# A REVISION OF THE NEW ADULT READING TEST

by

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**ABSTRACT**

A comparison of current with premorbid intellectual level is integral to the assessment of organic deterioration. Premorbid test data are rarely available, however, so methods of estimation are needed. Several methods measure performance on tests which are believed to resist deterioration. Other methods utilize the correlation between demographic variables and actual IQ in unimpaired subjects to estimate premorbid IQ. The limitations of these methods are discussed.

The New Adult Reading Test (NART) was developed as another attempt to assess premorbid IQ. Nelson and O'Connell (1978) noted that demented patients' word reading ability was maintained in spite of intellectual deterioration. Since word reading correlated highly with IQ level in a group of unimpaired subjects, it was considered a possible indicator of premorbid intelligence levels. The maintenance of word reading ability is most likely due to previous familiarity with the words, rather than the ability to phonetically decode those words.

Difficult words which can only be deciphered through the application of phonetic rules may be correctly read by the unimpaired, but prove too complex for a demented population. In order to capitalize on the individual's familiarity with words, the NART was devised. The NART consists of 50 words which could not be correctly phonetically decoded. In order to pronounce the words correctly, the individual must have previously learned how they sound. Nelson and O'Connell (1978) found that the NART correlated significantly with IQ in an unimpaired population, and discrepancies between predicted (on the basis of NART performance) and actual IQs were significantly greater in a demented population.

While the NART has promise as an assessment tool for the determination of premorbid intellectual function, it must be modified for current use in a North American population. The purpose of this study was to develop a revised NART word list and to standardize it on an unimpaired Canadian/U.S. population.

Sixty-six unimpaired subjects were tested with a revised NART and all subtests of the WAIS-R. Demographic variables were also recorded in order to

compare prediction accuracies between revised NART and demographic variable prediction equations. It was hypothesized that the revised NART score would correlate significantly with FSIQ, VIQ and PIQ. It was also hypothesized that prediction would prove more accurate with the use of equations based on revised NART and demographic variables than with demographic variables alone as outlined by Barona, Reynolds and Chastain (1984).

All hypotheses were supported. Correlations between actual VIQ, PIQ and FSIQ, and predicted IQs on the basis of revised NART score were .83, .40, and .75, respectively, all significant at $p < .001$. Stepwise multiple regressions of VIQ, PIQ and FSIQ on age, sex, education, occupation, source (U.S. vs. Canadian) and NART score were calculated to generate prediction equations for the estimation of IQs. NART score was the only variable entered into all three prediction equations. Prediction was more accurate with equations based on revised NART score than with prediction equations developed by Barona, et al. (1984).

The present study provides strong support for the use of the revised NART as an assessment tool for the

determination of organic deterioration. The support of further validation research is needed, however, before it can be used with confidence in a clinical setting.

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**DEDICATION**

To Mom, Dad, Matt

and especially Stuart

for

believing in this project

and

believing in me

# I. INTRODUCTION

When assessing neurologically compromised patients, the determination of current general intellectual function is relatively straightforward through the utilization of available neuropsychological assessment tools such as the Wechsler Adult Intelligence Scale - Revised (WAIS-R). Oftentimes, an estimate of premorbid intellectual ability is also sought. Establishing premorbid level of function is important in the determination of whether the individual has sustained deficit or deterioration when compared to their prior level, rather than by comparing performance to group means (Klesges, Wilkening and Golden, 1981; Nelson and O'Connell, 1978). A determination of this discrepancy between an individual's current and premorbid level of function is essential in providing a quantitative indication of the degree of organic dysfunction comparable to a pre-injury standard.

The most straightforward method of ascertaining degree of intellectual deterioration consists of testing the patient before onset of damage or disease and comparing the results to post-injury test results, but premorbid test data is rarely available. Methods of estimation are therefore needed.

# II. REVIEW

## Methods for the Assessment of Premorbid Intellectual Level

### Clinical Estimation

Premorbid intellectual level is often estimated through a clinical interview. From a cursory analysis of the patient's age, education, and occupational status before the onset of disease or injury, the clinician can derive a fairly serviceable estimate of premorbid IQ (Lezak, 1983). A number of studies have explored the actual accuracies of clinicians' estimates of subjects' IQs. Hanna (1950) found a correlation of only .71 between his predicted and actual IQs of a variety of subjects, accounting for less than 50% of the variance in the sample. Sperber and Adlerstein (1961) reported similar results, with a correlation of .70 between five clinicians' estimates and actual WAIS Full Scale IQ in a group of 30 female subjects.

After reviewing a series of studies which utilized both statistical and clinical prediction methods, Meehl (1954, p. 119) concluded, "... it is clear that the dogmatic, complacent assertion sometimes heard from clinicians that 'naturally', clinical prediction, being based on 'real

understanding', is superior, is simply not justified by the facts collected to date. In about half of the studies, the two methods are equal; in the other half, the clinician is definitely inferior."

Partially as a result of clinicians' reluctance to rely solely on interview data, many different methods of more objective estimation of premorbid levels have been designed. These methods generally fall into two categories: those which estimate premorbid IQ on the basis of demographic variables, and those which estimate on the basis of current test performance.

Estimation Based on Demographic Variables

Ladd (1964) and Fogel (1964) were the first investigators to attempt to predict IQ on the basis of demographic measures. In both studies, brain damaged subjects were successfully differentiated from controls on the basis of estimated premorbid IQ from level of education. Matarazzo (1972) also suggested utilizing the relationship between demographic variables and IQ as a method for determining premorbid intellectual level.

The first comprehensive effort to predict premorbid IQ on the basis of demographic variables was made by Wilson, Rosenbaum, Brown, Rourke, Whitman and

Grisell (1978). The subjects (N=1,700) consisted of the 1955 WAIS standardization sample, excluding the Kansas City elderly subjects. WAIS Verbal, Performance and Full Scale IQs were regressed on age, sex, race, education, and occupation. Wilson, et al., report that education and race were the most powerful predictors in each equation. The variance accounted for between education and Verbal IQ, Performance IQ, and Full Scale IQ was 44%, 31%, and 43%, respectively. The shared variance between all five demographic variables and Verbal IQ, Performance IQ, and Full Scale IQ was 53%, 42%, and 54%, respectively. Thus, the four additional variables accounted for approximately 10% more of the variance in their sample.

The regression equations developed by Wilson, et al. to estimate premorbid IQ are as follows:

Verbal IQ = (.18) Age - (2.02) Sex - (8.99) Race + (3.09) Education + (.97) Occupation + 70.80

Performance IQ = (.14) Age - (.66) Sex - (12.91) Race + (2.44) Education + (.91) Occupation + 81.55

Full Scale IQ = (.17) Age - (1.53) Sex - (11.33) Race + (2.97) Education + (1.01) Occupation + 74.05

Where: male=1, female=2, white=1 and nonwhite=2, and Wechsler's (1955, p.7) 13 occupation categories are assigned the following respective weights: 5, 1, 7, 7, 6, 3, 3, 5, 0, 1, 4, 10, and 0.

The standard errors of estimate for the three equations are 10.2, 11.4, and 10.2, respectively.

Several cross validation studies of the Wilson, et al. equations have been reported since their publication in 1978. In 1979, Wilson, Rosenbaum, and Brown compared the performance of 140 neurologic and 140 non-neurologic patients with both the Wilson equation and Wechsler's (1958) deterioration ("Hold-Don't Hold") quotient (see further discussion of this method, below) to assess the clinical utility of each method in the determination of neurologic impairment. If the formulae are sensitive to the effects of brain damage, then the difference between estimated and actual WAIS IQ should be very large in brain damaged subjects, and relatively small in unimpaired subjects. Classification of subjects into neurologic or non-neurologic groups was 63.2% accurate with the Wechsler formula, and 71.8% accurate with the utilization of the Wilson, et al. FSIQ equation.

Klesges, Sanchez, and Stanton (1981) provided further cross validation of the Wilson, et al. equations. Their study was designed to determine whether a significant relationship between actual IQ and estimated IQ existed in samples of neurologically unimpaired outpatients and functional psychiatric inpatients. Patients with any evidence of neurological insult were excluded from the study. In both the outpatient and inpatient samples,

correlations between predicted and obtained VIQ, PIQ and FSIQ values were significant beyond the .001 level. Actual correlations ranged from .36 to .66. In a further analysis, the predicted IQs were shown to be significant overestimates. To adjust for this significant overestimation, Klesges, et al. (1981) utilized an adjusted formula suggested by Wilson, et al. (1978) which accounted for the increase in educational achievement from a mean of 10.1 in 1955 (at the time of the WAIS standardization) to a median of 12.3 in 1975. This adjustment serves to lower the predicted IQ anywhere from 6 to 11 points, depending on the subject's educational level. When the adjusted formulae were utilized in the Klesges, et al. (1981) outpatient sample, the newly predicted mean IQ no longer significantly differed from the actual mean IQ. For the inpatient sample, the education correction factor did reduce the predicted mean, but the predicted mean was still a significant overprediction of the obtained mean. Klesges, et al. (1981) conclude that when the Wilson, et al. formulae are used, the educational correction should be taken into account.

Karzmark, Heaton, Grant, and Matthews (1985) cross-validated and attempted to improve the prediction equations of Wilson, et al. The subjects were 491 control subjects who had not sustained

neurologic damage. Subjects were given the WAIS, and individual demographic data were collected. The Wilson et al. equation FSIQ was able to account for 42% of the variance in the sample, with a standard error of estimate of 11.4. When the above-noted educational adjustment was applied, a less accurate estimate of mean FSIQ resulted.

Karzmark, et al. (1985) also utilized alternative occupational coding systems in an attempt to improve the Wilson, et al. equations, but this did not result in greater predictive accuracy than did the original Wechsler (1958) occupational coding system. Also reported was a univariate prediction formula that uses only education to predict premorbid IQ:

Predicted FSIQ = 2.10 (education) + 85.34

This equation was able to account for 34% of the variance in FSIQ in the sample, with a standard error of estimate of 12.32.

Bolter, Gouvier, Veneklasen, and Long (1982) tested the clinical validity of the Wilson, et al. FSIQ equation with a sample of head trauma patients. They found nonrecovered head injured patients could be correctly classified in 64% of cases. They did not find an advantage in using the educational adjustment suggested by Wilson, et al. (1978) and supported by Klesges, et al. (1981). Gouvier, Bolter, Veneklasen,

and Long (1983) provided further validation of the Wilson, et al. VIQ and PIQ equations with head injured subjects.

In contrast, Klesges, Fisher, Vasey and Pheley (1985) failed to support the use of the Wilson, et al. (1978) formulae. Their results indicated significant, but very small correlations between predicted and actual IQ levels in a group of 73 normal adults. In addition, the predicted premorbid IQs failed to reliably discriminate between groups of normal and brain damaged subjects. The educationally corrected formulae for premorbid IQs suggested by Klesges, et al. (1981) did not improve prediction accuracies. Klesges, et al. (1985, p. 2) conclude that "... we must temper our previous guarded optimism with the adult prediction formulae. Future uses of the Wilson et al. (1978) formulae should probably be restricted to research purposes for the present time."

A major limitation of the Wilson, et al. formulae (1978), as noted by Karzmark, et al. (1985), is that it is based on the WAIS, rather than the WAIS-R, standardization sample. Use of the WAIS results in a FSIQ of approximately 8 points higher, and a VIQ and PIQ of approximately 7 points higher than what would be obtained by the WAIS-R. It was therefore important to develop revised equations for use with the WAIS-R.

Barona, Reynolds, and Chastain (1984) did develop such equations. In addition to the original demographic variables utilized by Wilson, et al. (1978), Barona, et al. included region of residence, urban versus rural (U-R) residence, and handedness as demographic predictor variables. The subjects consisted of the 1981 WAIS-R standardization sample (N = 1,880). The variance accounted for between the five demographic variables and Verbal, Performance, and Full Scale IQ was 38%, 24%, and 36%, respectively. Handedness did not contribute significantly to the estimation of Verbal, Performance, or Full Scale IQ. Region of residence did not contribute significantly to the prediction of Verbal IQ, and U-R residence did not contribute significantly to the prediction of Performance or Full Scale IQ. The following regression equations were developed:

Verbal IQ = 0.49 (Age) + 1.92 (Sex) + 4.24 (Race) + 5.25 (Education) + 1.89 (Occupation) + 1.24 (U-R Residence) + 54.23

Performance IQ = 0.31 (Age) + 1.09 (Sex) + 4.95 (Race) + 3.75 (Education) + 1.54 (Occupation) + 0.82 (Region) + 61.58

Full Scale IQ = 0.47 (Age) + 1.76 (Sex) + 4.71 (Race) + 5.02 (Education) + 1.89 (Occupation) + 0.59 (region) + 54.96.

