The procedure utilized in the present study was the same procedure utilized in the Harmon et al. (1993) study.

CHAPTER 4

RESULTS

The results of the factor analysis for the entire sample of 113 individuals receiving vocational rehabilitation services are presented in Table 1, followed by the results obtained for the 74 males in Table 2, and conclude with the results obtained for the 39 females in Table 3. The eigenvalues of the factors extracted are given in parentheses while the subtest factor loadings are shown in the body of the table. The results of the factor analysis must be interpreted cautiously considering the ratio of subjects to variables is 8:1 for the entire sample, 5:1 for males, and only 3:1 for females. These low ratios increase the error variance and thus warrant attention when interpreting the results.

Three factors were found to be interpretable for the entire sample as shown in Table 1. Factor 1 had an eigenvalue of 5.89 and accounted for 45.3% of the variance. It was comprised of substantial *loadings (equal to or above .40) from Information, Vocabulary,* Arithmetic, Comprehension, and Similarities. This was similar with the Verbal Comprehension factor commonly reported in the literature (Fraboni et al., 1988; Kaufman, 1975; Ryan et al., 1984). Factor 2 had an eigenvalue of 1.97 and accounted for 15.1% of the variance. The subtests that loaded substantially on this factor consisted of Picture Completion, Picture Arrangement, Block Design, and Object Assembly, which were consistent with the Perceptual Organization

Table 1

Subtest Factor Loadings of the WAIS-R and Indices of the WMS-R for All Subjects

Wechsler Subtests	Factors		
n = 113	I	II	III
(Eigenvalues)	(5.89)	(1.97)	(1.01)
WMS-R			
Verbal Memory	.32	-.06	.73
Visual Memory	.30	.40	.58
WAIS-R			
Information	.90	.10	.10
Digit Span	.31	.22	.48
Vocabulary	.89	.10	.16
Arithmetic	.62	.27	.51
Comprehension	.80	.18	.24
Similarities	.82	.30	.13
Picture Completion	.17	.78	.10
Picture Arrangement	.24	.68	.32
Block Design	.27	.80	.24
Object Assembly	.07	.83	.07
Digit Symbol	-.18	.40	.66
Percent of Variance	45.3	15.1	7.8

factor reported in the literature, and also from Visual Memory and Digit Symbol (Fraboni et al, 1988; Kaufman, 1975; Ryan et al., 1984). Factor 3 had an eigenvalue of 1.01 and accounted for 7.8% of the variance. Factor 3 had substantial loadings from Verbal Memory, Visual Memory, Digit Span, Arithmetic, and Digit Symbol, referred to in the literature as Freedom from Distractibilty. It should be noted that Visual Memory and Digit Symbol loaded dually on Factors 2 and 3 and the Arithmetic loaded dually on Factors 1 and 3. These factor loadings, including the dual loadings mentioned, conform to the results obtained by Harmon et al. (1993).

In the present study similarities and differences in the cognitive factor structures of individuals receiving vocational rehabilitation services were examined by gender. The current sample of 113 individuals was broken into two groups by gender and a factor analysis of the WAIS-R subtests and the Verbal Memory and Visual Memory Indices of the WMS-R was conducted. The resulting factors for males and females are shown in Table 2 and Table 3, respectively.

Three factors were found to be interpretable for the males as shown in Table 2. Factor 1 had an eigenvalue of 6.00 and accounted for 46.2% of the variance. It included substantial loadings from Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities. This is consistent with the Verbal Comprehension factor reported in the literature (Fraboni et al., 1988; Kaufman, 1975; Ryan et al., 1984). With the exception of Digit Span, these subtest factor loadings were consistent with those of Harmon et

Table 2

Subtest Factor Loadings of the WAIS-R and Indices of the WMS-R for Males

Wechsler Subtests	Factors		
n = 74	I	II	III
(Eigenvalues)	(6.00)	(2.13)	(.93)
WMS-R			
Verbal Memory	.24	.16	.87
Visual Memory	.35	.44	.54
WAIS-R			
Information	.87	.05	.20
Digit Span	.63	.29	-.23
Vocabulary	.87	.02	.24
Arithmetic	.69	.38	.29
Comprehension	.77	.16	.30
Similarities	.85	.26	.10
Picture Completion	.14	.78	-.02
Picture Arrangement	.12	.75	.22
Block Design	.30	.81	.12
Object Assembly	.10	.83	.07
Digit Symbol	.11	.70	.15
Percent of Variance	46.2	16.4	7.2

al. (1993) and the entire sample of the current study. In these two samples Digit Span was found to load on Factor 3. The loading of Digit Span on Factor 1 as found for the males, however, is consistent with the two factor solution (Fraboni et al., 1988; Ryan et al., 1984).