Where: Sex: Male = 2, Female = 1; Race: Black = 1, Other = 2, White = 3; Region: Southern = 1, North Central = 2, Western = 3, Northeast = 4; Residence: Urban = 2, Rural = 1; Occupation: Professional and technical = 6, Managers, officials, proprietors,

clerical, and sales workers = 5, Craftsmen and foremen (skilled workers) = 4, Not in the labor force = 3, Operatives, service workers, farmers, and farm managers (semiskilled) = 2, Farm laborers, farm foremen, and laborers (unskilled) = 1; Age: 16-17 = 1, 18-19 = 2, 20-24 = 3, 25-34 = 4, 35-44 = 5, 45-54 = 6, 55-64 = 7, 65-69 = 8, and 70-74 = 9; Education: 0-7 = 1, 8 = 2, 9-11 = 3, 12 = 4, 13-15 = 5, and 16 or more = 6.

The standard error of estimate for the three equations are 11.79, 13.23, and 12.14, respectively.

Clinical validation of these equations has not yet appeared in the literature.

A further utilization of the multiple regression technique for determination of premorbid IQ was reported by Reynolds and Gutkin (1979), who used this method to generate prediction equations from the WISC-R standardization sample of 2200 children between the ages of 6 and 16-1/2 years. The demographic variables utilized were father's occupational status, sex, race, urban vs. rural residence, and geographic region of residence. Father's occupational status was categorized into one of five socioeconomic status classifications, as delineated by Wechsler (1974). The variance accounted for between the five demographic variables and WISC-R IQs was 44%, 37%, and 44% for Verbal, Performance, and Full Scale IQ, respectively. Geographic region of the country did not add significantly to the equation for Performance IQ. The following equations were obtained:

Verbal IQ = 127.85 - 3.7 (SES) - 8.86 (Race) - 2.40 (Sex) - 0.68 (Region) - 1.16 (Residence)

Performance IQ = 121.08 - 9.18 (Race) - 2.80 (SES) - 1.07 (Residence) - p.64 (Sex)

Full Scale IQ = 126.9 - 3.65 (SES) - 9.72 (Race) - 1.79 (Sex) - 1.20 (Residence) - 0.41 (Region)

Where: Sex: male = 1, female = 2; Race: white = 1, black = 2, other = 3; SES: upper class = 1, upper middle = 2, middle = 3, lower middle = 4, lower class = 5; Region: Northeast = 1, Northcentral = 2, South = 3, West = 4; Residence: Urban = 1, Rural = 2.

The standard errors of estimate for the three equations are 13.47, 13.97, and 13.50, respectively.

Two attempts at cross validation of the Reynolds and Gutkin (1979) WISC-R prediction equations have been reported. In a sample of 76 unimpaired and 23 organically impaired children, Klesges and Sanchez (1981) reported minimal and nonsignificant correlations between WISC-R IQs and those predicted by the Reynolds and Gutkin equations (unimpaired group: r = .19, .13 and .18 for VIQ, PIQ and FSIQ, respectively; organically impaired group: r = .18, .19, and .18, respectively). The index's ability to discriminate between the two groups was also extremely limited, with an occurrence of 12% false positive and 65% false negative errors.

As Klesges and Sanchez (1981) and Reynolds and Gutkin (1982) clearly point out, however, the Klesges and Sanchez (1981) sample of non-neurologic patients

were actually a clinical referral sample from relatively low socioeconomic status families with lower intellectual function than what would be expected (Mean IQs of the group were 80, 91, and 84 for Verbal, Performance, and Full Scale, respectively). As a result, it is difficult to determine the accuracy of any conclusions regarding the validity of the Reynolds and Gutkin equations on the basis of this sample.

In an attempt to overcome this shortcoming, Klesges (1980) collected WISC-R and demographic data on a sample of 35 normal subjects from middle income families. The mean IQs for this sample were 95, 90, and 93 for Verbal, Performance, and Full Scale IQ, respectively. Correlations between estimated IQs on the basis of the Reynolds and Gutkin formulae and actual WISC-R IQs were .14, .13, and .14 for Verbal, Performance, and Full Scale IQs, respectively, all non-significant. Klesges (1980) also obtained data from a sample of 26 organically impaired children in an attempt to determine whether the Reynolds and Gutkin formulae could discriminate between the two groups. None of the three formulae significantly discriminated between the normal and brain damaged groups.

In summary, the utilization of prediction

equations on the basis of demographic variables can apparently provide only a rough estimate of premorbid IQ. Until more validation research is reported, use of these equations with individual cases should perhaps be tempered with information from other clinical sources.

## Estimation Based on Test Performance

### Vocabulary Tests

The oldest method of estimating premorbid intellectual level comes from the use of performance on vocabulary type tests. This notion arose from clinical observations that vocabulary seems relatively resistant to change in the face of general intellectual decline (Babcock, 1930). The rationale for using vocabulary (or any other current test performance) as a tool for the determination of whether intellectual decline has occurred follows six logical steps, as clearly outlined by Yates (1956) and paraphrased as follows. 1) Certain abilities decline as a result of mental illness. 2) Vocabulary, on the other hand, is relatively resistant to decline. 3) Vocabulary is highly correlated with other estimates of intellectual level. 4) Vocabulary may, therefore, be used as a measure of previous level of intelligence. 5) Other tests may be used as a measure

of present level of functioning. 6) The discrepancy between past and present level estimates serve as an indication of the amount of decline.

The first attempt at utilizing vocabulary to determine premorbid intellectual level was presented by Babcock (1930) as the Babcock-Levy Revised Examination for the Measurement of Efficiency of Mental Functioning. In this test, performance on vocabulary is compared to performance on several other measures (tests of memory, learning, and motor ability). Babcock hypothesized that in organically dementing patients, vocabulary performance would be higher than that found on other measures. Babcock provided clinical validation (1930, 1933) which showed that the ratio between vocabulary and other test performance was related to the amount of deterioration sustained.

The Hunt-Minnesota Test for Organic Brain Damage was described by Hunt in 1943. The test was introduced as a modification of the Babcock-Levy test. It consisted of two major divisions: vocabulary tests and "sensitive deterioration" tests (i.e. new learning tests). The subject's score on the vocabulary section is compared with his score on the deterioration tests, and a T score is derived; high T scores are associated with brain damage. This test is based on the same

principle as the Babcock-Levy test, namely, that vocabulary is resistant to intellectual decline, while other measures of ability will deteriorate.

Shipley (1940) developed a scale for organic deterioration which compared the relative stability of vocabulary skills to deterioration of abstract thinking. In the Shipley-Hartford Retreat Scale, 20 abstraction items and 40 multiple choice vocabulary items are presented in a timed paper and pencil test. A Conceptual Quotient (CQ) is then calculated by contrasting vocabulary to abstraction scores. A low CQ (abstraction/vocabulary ratio) indicates organic deterioration. As the revised manual (1986) states, "this assumption is based on the supposition that impairment has a greater detrimental effect on 'mental processes', such as abstract thinking, than on 'mental content', such as a person's vocabulary." Shipley and Burlingame (1941) provided validation of the Shipley-Hartford Scale through its successful discrimination of psychotic, non-psychotic (but psychiatric) and brain-damaged patients (N = 374).

However, several problems exist with the Shipley-Hartford Scale which should be noted when interpreting the CQ as a measure of organic deterioration. Manson and Grayson (1947) reported a high incidence of impairment in Army prisoners as measured by the

Shipley and suggest that the vocabulary score is artificially high. In addition, normative data were collected only on individuals from fourth grade to the college undergraduate level. Therefore, conclusions cannot be drawn from this test with regard to an older population. The CQ is also significantly correlated with educational level. In general, individuals who have experienced little formal education tend to obtain lower CQ's than individuals with more extensive education (Shipley Institute of Living Scale: Revised Manual, 1986). Due to these problems the scale is not commonly used as a measure of intellectual deterioration. More recently, the efficacy of the Shipley-Hartford Scale as a quick measure of WAIS-R IQ in a normal population has been evaluated (Zachary, Crumpton & Spiegel, 1985; Retzlaff, Slicner & Gibertini, 1986; Heinemann, Harper, Friedman & Whitney, 1985) due to its high correlation with FSIQ in an organically unimpaired population.

An additional method of determining premorbid intellectual level through current vocabulary test performance has been through a comparison of WAIS Vocabulary subtest score with performance on other subtests on the WAIS. Such pattern analyses of the WAIS were very popular after Wechsler's initial introduction of the scale (Wechsler, 1944; Rapaport,

Gill and Schafer, 1945; Rogers, 1951). Underlying this method also lies the assumption that Vocabulary is resistant to intellectual decline.

A more complex method of analyzing WAIS performance to determine organic deterioration was put forth by Wechsler (1944) and modified by subsequent authors. This method, the calculation of Wechsler's "Deterioration Quotient," will be discussed separately below.

An important step in the rationale for the use of vocabulary tests is in the determination that vocabulary does, indeed, correlate highly with general intellectual level in a normal population. If it does not correlate highly, vocabulary's use as a predictor of premorbid intellectual level cannot be justified. The correlation between vocabulary test scores and Verbal IQ as a whole is relatively high. Lewinski (1948) reported a correlation of .809 between Wechsler Vocabulary and the Wechsler Verbal scale. Corsini (1951) reported a correlation of .91 between a 66 word test of vocabulary (the Immediate Test) and the Wechsler-Bellevue Verbal Scale. Zimmerman and Woo-Sam (1973), McFie (1975) and Lezak (1983) identify the Vocabulary subtest of the WAIS and WAIS-R as the commonly accepted single best measure of verbal

ability.

When the IQ measure is non-verbal, however, Vocabulary does not appear to correlate as highly. Thus, Lewinski (1948) found a correlation of .684 between the Vocabulary subtest of the Wechsler and overall Performance IQ. When the intelligence test is a non-verbal test of intellectual ability such as Raven's Standard Progressive Matrices, correlations tend to be very low. Desai (1955) found a correlation of only .34 between Wechsler Vocabulary and Matrices for 190 psychiatric patients.

When the intelligence test is a composite measure of both verbal and non-verbal abilities, the correlation between vocabulary and overall score is variable. Lewinski (1946) reported the correlation between Shipley-Hartford vocabulary and Wechsler FSIQ to be .877. In contrast, Garfield and Fey (1948) found the correlation between Shipley-Hartford vocabulary and Wechsler FSIQ to be only .49 for 100 psychiatric patients.

The degree to which vocabulary measures intelligence therefore appears to depend on what type of intelligence test is being used. If the intelligence measure is largely verbal, correlations between vocabulary and intelligence can be relatively high. With non-verbal type intelligence tests,

however, correlations tend to be much lower.

Several additional criticisms of the use of vocabulary as a measure of organic deterioration have been suggested. Yacorzynski (1941) noted that vocabulary tests are difficult to score, since the answers do not involve a "right" or "wrong" answer; therefore, correct responses on vocabulary tests may occur more often in organically impaired persons solely due to the scoring method employed. If scoring were more rigorous, then vocabulary scores would reflect the same deterioration that other tests do. Numerous early studies were generated in response to this criticism, as reported in Yates (1956). Overall, when more objective scoring methods are utilized for vocabulary tests, a decline in vocabulary remains equivocal in various organically impaired populations (Yates, 1956).

Another criticism of the use of vocabulary is that it does deteriorate, even when rigorously scored. Gottschalk (1942) concluded that the Babcock test could not be reliable in any but the most mild cases of deterioration, since in many organically impaired subjects vocabulary skills had declined as much as other intellectual skills. Russell (1972) noted that vocabulary was as much affected as all other WAIS subtests in brain damaged subjects. And Swiercinzky

and Warnock (1977) demonstrated that vocabulary scores successfully discriminated between brain damaged and normal subjects, indicating a decline in vocabulary skills in the organically impaired group.

Other researchers, however, support Babcock's (1930) contention that Vocabulary tends to be among the least affected verbal capacity. Gonen (1968) reported a single case study of a deteriorated patient with alcoholic encephalopathy who demonstrated dramatic gains in intellectual function following a shunt operation to reduce cerebrospinal fluid pressure in the brain. Results indicated that neither the deterioration nor the restitution of vocabulary performance was as dramatic as on other verbal tasks. In a follow-up study, Gonen and Brown (1968) tested 13 severely intellectually impaired alcoholic encephalopathy patients who also underwent ventroarticular shunting. The authors concluded that vocabulary performance will maintain a "hold" position with moderate to severe deterioration. However, when deterioration becomes severe to the point of disruption in "verbal integration processes" or aphasia, the level of vocabulary performance decreases dramatically, approaching zero.

In conclusion, the evidence to date is equivocal

regarding the use of vocabulary tests as a measure of non-deteriorated performance level in organically impaired patients. In cases of mild deterioration, vocabulary may remain stable. When the dementing process has progressed, however, it is questionable whether vocabulary scores "hold." Caution appears to be warranted when this method is used for the determination of premorbid intellectual level.

## WAIS Deterioration Quotients

An additional method for the determination of premorbid intellectual level on the basis of current test performance is through an analysis of performance on the WAIS. This method essentially expands on the utilization of the Vocabulary subtest of the WAIS alone. Wechsler (1944) was the first to suggest this method of analysis. This method utilizes subtests which are felt to "hold" in relation to those which "don't hold" in the face of organic deterioration with the aging process. As Lezak (1983) states, Wechsler deterioration quotients were developed because of the observation that "subtests requiring immediate memory, concentration, response speed, and abstract concept formation were most likely to show the effects of brain damage ["don't hold"]. The performance of these same patients on tests of previously learned

information and verbal associations tended to be least affected ["hold"]." The Deterioration Quotient (D.Q.) was conceptualized as a comparison between the individual's current level of performance ("don't hold") with his premorbid level of functioning ("hold") (Wechsler, 1958). The formula for the D.Q. is Hold-Don't Hold/Hold, and the cutting score for possible deterioration is .10. Wechsler (1958) suggests .20 as the indicator of "definite deterioration."

The "hold" tests were originally identified on the Wechsler-Bellevue Test as Comprehension, Object Assembly, and Picture Completion. Digit Span, Arithmetic, Digit Symbol, and Block Design were designated as "don't hold" tests (Wechsler, 1944). With the development of the Wechsler Adult Intelligence Scale in 1955 (Wechsler, 1955), the make-up of "hold" and "don't hold" tests changed. Vocabulary replaced Comprehension as a "hold" test, and Similarities was substituted for Arithmetic as a "don't hold" test.

Several studies have been reported regarding the effectiveness of the Wechsler's deterioration quotients in discriminating between organically impaired, schizophrenic, neurotic and normal groups. McFie (1960), Reitan (1959), and Rogers (1950a, 1950b)

report effective discrimination between brain-damaged patients and normals with the use of the Wechsler deterioration quotient, while Bersoff (1970), Kraus and Selecki (1965) and Ladd (1964) report ineffective discrimination between organic and normal groups.

When patients with psychiatric symptoms are also considered, researchers consistently report the ineffectiveness of Wechsler's deterioration quotient to discriminate between the three groups: normal, organically impaired, and psychiatric. Rogers (1950a) found that the deterioration quotient would correctly classify approximately 75% of the subjects, when only brain injured and normal groups were considered. With a psychiatric population included, however, the results were no better than chance; approximately 50% of each group would be incorrectly classified. Crookes (1961) incorrectly classified 35.6% organic and 20.8% nonorganic ("depressive, schizophrenics, paranoid states, neurotics, and psychopaths") subjects with the deterioration quotient. And Bersoff (1970) also failed to support the DQ as a successful discriminator between normal, organic, and psychotic groups.

Additional research has focused on the specific subtests identified by Wechsler as "hold" and "don't hold" indicators. It has been demonstrated, for

example, that Object Assembly as a "hold" test may be a poor predictor (Hunt, 1949; Vogt and Heaton, 1977). Vocabulary, as noted above, has been reported as the best predictor of intellectual status (Zimmerman and Woo-Sam, 1973; McFie, 1975; Lezak, 1983), but may not hold in more severe cases of deterioration (Gonen and Brown, 1968). Picture Completion also correlates highly with general intelligence (Zimmerman and Woo-Sam, 1973) and would be a good "hold" test if it were impervious to the effects of brain damage. But Reitan (1959) found significant differences between brain damaged and normal subjects on this subtest. In addition, McFie (1975) noted that performance on Picture Completion may be sensitive to secondary area occipital and left parieto-occipital lesions.

In addition to the Wechsler (1958) deterioration quotient, several other "hold"/"don't hold" formulae have been suggested by subsequent authors. The one which has generated the most literature is that of Hunt (1949), who suggests using only Information and Comprehension as "hold" tests, while Block Design and Digit Symbol should be considered "don't hold" tests. Gonen (1970) provided validation for the use of these tests as effective determinants for organic impairment in individuals with diffuse cerebral atrophy.

Vogt and Heaton (1977) assessed the diagnostic

accuracies of eight cerebral dysfunction indices based upon the WAIS (Allen, 1948; Hewson, 1949; Hunt, 1949; Norman, 1966; Saunders, 1961; Wechsler, 1944, 1958; Wolff, 1960) with 117 organically impaired and 116 control subjects. They found correct classification rates on the basis of these indicates to be quite low. All formulae, with the exception of the Hunt and Hewson formulae, misclassified high percentages (up to 85.5%) of impaired subjects. Vogt and Heaton conclude that the use of deterioration indices based upon the WAIS have questionable clinical utility in the determination of organic deterioration.

## The New Adult Reading Test

The New Adult Reading Test (NART) (Nelson, 1982) was developed in Britain in another attempt to provide a reliable measure of premorbid intellectual level in patients who had suffered intellectual deterioration. It was noted in clinical assessment of demented patients that their ability to read aloud appeared to be surprisingly well-preserved in comparison to other intellectual abilities. Reading ability was therefore felt to be a possible indicator of premorbid intelligence levels.

In their first level of investigation, Nelson and McKenna (1975) found word reading ability, as measured

by the Schonell Graded Word Reading Test, Form A (SGWRT), and general intelligence level to be significantly correlated ($r = 0.75$) in a group of 98 normal adults, indicating that reading ability could be utilized as a fairly good indicator of IQ in a normal population.

They then tested a demented population and found a positive discrepancy between predicted IQ (on the basis of the SGWRT reading score) and obtained IQ (on the basis of the WAIS administration). In addition, this discrepancy between predicted and obtained scores was significant with the SGWRT score, but not with the WAIS Vocabulary subtest score. This result indicates that reading score as measured on the SGWRT may "hold" in the face of deterioration better than the more traditionally regarded "hold" test of WAIS Vocabulary.

The use of a word reading test as a measure of premorbid ability capitalizes on the subject's previous familiarity with the words. Unlike most vocabulary tests, it does not require the subject to generate examples or provide meanings of the word, which may demand level of abstraction higher than the patient is currently capable. In addition, it does not contain the scoring difficulties inherent in a vocabulary test.

In 1978, Nelson and O'Connell developed a new

word reading test in an attempt to overcome the limitations of the SGWRT; namely, that it could not differentiate higher levels of intelligence because its ceiling was comparable to a Full Scale IQ of only 115, and the easier items did not discriminate differences of ability in an adult population. In addition, Nelson and O'Connell (1978) found that dementing subjects were impaired relative to a group of non-dementing patients in the reading of long, complex, "regular" words, indicating that word reading of this kind may decline. Therefore, a different type of reading test was developed.

Nelson and O'Connell's new word list was composed mainly of "irregular" words which could not be correctly pronounced through the use of common rules of phonetic interpretation. For example, correct pronunciation of "naive" could not be achieved through application of standard phonetic rules. Since the reading of "regular" words may largely depend on the subject's current ability to apply phonetic rules, the use of "irregular" words was felt to capitalize on the subject's premorbid familiarity with the words and therefore be a somewhat more reliable indicator of premorbid ability.

Nelson and O'Connell (1978) standardized the New Adult Reading Test (NART) on a group of 120 patients

admitted to the National Hospital in Queen Square, London, for extracerebral disorders. Seven subtests of the WAIS were administered to all subjects; namely, Arithmetic, Similarities, Digit Span, Vocabulary, Picture Completion, Block Design and Picture Arrangement. VIQ, PIQ and FSIQs were prorated on the basis of these tests. Since age and social class were not found to have a significant effect on reading ability in this sample, the regression of intelligence on NART reading ability was calculated without corrections. The following equations were obtained:

Predicted VIQ = 129.0 - 0.919 x Errors on NART

Predicted PIQ = 123.5 - 0.645 x Errors on NART

Predicted FSIQ = 127.7 - 0.826 x Errors on NART

Standard errors of estimate were 7.6, 9.4, and 7.6, respectively.

In a validation study (1978), Nelson & O'Connell compared the performance of 40 subjects with evidence of bilateral cortical atrophy with the 120 subjects utilized in the standardization sample. The demented group had a significantly lower ($p < .001$) WAIS FSIQ than the control group, as was expected. NART scores between the two groups were not significantly different, however, suggesting resistance of the NART to the effects of the dementing process.

Hart, Smith & Swash (1986) recently reported that

performance on the NART was a better indicator of premorbid function in terms of size of predicted-obtained discrepancies than Verbal-Performance IQ discrepancy (a method of WAIS pattern analysis) or Schonell's Graded Word Reading Test (SGWRT) in demented subjects. Hart, et al. (1986) also report that in a preliminary longitudinal study, NART performance appears stable in the face of intellectual decline.

## III. OUTLINE AND HYPOTHESES FOR THE CURRENT STUDY

While the NART is an extremely promising assessment tool for the determination of premorbid intellectual function in patients who have experienced brain damage or deterioration, it must be modified for current use in a Northern American population. Several items on the NART word list, for example, appear to be correctly read if they are phonetically decoded (e.g., according to Webster's Ninth New Collegiate Dictionary, "thyme" is correctly pronounced both as "thīm" or "tīm"). Standardization for North American pronunciations must also be determined before the NART can be used with confidence in the United States or Canada. In addition, NART performance estimates IQ level on the WAIS rather than

the WAIS-R. A determination of NART correlation with WAIS-R scores is therefore needed. Lastly, the original NART was standardized on the basis of only seven subtests of the WAIS. Such prorating has been regarded as inadvisable (Matarazzo, 1972), and further research with this test should include administration of all subtests of the WAIS-R.

A pilot normal North American sample was tested on a revised NART and all subtests of the WAIS-R to make preliminary determinations regarding the estimation of premorbid intellectual level on the basis of revised NART performance. Both current level of performance (on the basis of the NART) and demographic variables were included in regression equations for the prediction of WAIS-R IQ. The NART was revised to address those problems outlined above.

A pilot sample of clinically referred subjects were also tested on the WAIS-R and the revised NART. Case histories and predicted-obtained discrepancies are discussed.

## Hypotheses

1) Estimated premorbid VIQ and FSIQ scores derived from regression equations based on revised NART performance and demographic variables, and actual

VIQ and FSIQ will be significantly correlated in a group of unimpaired subjects.

2) Correlation between actual and predicted PIQ will be significant, but not as large as VIQ and FSIQ correlations. This result is hypothesized on the basis of Nelson's (1982) previous results and the NART's strong verbal component.

3) The correlations between actual VIQ, PIQ and FSIQ, and estimated VIQ, PIQ and FSIQ will be greater than that achieved through the use of the Barona, et al. (1984) regression equations. This hypothesis is based on the fact that the NART prediction estimates will consider both demographic and current ability (NART performance) variables.

## IV. METHOD

Subjects. The subjects were 17 Americans and 49 Canadians. This total group (N=66) consisted of 35 females and 31 males. Age ranged from 18 to 49 years (mean = 27.4 $\pm$ 8.05).

The American subjects (N=17) consisted of a group of family members of head injured patients seen at an outpatient clinic in Puyallup, Washington. These subjects were 6 males and 11 females between the ages of 18 and 49 years, with a mean age of 29.5.

The Canadian subjects (N=49) were 25 males and 24 females between the ages of 19 and 47 years. The mean age of this group was 26.6 years. Thirty-three of these subjects were volunteers obtained through the Department of Psychology Human Subject Pool at the University of Victoria and were all enrolled in at least one undergraduate psychology course. Of this subgroup, 19 were females and 14 were males, and the age range was from 19 to 47 years (mean age = 27.5 years). Seven Canadian subjects were volunteers from Camosun College in Victoria, B.C., who were all enrolled in adult basic education courses. Of this subgroup, 2 were females and 5 were males, and the age range was from 19 to 27 years (mean age = 23.3). Nine subjects volunteered by signing their names on sign-up sheets distributed throughout Camosun College campus. Of this subgroup, 3 were females and 6 were males, and the age range was from 20 to 40 years (mean age = 25.9 years).