With respect to Factor 2, an eigenvalue of 2.13 was obtained which accounted for 16.4% of the variance. Subtests with substantial loadings on this factor included Picture Completion, Picture Arrangement, Block Design, and Object Assembly, comprising the Perceptual Organization factor, and also loadings from Visual Memory and Digit Symbol (Kaufman, 1975; Ryan et al., 1984). With the exception of Digit Symbol, these subtest factor loadings were consistent with the Harmon et al. (1993) study and the loadings found for the entire sample of the current study. In these two samples Digit Symbol was found to load on Factor 3. The loading of Digit Symbol on Factor 2, however, is consistent with the two factor solution (Fraboni et al., 1988; Ryan et al., 1984).

Factor 3 had an eigenvalue of .93 and accounted for 7.2% of the variance. Substantial factor loadings included the Verbal Memory and the Visual Memory Indices of the WMS-R. The loadings of these two subtests were consistent with the results found by Harmon et al. (1993) and the entire sample of the current study. Digit Span, Arithmetic, and Digit Symbol which were expected to load on Factor 3 as they did for Harmon et al. (1993) and the entire sample of the current study, loaded instead on Factor 2, consistent with the two

factor solution (Fraboni et al., 1988; Ryan et al., 1984). In fact, all WAIS-R subtests loaded according to the two factor solution while the WMS-R Indices loaded on the third factor (Fraboni et al., 1988; Ryan et al., 1984). Thus, although three factor solution appears to be appropriate for the current sample of males, it is not the same three factor solution found by Harmon et al. (1993) or for the entire sample of the current study.

Three factors were also found to be interpretable for the females as shown in Table 3. However, these three factors were not precisely the same three factor solution found by Harmon et al. (1993), the entire sample of the current study, or the males. Factor 1 had an eigenvalue of 6.22 and accounted for 47.9% of the variance. The subtests comprising this factor included substantial loadings from Information, Vocabulary, Arithmetic, Comprehension, and Similarities, comprising the Verbal Comprehension factor, and also loadings from Verbal Memory and Picture Arrangement. With the exception of Verbal Memory and Picture Arrangement these subtest loadings were similar to the results obtained by Harmon et al. (1993), the entire sample of the current study, and the males. Verbal Memory was found to load on Factor 3 for Harmon et al. (1993), the entire sample of the current study, and the males, rather than on Factor 1 as it did for the females. Picture Arrangement which had a dual loading in this sample of females on Factors 1 and 2 loaded

Table 3

Subtest Factor Loadings of the WAIS-R and Indices of the WMS-R for Females

Wechsler Subtests	Factors		
n = 39	I	II	III
(Eigenvalues)	(6.22)	(2.00)	(1.12)
WMS-R			
Verbal Memory	.60	.26	-.47
Visual Memory	.34	.70	.20
WAIS-R			
Information	.91	.06	-.13
Digit Span	.27	.69	-.02
Vocabulary	.85	.22	.06
Arithmetic	.64	.52	-.16
Comprehension	.88	.14	.17
Similarities	.79	.17	.23
Picture Completion	.29	.62	.24
Picture Arrangement	.66	.57	.28
Block Design	.23	.75	.33
Object Assembly	.10	.28	.87
Digit Symbol	-.15	.81	-.08
Percent of Variance	47.9	15.4	8.6

solely on Factor 2 for Harmon et al. (1993), the entire sample of the current study, and the males.

Factor 2 had an eigenvalue of 2.00 and accounted for 15.4% of the variance. Factor 2 had substantial loadings from Visual Memory, Digit Span, Arithmetic, Picture Completion, Picture Arrangement, Block Design, and Digit Symbol. With the exception of Digit Span and Arithmetic these results are similar to those obtained by Harmon et al. (1993), the entire sample of the current study, and the males. Harmon et al. (1993) found Digit Span to load on Factor 3 as did the results of the entire sample of the current study. These same samples found Arithmetic to load on Factors 1 and 3 whereas the females found Arithmetic to load on Factors 1 and 2. The males found Digit Span and Arithmetic to load solely on Factor 1.