Materials and Procedure. Demographic data, including age, education, race, occupation, and residence, were collected.

All subtests of the WAIS-R and a revised form of the NART (see Appendix A for scoring sheet) were administered in that order. The American subjects

were tested at Good Samaritan Neuropsychological Services in Puyallup, Washington. All Canadian subjects were tested at the University of Victoria Neuropsychology Clinic. The WAIS-R was administered according to standardized instructions outlined by Wechsler (1981).

Modification of the NART word list included:

1) Addition of Words: 54 words were added to the original NART word list (Appendix B) in an attempt to obtain an adequate sample of items from which to devise the final, revised NART. All words were chosen from the Webster's Ninth New Collegiate Dictionary (1985). The words could not be correctly phonetically decoded.

2) North American Pronunciation: Pronunciations were obtained from the Webster's Dictionary (1985) and from the Gage Dictionary of Canadian English (1967). Several language/dialect specialists (Dr. M. H. Scargill, Victoria, B.C.; Dr. R. J. Gregg, Vancouver, B.C.; Dr. J. L. Aten, Long Beach, CA) were consulted regarding "correct" Canadian and American pronunciation of all words on the revised NART. Correct pronunciation of vowel sounds was not considered as important as correct consonant pronunciation. Scoring procedures were modified accordingly to include Canadian and U.S.

pronunciations.

See Appendix C for NART administration procedure.

The revised NART performance for 20 subjects was audiotaped for the purpose of obtaining a measure of interscorer reliability. The alternate scorer was a 26 year-old male with a B.A. degree in Psychology. He was verbally instructed in scoring procedures. Total training time was approximately 15 minutes.

## V. RESULTS

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS-X) (1986), unless otherwise indicated.

The final, revised NART will be referred to as the North American Adult Reading Test (NAART).

1) Description of Population Means. A description of this sample's FSIQ and preliminary NAART scores is presented to provide data regarding sample composition.

Mean Verbal, Performance and Full Scale IQs and NAART scores are presented in Table 1. The correlation of preliminary NAART and FSIQ was calculated separately for American ($r = .66$, $p = .002$) and Canadian ($r = .78$, $p = .000$) groups. A comparison of the difference between the two correlation coefficients was made through the utilization of an r

**Table 1**

Means and Standard Deviations of Test Scores by Population

Total Population (N = 66)

| | |
|---|---|
| VIQ | 105.24 ± 11.71 |
| PIQ | 108.26 ± 11.56 |
| FSIQ | 107.17 ± 11.44 |
| NAART | 36.70 ± 12.50 |

US Population (N = 17)

| | |
|---|---|
| VIQ | 101.82 ± 11.30 |
| PIQ | 110.71 ± 12.99 |
| FSIQ | 106.35 ± 12.25 |
| NAART | 41.82 ± 10.07 |

Canadian Population (N = 49)

| | |
|---|---|
| VIQ | 106.43 ± 11.72 |
| PIQ | 107.41 ± 11.04 |
| FSIQ | 107.45 ± 11.26 |
| NAART | 34.92 ± 12.86 |

to Fisher's z transformation as outlined in Garrett (1958). This difference was not significant ($p > .05$).

The distribution of subjects by age, sex, source, and education is found in Table 2. Figures 1, 2, 3 and 4 are graphic representations of correlations between NAART and FSIQ based on source (U.S. vs. Canadian), sex, education (1-12 vs. 13 and above), and age (18-24 years vs. 25 years and above).

2) Item Analysis. A series of item analyses were performed to provide the best group of items for prediction of IQ in this population.

a) Item-IQ Correlations. Items were correlated with FSIQ, the primary criterion. This procedure was utilized (rather than item-total score correlations) because it maximizes the validity of the test against FSIQ (as opposed to maximizing internal consistency) (Anastasi, 1982). Homogeneity of items is therefore not insured. However, the item content of the revised NART is homogeneous in nature. By utilizing item-IQ correlations but maintaining internal consistency through the inherent nature of the test, the best group of items were selected. A measure of internal consistency is reported below.

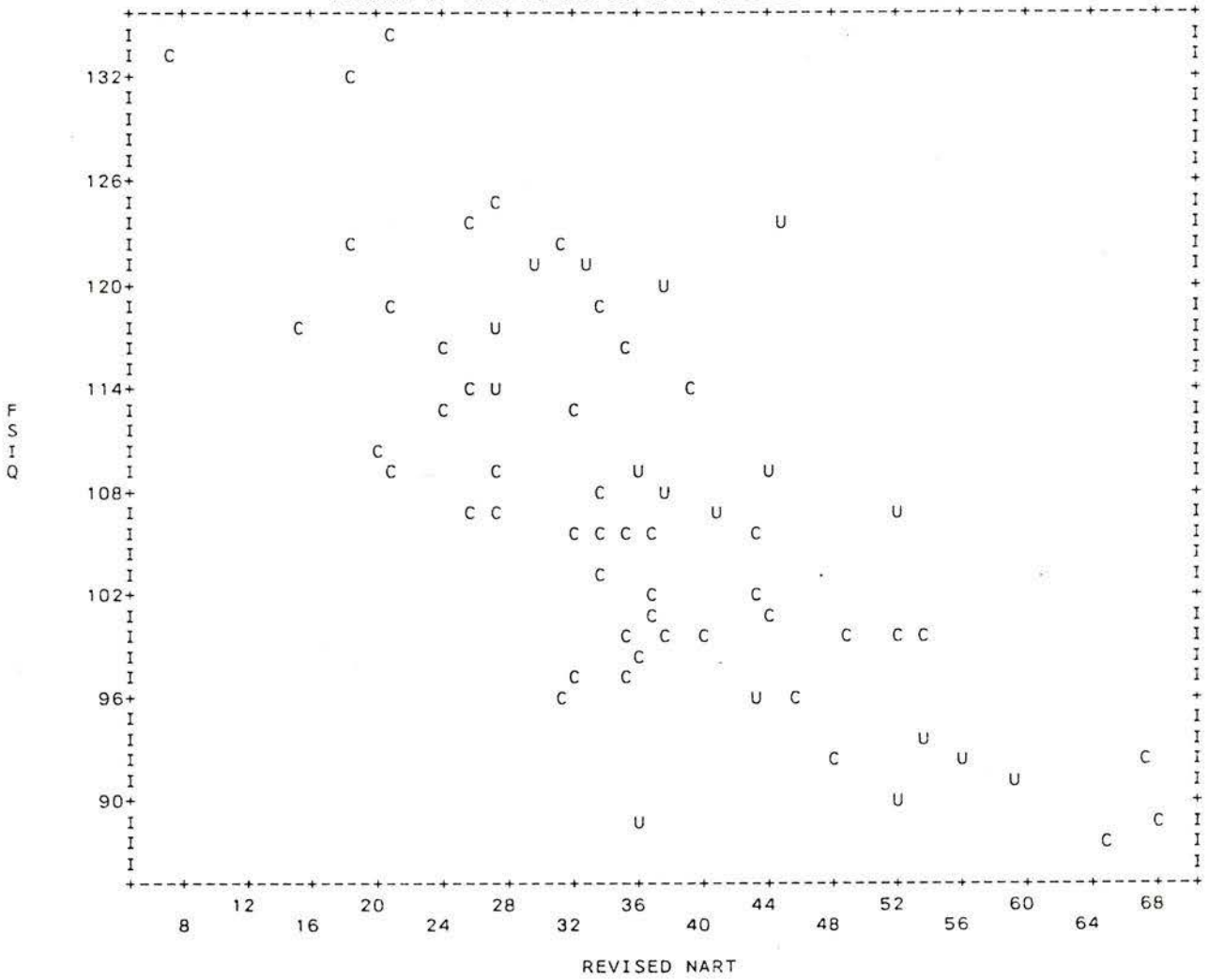
Items with correlations over .2 were considered acceptable (Nunnally, 1967). Items with correlations

**Table 2**

Distribution of Age, Sex, Source, and Education for the Total Sample (N = 66) in Phase I

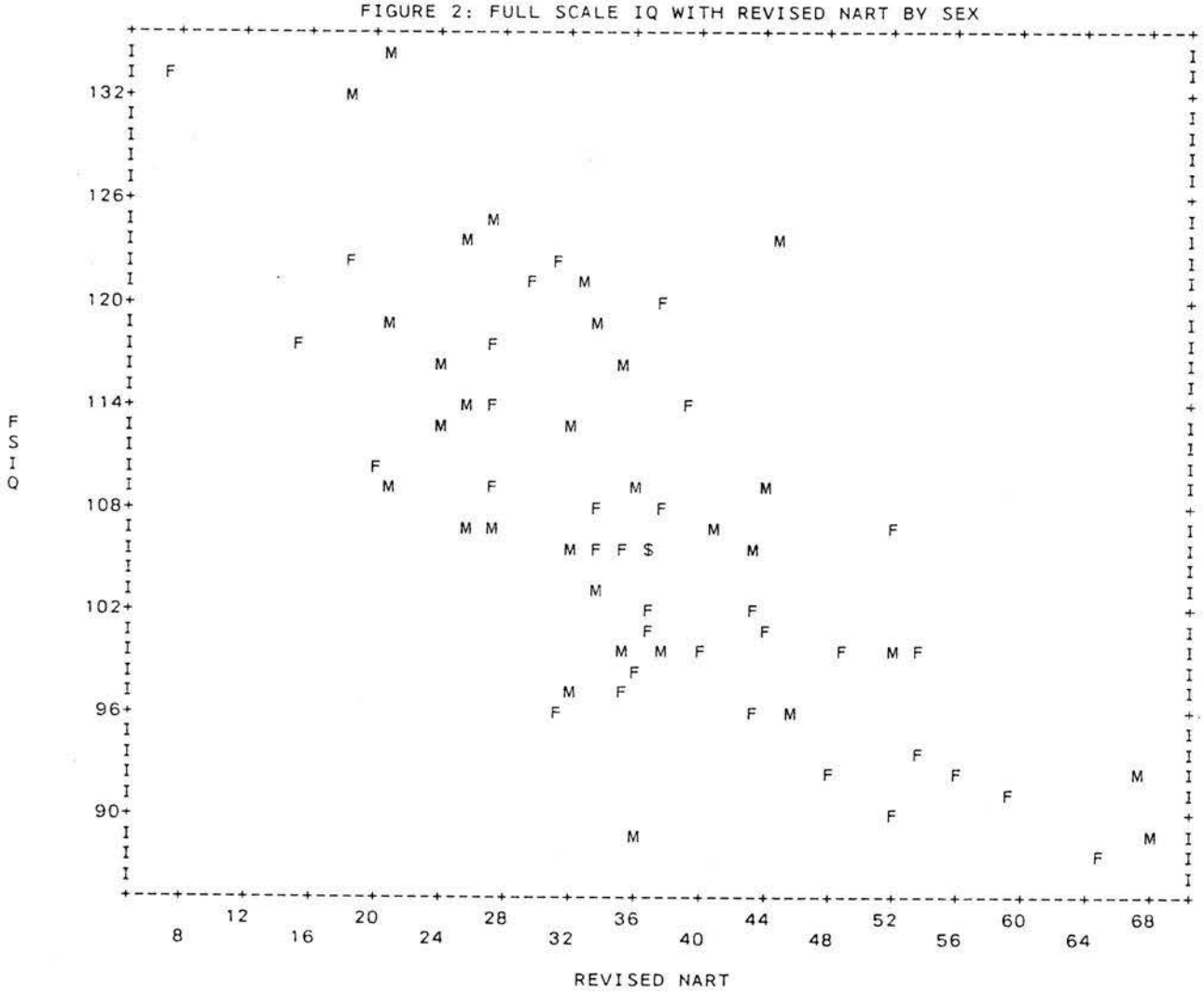
| | | N |
|---|---|---|
| Age | 25 and above | 33 |
| | 18-24 | 33 |
| Sex | Male | 31 |
| | Female | 35 |
| Source | US | 17 |
| | Univ. of Victoria | 33 |
| | Camosun Classes | 07 |
| | Camosun Sign | 09 |
| Education | Above grade 12 | 37 |
| | Grade 12 and below | 29 |

FIGURE 1: FULL SCALE IQ WITH REVISED NART BY SOURCE



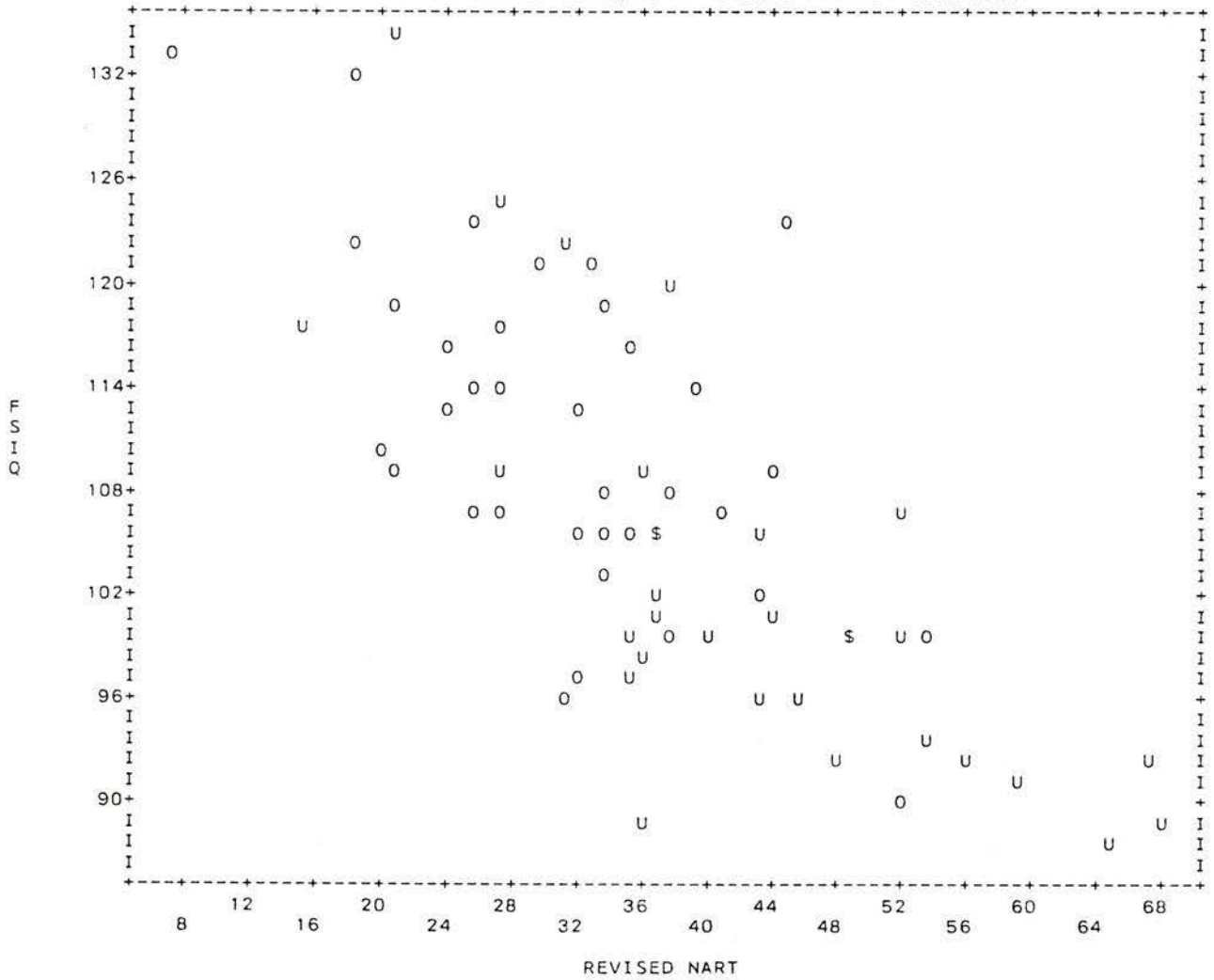

66 cases plotted.
U:US C:CANADIAN $:Multiple occurrence

FIGURE 2: FULL SCALE IQ WITH REVISED NART BY SEX



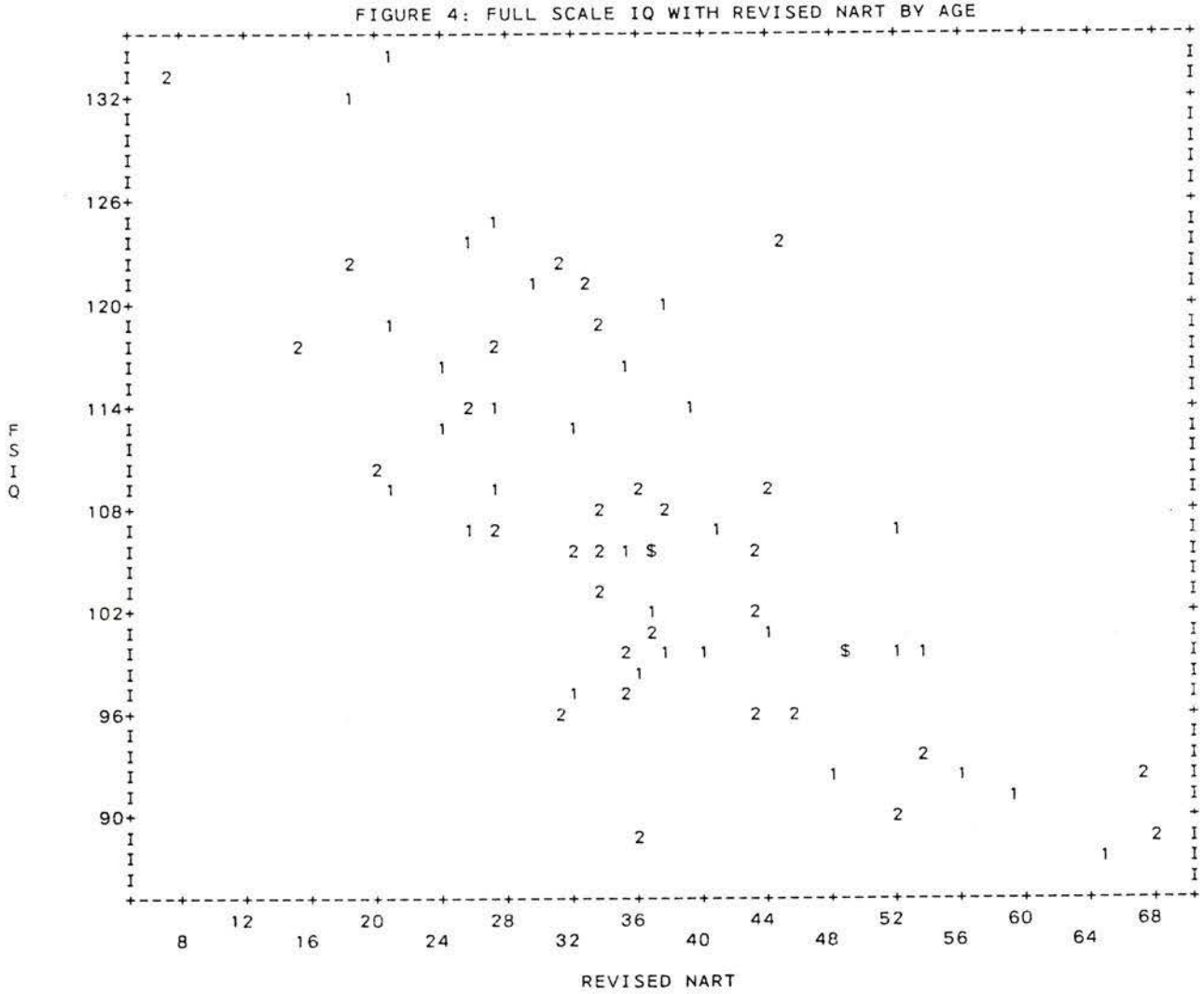

66 cases plotted.
M:MALE F:FEMALE $:Multiple occurrence

FIGURE 3: FULL SCALE IQ WITH REVISED NART BY EDUCATION




66 cases plotted.
U:UNDER 12 O:OVER 12 $:Multiple occurrence

FIGURE 4: FULL SCALE IQ WITH REVISED NART BY AGE




66 cases plotted.
1:18-24 2:25 AND A $:Multiple occurrence

under .2 were not included in subsequent analyses. Item-IQ correlations for each word are presented in Table 3.

b) Order for Item Difficulty. The remaining 61 items were ordered for item difficulty on the basis of total number of errors made on each item. The resulting ordered list of words is presented in Table 4. This final word list, including correct pronunciations, is presented in Appendix D.

c) Figure 5 demonstrates the number of errors for each word in order of item difficulty.

3) Reliability.

a) Internal Consistency. Coefficient alpha is reported as a measure of internal consistency. This statistical method is considered superior to the alternate item split-half method, since it actually represents the mean of all split-half coefficients resulting from different splittings of a test (Anastasi, 1982). Coefficient alpha was calculated to be .935.

b) Interscorer reliability. The number of NAART errors as determined by the author and an alternate scorer for a group of 20 subjects are correlated and presented in Table 5. The reliability coefficient is significant ($r = .99$, $p < .001$).

4) The correlations of the final NAART with VIQ, PIQ and FSIQ are .83, .40 and .75, respectively.

## Table 3

Revised NART Item-FSIQ Correlations

| Word # | Word | r | p | |
|---|---|---|---|---|
| 001 | Come | / | / | |
| 002 | Bear | / | / | |
| 003 | Said | / | / | |
| 004 | Know | / | / | |
| 005 | Above | / | / | |
| 006 | Would | / | / | |
| 007 | Friend | / | / | |
| 008 | People | / | / | |
| 009 | Beauty | / | / | |
| 010 | Tongue | / | / | |
| 011 | Bomber | -.1767 | .078 | |
| 012 | Ache | / | / | |
| 013 | Chalk | / | / | |
| 014 | Debt | -.2830 | .011 | * |
| 015 | Psalm | -.2873 | .010 | * |
| 016 | Depot | -.3003 | .007 | * |
| 017 | Yacht | / | / | |
| 018 | Fasten | / | / | |
| 019 | Chord | / | / | |
| 020 | Cafe | -.1492 | .116 | |
| 021 | Rough | -.1506 | .114 | |
| 022 | Bouquet | -.3132 | .005 | * |
| 023 | Deny | -.0855 | .247 | |
| 024 | Recipe | -.2999 | .007 | * |
| 025 | Debris | -.2788 | .012 | * |
| 026 | Capon | -.2412 | .026 | * |
| 027 | Corps | -.4605 | .000 | * |
| 028 | Quiche | -.1739 | .081 | |
| 029 | Heir | -.3346 | .003 | * |
| 030 | Lingerie | -.3927 | .001 | * |
| 031 | Aisle | -.2596 | .018 | * |
| 032 | Receipt | -.1108 | .188 | |
| 033 | Reign | -.2980 | .008 | * |
| 034 | Subtle | -.4776 | .000 | * |
| 035 | Suave | -.1606 | .099 | |

**Table 3, Continued**

Revised NART Item-FSIQ Correlations

| Word # | Word | r | p | |
|---|---|---|---|---|
| 036 | Nausea | -.1808 | .068 | |
| 037 | Suede | .0597 | .317 | |
| 038 | Equivocal | -.2048 | .050 | * |
| 039 | Coyote | / | / | |
| 040 | Naive | .0664 | .298 | |
| 041 | Gauge | -.2548 | .019 | * |
| 042 | Thyme | -.0653 | .301 | |
| 043 | Courteous | -.1606 | .099 | |
| 044 | Apostrophe | -.1548 | .107 | |
| 045 | Gaoled | -.4145 | .000 | * |
| 046 | Lasagna | -.1506 | .114 | |
| 047 | Procreate | -.3684 | .001 | * |
| 048 | Sieve | -.2709 | .014 | * |
| 049 | Quadruped | -.4981 | .000 | * |
| 050 | Catastrophe | -.1350 | .140 | |
| 051 | Sergeant | -.0481 | .351 | |
| 052 | Catacomb | -.3736 | .001 | * |
| 053 | Reify | -.4169 | .000 | * |
| 054 | Superfluous | -.4302 | .000 | * |
| 055 | Radix | -.3519 | .002 | * |
| 056 | Colonel | -.3521 | .002 | * |
| 057 | Assignate | -.2614 | .017 | * |
| 058 | Hors D'Oeuvre | -.2451 | .024 | * |
| 059 | Gist | -.5126 | .000 | * |
| 060 | Hiatus | -.3802 | .001 | * |
| 061 | Isthmus | -.1796 | .074 | |
| 062 | Simile | -.3450 | .002 | * |
| 063 | Rarefy | -.2040 | .050 | * |
| 064 | Cellist | -.5526 | .000 | * |
| 065 | Impugn | -.2118 | .044 | * |
| 066 | Zealot | -.4325 | .000 | * |
| 067 | Abstemious | -.3255 | .004 | * |
| 068 | Gouge | -.2786 | .012 | * |
| 069 | Indices | -.3305 | .003 | * |
| 070 | Placebo | -.3525 | .002 | * |