Factor 3, with an eigenvalue of 1.12, accounted for 8.6% of the variance and included substantial loadings from Verbal Memory and Object Assembly. Verbal Memory was expected to load on Factor 3 as it did for Harmon et al. (1993), the entire sample of the current study, and the males, however, it also loaded on Factor 1 a result inconsistent with the previous samples. Furthermore, Verbal Memory was a negative loading, a finding unique to this sample. Object Assembly, the next inconsisent loading, unexpectedly loaded on Factor 3. This subtest was expected to load on Factor 2 as it does in both the two factor and three factor solutions (Fraboni et al., 1988; Harmon et al., 1993; Kaufman, 1975; Ryan et al., 1984). Harmon et al. (1993), the entire sample of the current study, and the males

found Object Assembly to load on Factor 2 consistent with the two factor and three factor solutions. Thus, although a three factor solution appears appropriate for this current sample of females, it is not precisely the same three factor solution found by Harmon et al. (1993), the entire sample of the current study, or the males.

CHAPTER 5

DISCUSSION

The cognitive factor structure of the present sample of 113 individuals who have received vocational rehabilitation services conformed to those found by Harmon et al. (1993) and support the uniqueness of Factor 3 when utilizing the WAIS-R and the Verbal Memory and Visual Memory Indices of the WMS-R. The Digit Span, Arithmetic, and Digit Symbol subtests of the WAIS-R loaded on Factor 3, the Freedom from Distractability factor, as did both indices of the WMS-R lending support for a third factor in a vocational rehabilitation sample.

The cognitive factor structures of males and of females also indicate a three factor solution, however, these findings did not conform precisely to those results obtained by Harmon et al. (1993) or by the entire sample of the current study. Furthermore, the cognitive factor structures of males and of females did not conform precisely to each other. For this sample of males, all subtests conformed to the results found by Harmon et al. (1993) and the entire sample of the current study with the exception of Digit Span and Digit Symbol. These two subtests were expected to load on Factor 3 as they did for Harmon et al. (1993) and the entire sample of the current study. They instead loaded on Factor 2, according to the two factor solution (Fraboni et al., 1988; Ryan et al., 1984). These inconsistent subtest loadings are likely the result of the small sample size utilized in the current study.

The third factor for this sample of males was defined by the WMS-R subtests, Verbal Memory and Visual Memory. These subtest loadings conformed to those found by Harmon et al. (1993) and the entire sample of the current study. This third factor might be interpreted as a memory component for males in this sample, however, additional research would have to be conducted in this area to support this suggestion.

Overall, the results found for males who have received vocational rehabilitation services lends support for a three factor solution. The results found for the males are similar to those found by Harmon et al. (1993) and the entire sample of the current study, although they do not conform precisely to what was found by these samples. It is likely that the small sample size utilized explains differences found between the males and other samples. It is expected that as the sample size for the males increases, their cognitive factor structure will conform to the results obtained by Harmon et al. (1993) and the entire sample of the current study.

For this sample of females all subtests conformed to the results found by Harmon et al. (1993), the entire sample of the current study, and the males with the exception of Verbal Memory, Picture Arrangement, Digit Span, Arithmetic, and Object Assembly. Verbal Memory had dual loadings for the females on Factor 1 and Factor 3. The Factor 3 loading was consistent with Harmon et al. (1993), the entire sample of the current study, and the males except that a negative loading occurred, a finding inconsistent with the

previous samples. Picture Arrangement loaded dually on Factors 1 and 2 for the females whereas it loaded solely on Factor 2 for Harmon et al. (1993), the entire sample of the current study, and the males. The third inconsistency occurred from Digit Span which loaded on Factor 2 for the females. Harmon et al. (1993) and the entire sample of the current study found Digit Span to load on Factor 3, consistent with the three factor solution, while the males found it to load on Factor 1, consistent with the two factor solution.

The next inconsistency occurred from Arithmetic which had dual loadings for the females on Factors 1 and 2. Arithmetic loaded on Factors 1 and 3 for Harmon et al. (1993) and the entire sample of the current study and loaded solely on Factor 1 for the males. The final inconsistency occurred from Object Assembly which unexpectedly loaded on Factor 3 for the females. In both the two factor and three factor solutions Object Assembly loads on Factor 2 which is what was found by Harmon et al. (1993), the entire sample of the current study, and the males. It is likely that the small sample size utilized explains the differences found between the females and the other samples. It is expected that as the sample size for the females increases, their cognitive factor structure will conform to the results obtained by Harmon et al. (1993) and the entire sample of the current study.

In conclusion, based on the data obtained in the current study, the cognitive factor structure of individuals who have received vocational rehabilitation services appears to support the three factor solution found by Harmon et al. (1993). When this

sample is broken down by gender the results found for males and females also support a three factor solution, although it does not conform precisely to the three factor solution traditionally found in the literature (Harmon et al., 1993; Kaufman, 1973). Furthermore, the data indicate some differences in the cognitive factor structures of males and females who have received vocational rehabilitation services. These differences in subtest factor loadings are likely the result of the small sample sizes utilized in the male and female samples. It is expected that as the sample sizes for the males and females increases, their cognitive factor structures will look more similar to each other and conform to the results found by Harmon et al. (1993) and the results of the current study.

Future research in this area should be conducted utilizing a larger sample size in an attempt to gain a better understanding of the cognitive factor structures of males and females who have received vocational rehabilitation services. If different factor structures are found to exist by gender in this population, it may be necessary to design different educational and vocational goals to reflect these differences. It is always important, however, to remember not to make broad generalizations about any population without first looking at the individual.

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Appendix A

Description of the WAIS-R

Verbal Subtests

1. Information--29 questions which sample of broad range of general knowledge, including literary, historical, and geographical facts and dates.

2. Vocabulary--35 words arranged in order of increasing difficulty which the examinee is asked to verbalize its meaning.

3. Arithmetic--a timed subtest containing 14 problems; 13 are presented orally and the other involves blocks.

4. Similarities--14 pairs of words are presented orally to the examinee who must explain the similarity between the words in each pair.

5. Comprehension--16 questions covering a wide array of situations and proverbs such as governmental operations, laws, and social mores.

6. Block Design--a timed subtest consisting of 9 items in which the examinee is shown two-dimensional, red and white pictures of abstract designs and then asked to assemble using three-dimensional red and white plastic blocks.

Performance Subtests

1. Digit Span--consists of Digits Forward in which the examinee repeats a series of numbers presented orally by the examiner, and Digits Backward in which the examinee gives the number sequence in reverse order.

2. Picture Completion--20 drawings of common objects, each of which lacks a single essential element which the examinee must identify.

3. Picture Arrangement--a timed subtest in which the examinee places a series of disordered picture cards in a logical sequence.

4. Object Assembly--a timed subtest where the examinee puts jigsaw pieces together to form common objects.

5. Digit Symbol--a timed subtest which requires the examinee to copy symbols that are paired with numbers.

Like its predecessor, the WAIS, the WAIS-R employs the deviation IQ, with a mean of 100 and standard deviation of 15 for the Verbal Scale, Performance Scale, and Full Scale IQ's. Standard scores for the subtests of the WAIS-R have a mean of 10 and a standard deviation of 3. Standard scores are obtained by converting raw scores into scaled scores using the tables in the WAIS-R manual. These scaled scores are found by comparing the examinee's scores with that of a representative sample of his/her age group (Sattler, 1988).

To obtain the Verbal Scale and Performance Scale IQ's, the subtest scaled scores are summed and this number is compared to the examinee's representative sample age group. The Full Scale IQ is determined by adding the scaled scores of the 6 Verbal Scale subtests with the scaled scores of the 5 Performance Scale subtests. This total score is then compared to that of the representative sample (Sattler, 1988).

The WAIS-R provides reliable IQ's with the reliablilities ranging from r = .95 to r = .97 for the Verbal Scale IQ, from r = .88 to r = .94 for the Performance Scale IQ, and from r = .96 to r = .98 for the Full Scale IQ (Sattler, 1988). Furthermore, the correlation between the WAIS-R and the WAIS remains high. In reviewing several studies, Sattler (1988) found the median correlation for the Verbal Scale equal to r = .94, r = .86 for the Performance Scale, and r = .94 for the Full Scale. The Full Scale IQ's for the WAIS-R were found to be about 8 points lower for average and low average ability individuals, 5 points lower for high average individuals, and 3 points lower for individuals of superior abilities than the Full Scale IQ's of the WAIS. Overall, the WAIS-R appears to be a valid and reliable instrument for assessing ability in adults.

Appendix B

Description of the WMS-R

Verbal Index

1. Logical Memory I--consists of having an individual retell stories that has been read to them.

2. Verbal Paired Associates I--the individual learns eight pairs of words and is asked to recall the correct response to the stimulus words.

Visual Index

1. Figural Memory--the examinee is asked to identify a previously shown design within a larger set of designs.

2. Visual Paired Associates I--requires the examinee to learn the color associated with each of six abstract line drawings.

3. Visual Reproduction I--requires the examinee to draw from memory simple geometric designs that are exposed for ten seconds.

The WMS-R is divided into thirteen subtests which are designed to measure specific aspects of memory. The WMS-R consists of four composites or indices: the Verbal Memory Index, the Visual Memory Index, the Attention-Concentration Index, and the Delayed Recall Index. Scores from the Verbal Memory and Visual Memory Indices are combined to yield a General Memory of Mental Quotient (MQ) score. The Verbal Memory Index is comprised of the Logical Memory I and Verbal Paired Assoicates I subtests. The Visual Memory Index is composed of Figural Memory, Visual Paired Associates I, and Visual Reproduction I subtests.