Table 3, Continued

Revised NART Item-FSIQ Correlations

| Word # | Word | r | p |
|---|---|---|---|
| 071 | Facade | -.6259 | .002 * |
| 072 | Epitome | -.3217 | .004 * |
| 073 | Aver | -.0953 | .223 |
| 074 | Leviathan | -.4740 | .000 * |
| 075 | Subpoena | -.3637 | .001 * |
| 076 | Aeon | -.2226 | .036 * |
| 077 | Detente | -.4988 | .000 * |
| 078 | Ennui | -.4221 | .000 * |
| 079 | Gauche | -.3032 | .007 * |
| 080 | Caveat | -.5472 | .000 * |
| 081 | Drachm | -.3331 | .003 * |
| 082 | Idyll | -.0722 | .282 |
| 083 | Indict | -.3746 | .001 * |
| 084 | Beatify | -.2836 | .011 * |
| 085 | Banal | -.3228 | .004 * |
| 086 | Paradigm | -.4163 | .000 * |
| 087 | Sidereal | -.2966 | .008 * |
| 088 | Puerperal | -.1578 | .103 |
| 089 | Topiary | -.2077 | .047 * |
| 090 | Praecipe | -.1582 | .102 |
| 091 | Demesne | -.2657 | .016 * |
| 092 | Synecdoche | -.2278 | .033 * |
| 093 | Campanile | -.1709 | .085 |
| 094 | Labile | -.1672 | .090 |
| 095 | Syncope | -.4332 | .000 * |
| 096 | Prelate | -.3717 | .001 * |
| 097 | Vivace | -.2972 | .008 * |
| 098 | Gigue | -.1697 | .087 |
| 099 | Cidevant | -.2601 | .017 * |
| 100 | Epergne | -.3111 | .005 * |
| 101 | Talipes | -.2090 | .046 * |
| 102 | Guyot | -.1570 | .104 |
| 103 | Duiker | -.0028 | .491 |
| 104 | Puisne | -.0200 | .437 |

* Item left in subsequent analyses
/ No correlation coefficient computed due to absence of variance

**Table 4**

North American Adult Reading Test
in Order of Level of Difficulty

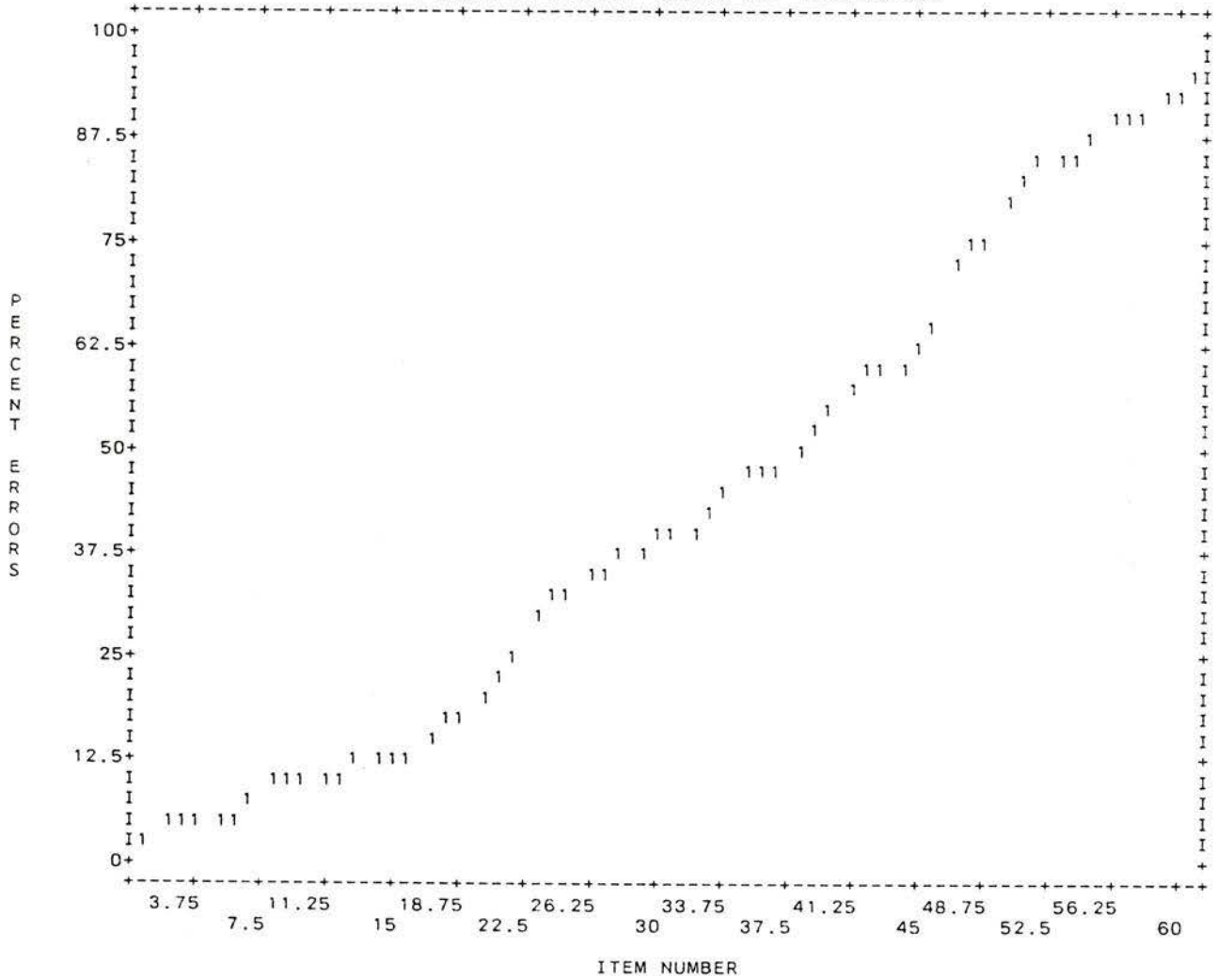
| Word | # Errors |
|---|---|
| Debt | 02 |
| Debris | 03 |
| Aisle | 03 |
| Reign | 03 |
| Depot | 04 |
| Simile | 04 |
| Lingerie | 05 |
| Recipe | 06 |
| Gouge | 06 |
| Heir | 07 |
| Subtle | 07 |
| Catacomb | 07 |
| Bouquet | 08 |
| Gauge | 09 |
| Colonel | 09 |
| Subpoena | 09 |
| Placebo | 10 |
| Procreate | 11 |
| Psalm | 12 |
| Banal | 13 |
| Rarefy | 15 |
| Gist | 17 |
| Corps | 19 |
| Hors D'Oeuvre | 21 |
| Sieve | 22 |
| Hiatus | 23 |
| Gauche | 23 |
| Zealot | 24 |
| Paradigm | 24 |
| Facade | 26 |

**Table 4, Continued**

North American Adult Reading Test
in Order of Level of Difficulty

| | |
|---|---|
| Cellist | 27 |
| Indict | 27 |
| Detente | 28 |
| Impugn | 30 |
| Capon | 31 |
| Radix | 32 |
| Aeon | 32 |
| Epitome | 33 |
| Equivocal | 34 |
| Reify | 37 |
| Indices | 38 |
| Assignate | 39 |
| Topiary | 39 |
| Caveat | 40 |
| Superfluous | 42 |
| Leviathan | 43 |
| Prelate | 48 |
| Quadruped | 49 |
| Sidereal | 49 |
| Abstemious | 53 |
| Beatify | 55 |
| Gaoled | 56 |
| Demesne | 56 |
| Syncope | 56 |
| Ennui | 57 |
| Drachm | 59 |
| Cidevant | 59 |
| Epergne | 60 |
| Vivace | 61 |
| Talipes | 61 |
| Synecdoche | 62 |

FIGURE 5: PERCENT ERRORS VS. ITEM NUMBER




61 cases plotted.

**Table 5**

Interscorer Reliability:
Number of Revised NAART Errors
as Determined by Two Scorers

| ID # | First Scorer | Second Scorer |
|---|---|---|
| 46 | 26 | 25 |
| 47 | 22 | 24 |
| 48 | 20 | 23 |
| 49 | 14 | 17 |
| 50 | 07 | 07 |
| 51 | 25 | 25 |
| 52 | 18 | 17 |
| 53 | 49 | 53 |
| 54 | 12 | 12 |
| 55 | 28 | 29 |
| 56 | 20 | 20 |
| 57 | 42 | 42 |
| 58 | 50 | 49 |
| 59 | 15 | 18 |
| 60 | 48 | 52 |
| 61 | 14 | 16 |
| 62 | 28 | 29 |
| 63 | 20 | 22 |
| 64 | 28 | 34 |
| 65 | 16 | 19 |

$r = .99$, $p < .001$

These correlations are all significant at the $p < .001$ level. The correlations of the original New Adult Reading Test with VIQ, PIQ and FSIQ are .81, .36, and .72, respectively, all of which are significant at the $p < .001$ level.

5) Prediction Equations. Step-wise multiple regressions of VIQ, PIQ, and FSIQ on age, sex, education, occupation, source (U.S. vs. Canadian) and NAART score were calculated to generate prediction equations for the estimation of IQs.

NAART score was the only variable entered into all three prediction equations. None of the demographic variables accounted for a significant amount of the variance in this sample and were therefore not included as predictors. Prediction equations are as follows:

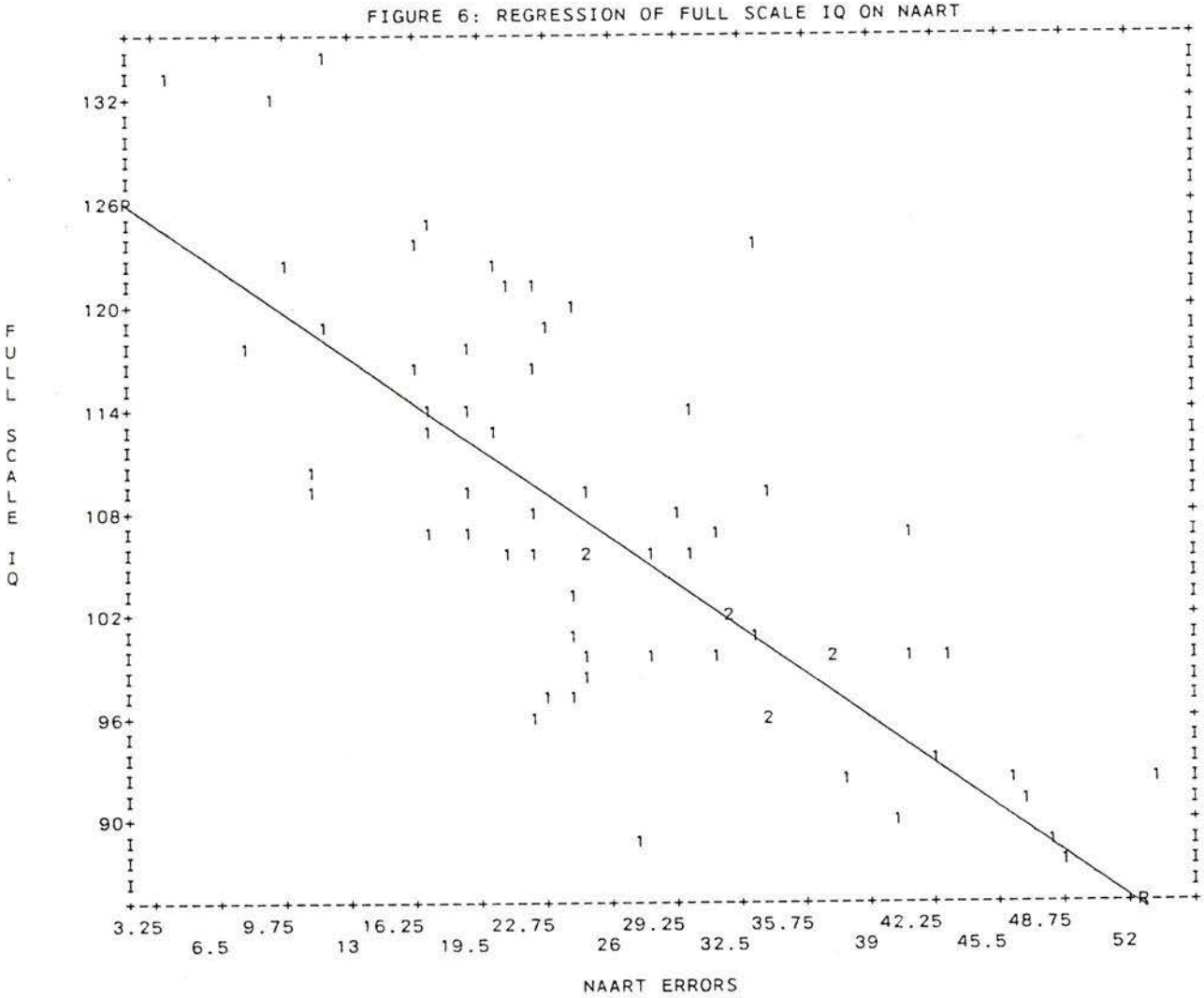
Estimated VIQ = 128.7 - .89 (NAART Errors)

Estimated PIQ = 119.4 - .42 (NAART Errors)

Estimated FSIQ = 127.8 - .78 (NAART Errors)

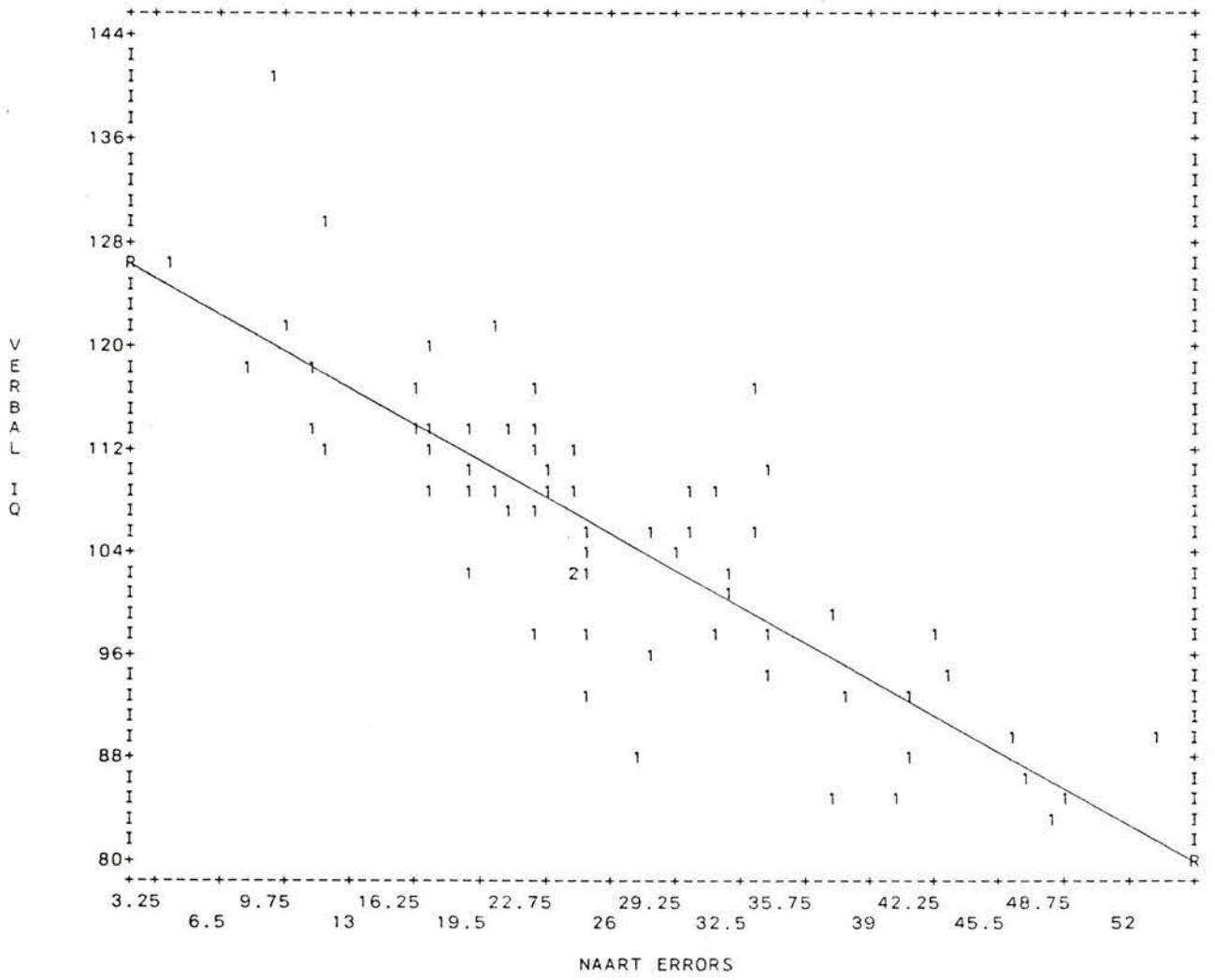
The standard errors of estimate are 6.56, 10.67, and 7.63, respectively. Multiple correlations are .83, .40 and .75, accounting for 68%, 16%, and 56% of the variance in VIQ, PIQ and FSIQ, respectively. Figures 6, 7, and 8 are graphs of the regression lines for FSIQ, VIQ, and PIQ on NAART.

FIGURE 6: REGRESSION OF FULL SCALE IQ ON NAART



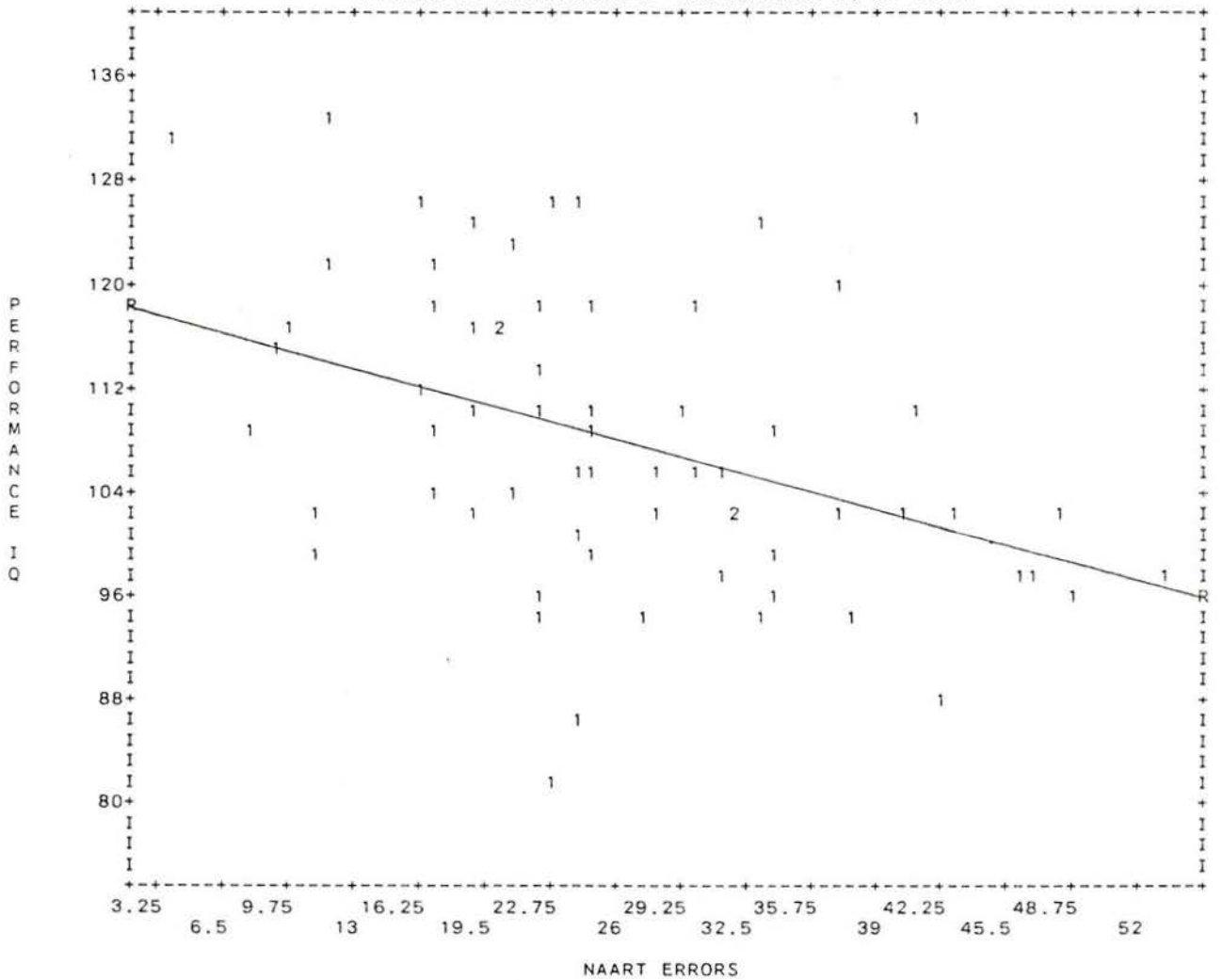

66 cases plotted. Regression statistics of FSIQ on NNAART:
Correlation -.74886 R Squared .56080 S.E. of Est 7.63805 2-tailed Sig. .0000
Intercept(S.E.) 127.81842( 2.47043) Slope(S.E.) -.78334( .08665)

FIGURE 7: REGRESSION OF VERBAL IQ ON NAART




66 cases plotted. Regression statistics of VIQ on NNAART:
Correlation -.83130 R Squared .69107 S.E. of Est 6.55745 2-tailed Sig. .0000
Intercept(S.E.) 128.71002( 2.12092) Slope(S.E.) -.89015( .07440)

FIGURE 8: REGRESSION OF PERFORMANCE IQ ON NAART




66 cases plotted. Regression statistics of PIQ on NNAART:
Correlation -.40033 R Squared .16027 S.E. of Est 10.67717 2-tailed Sig. .0009
Intercept(S.E.) 119.41883( 3.45339) Slope(S.E.) -.42336( .12113)

When NAART score is excluded from the multiple regression analysis and only demographic variables are utilized as predictor variables, multiple correlations are .45, .33, and .39, accounting for 20%, 11% and 15% of the variance in VIQ, PIQ and FSIQ, respectively.

6) Barona, et al. equations. VIQ, PIQ and FSIQ were estimated with the utilization of the Barona, et al. equations and NAART equations. Table 6 lists means and standard deviations of Barona estimated and NAART estimated FSIQ, VIQ and PIQs. Table 7 lists correlations between Barona estimated and actual IQs, and NAART estimated and actual IQs. Using the r to Fisher's z transformation outlined in Garrett (1958), correlations of FSIQ and VIQ were significantly different ($p < .05$); PIQ correlations were not significantly different ($p > .05$).

**Table 6**

Estimated VIQ, PIQ, and FSIQs
from Barona and NAART Prediction Equations

Estimated on Basis of Barona Equations:

| | | |
|---|---|---|
| Verbal IQ | Mean 103.39 | S.D. 5.60 |
| Performance IQ | Mean 103.39 | S.D. 3.96 |
| Full Scale IQ | Mean 103.78 | S.D. 5.33 |

Estimated on Basis of NAART Equations:

| | | |
|---|---|---|
| Verbal IQ | Mean 105.24 | S.D. 9.73 |
| Performance IQ | Mean 108.33 | S.D. 4.59 |
| Full Scale IQ | Mean 107.24 | S.D. 8.53 |

Actual IQs:

| | | |
|---|---|---|
| Verbal IQ | Mean 105.24 | S.D. 11.71 |
| Performance IQ | Mean 108.26 | S.D. 11.56 |
| Full Scale IQ | Mean 107.17 | S.D. 11.44 |

**Table 7**

Correlations of Estimated with Actual IQs

Barona Equations

| | r | p |
|---|---|---|
| FSIQ | .4727 | .000 |
| VIQ | .5301 | .000 |
| PIQ | .2923 | .009 |

NAART Equations

| | r | p |
|---|---|---|
| FSIQ | .7489 | .000 |
| VIQ | .8313 | .000 |
| PIQ | .4003 | .000 |

# VI. DISCUSSION

## A. Population Composition

The subject sample was composed of a heterogeneous group of adults from the United States and Canada. This sample was pooled because no significant difference between correlations of Canadians and Americans on FSIQ and NAART were found. Age, sex, and education MANOVA group comparisons were not reported due to the limited sample size. Visual inspection of scatterplots on the basis of age, sex, education and source reveal a subjectively homogeneous distribution of scores for these demographic variables.

As with all research on non-randomly selected, small samples, generalizations of results to other populations should be made with caution.

## B. Word List

Item-IQ correlations on the revised NART resulted in the deletion of 43 items, 12 of which were from the original NART. Items with correlations below .2 were not included in the final NAART. Sixteen items were not included due to the absence of variance in error scores (no subjects committed errors). Visual inspection of items did not generate a hypothesis to

account for low item-total correlations.

Further inspection of the final word list reveals that the distribution of error scores is relatively linear (as graphically represented in Figure 5). This homogeneous distribution of item difficulty is essential in order to make fine predictive discriminations.

A ceiling score was not established for the NAART. The NAART only takes approximately 10 minutes to administer and does not appear to cause a significant amount of frustration on the part of the test taker. In fact, most subjects tend to think they are doing quite well on this test since all words are relatively easily pronounced through the application of phonetic rules. Even after 10 consecutive errors, 19.7% of subjects correctly pronounced at least one more word (a difference of one or more IQ points). It is therefore recommended that the test taker be allowed to complete the entire test regardless of the number of errors made.

C. Reliability

1. Internal Consistency. Coefficient alpha for this sample was .935. This result reflects a high degree of internal consistency with regard to content sampling. This result was expected in light of the

homogeneous nature of the NAART.

2. Scorer Reliability. Since scoring of the NAART involves some subjective interpretation on the part of the examiner, a measure of scorer reliability was calculated. This measure was obtained with 20 Canadian subjects. Reliability was .99 ($p < .001$), reflecting a high degree of agreement between the two scorers. This is an encouraging result given the nature of NAART scoring procedures.

D. Validity

1. Content-Related Validity. Content validation consists of the systematic evaluation of a test to determine whether it covers a representative sample of the behavior to be measured (Anastasi, 1982). In this case, the behavior measured is the ability to correctly pronounce words which are not phonetically decodable. Items added to the NART were therefore chosen on the basis of one straightforward criterion: an inability to correctly pronounce the word through the application of phonetic rules. A few items from the original NART could be correctly phonetically decoded (e.g. thyme, labile, prelate, courteous, procreate, radix), and these were left in the analyses of the word list, but were generally excluded from the final NART on the basis of low item-IQ correlations.

Since the included words (radix, procreate, assignate, banal, topiary, prelate) do not constitute a large proportion of the word list, content validation of the NAART is reasonably insured.

2. Concurrent Validity. Concurrent validity is measured by the extent to which NAART error score correlates with current FSIQ, PIQ and VIQ. These correlations are all significant at $p < .001$. These significant correlations are integral to the validation of the NAART as a predictor of premorbid IQ.

3. Construct-Related Validity. Construct validity is the extent to which the test measures a theoretical construct or trait (Nunnally, 1978; Anastasi, 1982). This issue is important for validation of the WAIS-R, since intelligence is a complex and multifaceted construct which is difficult to measure through psychometric means. Construct validation of the NAART is not critical, however, since its purpose is not to measure intelligence per se. Critical validation measures for the NAART are the concurrent validity in a normative sample and the postdictive validity in a demented population.

## E. Prediction Equations

NAART error score was the only variable which

accounted for a significant amount of variance in VIQ, PIQ, or FSIQ, and therefore the only variable entered into prediction equations. When all demographic variables were forced into the FSIQ regression equation along with NAART score, the percentage of variance accounted for increased by only three per cent (56% to 59%). Utilization of only demographic variables as predictors resulted in a decrease of 49%, 5%, and 41% of variance accounted for in VIQ, PIQ and FSIQ, respectively. Demographic variables were not significant or meaningful predictors of IQ in this sample.

This result was not expected given previous IQ prediction success with the use of these variables. The factor which most likely accounts for this result is limited sampling of age, education, and occupation (see Appendix E). Fifty-four of the sixty-six subjects were students, thereby dramatically reducing the contribution of occupational variability to the prediction of IQs. In addition, a relatively small distribution of age ranges was sampled in the Canadian group, with 24 of 49 subjects falling between the ages of 20 and 25. Highest educational level achieved was also limited in variability, with only 11 of 66 subjects having below a grade 12 education. Finally, demographic variables may have been significant

predictors of IQs if the sample size was larger. These limitations in sample composition restrict the use of demographic variables for prediction of IQs.

Standard errors of estimate are relatively large for all three prediction equations, making predictions about individual cases somewhat guarded. For predictions of VIQ, PIQ and FSIQ, the "true" values are at most 12.86, 20.91, and 14.95 IQ points different from the predicted values at the 95% confidence level, respectively. When making predictions for individual cases, a cut-off score of 15 VIQ and FSIQ, and 21 PIQ points predicted-obtained positive discrepancy are therefore recommended on the basis of the 95% confidence level. Greater discrepancies can be interpreted by the clinician as indicators of organic deterioration.

As with all indices of organic dysfunction, however, the NAART should be used in combination with an overall pattern of clinical observation, history and additional test scores when making determinations regarding deterioration.

G. Barona, et al. vs. NAART Prediction Equations

The NAART VIQ and FSIQ prediction equations resulted in significantly higher predicted-obtained correlations than the Barona, et al. equations.

Comparisons regarding relative efficacy of the two approaches can not be made, however, due to the limitations in sample composition discussed above. The nonsignificant difference in PIQ predicted-obtained correlations is most likely due to the relatively low correlation between PIQ and NAART error score.

H. Summary of Hypotheses

1. Estimated premorbid FSIQ and VIQ scores derived from regression equations based on NAART performance and actual FSIQ and VIQ were significantly correlated in a group of organically unimpaired subjects. This result supports hypothesis 1.

2. The correlation between actual and predicted PIQs was significant, but not as high as FSIQ and VIQ correlations. This result supports hypothesis 2.

3. The correlations between actual FSIQ, VIQ, and PIQ, and estimated FSIQ, VIQ and PIQ were greater through utilization of NAART error scores than that achieved through the use of the Barona, et al. (1984) regression equations. Due to inadequacies in population composition, however, these data provide only limited support for hypothesis 3.

I. Clinical Experience with the NAART

Case #1

Mr. H.

Mr. H. is a 76 year-old man who was referred to the University of Victoria Neuropsychology Clinic for assessment of his memory impairment. According to his wife, he repeated himself unknowingly during conversations, forgot names and had word finding problems. These problems had become progressively worse since their onset twelve years ago. Mr. H. quit school upon completion of grade 10, a decision which he says was "silly." He had held a number of relatively high level professional positions throughout his life. Mr. H. presented himself as a well-dressed, cooperative and articulate man with a good sense of humor. Mr. H.'s WAIS-R age-scaled subtest and IQ scores are as follows:

| Verbal Scale | | Performance Scale | |
|---|---|---|---|
| Information | 8 | Picture Completion | 9 |
| Digit Span | 14 | Picture Arrangement | 12 |
| Vocabulary | 12 | Block Design | 19 |
| Arithmetic | 8 | Object Assembly | 12 |
| Comprehension | 10 | Digit Symbol | 11 |
| Similarities | 10 | | |
| Verbal IQ | 102 | Performance IQ | 109 |

Full Scale IQ 105

Upon complete neuropsychological evaluation, it was determined that Mr. H.'s significant short-term memory loss was organic in nature, but not consistent with an Alzheimer-type dementia. Mr. H.'s significant memory impairment most likely resulted in decreased subtest scores on the Information and Arithmetic subtests, leading to somewhat lowered VIQ and FSIQ values.

Mr. H. was given the NAART in an attempt to obtain an estimate of his premorbid IQ status. His performance (8 errors) placed him at an estimated VIQ of 122, PIQ of 116, and FSIQ of 122. Estimated-obtained discrepancies are 20, 7, and 17 for VIQ, PIQ and FSIQ, respectively. Based on cut-off scores reported above, Mr. H. would be considered organically impaired on VIQ and FSIQ measures. This result is consistent with his history and current memory impairment.

Case #2

Mrs. D.

Mrs. D. is a 77 year-old woman who was seen at the University of Victoria Neuropsychology Clinic for assessment of her memory difficulty. Her primary complaint was "forgetfulness," which she described as difficulty finding the correct word in conversation. Mrs. D. was a college-level mathematics teacher until

a forced retirement at age 65. She said she had noticed slight word finding problems while lecturing just prior to retirement but that this had worsened in the past two years.

Mrs. D. also reported symptoms of disorientation and confusion. She stated that she became confused while watching educational television programs and when listening to conversations. She also reported difficulty with simple arithmetic.

Her performance on the WAIS-R is reported as follows:

| Verbal Scale | | Performance Scale | |
|---|---|---|---|
| Information | 8 | Picture Completion | 2 |
| Digit Span | 12 | Picture Arrangement | 4 |
| Vocabulary | 11 | Block Design | 5 |
| Arithmetic | 8 | Object Assembly | 3 |
| Comprehension | 5 | Digit Symbol | 6 |
| Similarities | 9 | | |
| Verbal IQ | 91 | Performance IQ | 68 |

Full Scale IQ 81

Interpretation of her neuropsychological test performance resulted in the conclusion that Mrs. D. was suffering from significant difficulty in cognitive performance consistent with dementia. Due to a significant visual acuity problem, however, it was difficult to interpret her poor scores on Performance Scale subtests.

Mrs. D. made 27 errors on the NAART, which resulted in an estimated VIQ of 105, PIQ of 108, and

FSIQ of 107. Predicted-obtained discrepancies were 14, 40 and 27, respectively. These results are indicative of a moderate but not significant VIQ decline, a substantial and significant PIQ decline, and a significant FSIQ decline. The very large PIQ discrepancy is partially due to Mrs. D.'s poor visual acuity, which also contributed to a low actual FSIQ score. Overall, Mrs. D.'s performance on the NAART suggests moderate but not marked cognitive decline.

## Case #3

### Mrs. M.

Mrs. M. was referred to the Neuropsychology Clinic at the University of Victoria for assessment of memory problems. She stated that she often forgot to do important things, like pick up her children from school. She also reported some word finding difficulties and problems with concentration. Mrs. M. was concerned about the possibility of Alzheimer's disease.

Mrs. M., a 36 year-old, was a homemaker and lived with her husband and their three children. She reported experiencing some stress related to her children, but did not endorse classical depressive symptoms. Mr. M. had worked in several different labor-type jobs in the past. She had a high school

education with some post-high school training.

Mrs. M. presented with a somewhat flat affect and unkempt appearance. Her scores on the WAIS-R are as follows:

| Verbal Scale | | Performance Scale | |
|---|---|---|---|
| Information | 14 | Picture Completion | 11 |
| Digit Span | 12 | Picture Arrangement | 12 |
| Vocabulary | 17 | Block Design | 13 |
| Arithmetic | 7 | Object Assembly | 12 |
| Comprehension | 16 | Digit Symbol | 10 |
| Similarities | 15 | | |
| Verbal IQ | 123 | Performance IQ | 111 |
| | | Full Scale IQ | 121 |

Neuropsychological testing revealed no cognitive impairments consistent with organic deterioration or damage, and it was concluded that Mrs. M.'s memory complaints were most likely due to functional factors.

Mrs. M.'s performance on the NAART supports the above conclusion. She made 17 errors, leading to a predicted VIQ of 114, PIQ of 112, and FSIQ of 115. Predicted-obtained discrepancies are -9, 1, and -6 for VIQ, PIQ and FSIQ, respectively, none of which are indicative of cognitive decline.

## I. Suggestions for Future Research

Further validation studies of the NAART should be done on a wider sample of unimpaired and a variety of clinical populations, including a large sample of demented subjects, other neurologically impaired

groups such as head injured and stroke victims, and patients with psychiatric diagnoses. Until such additional studies validate the use of the NAART, it cannot be used with confidence for the determination of organic impairment.

The results of this investigation provide preliminary support for the use of the NAART in the assessment of organic dysfunction.

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Appendix A
NORTH AMERICAN ADULT READING TEST (NAART)
Scoring Sheet

| | |
|---|---|
| COME | kəm |
| BEAR | ba(ə)r |
| SAID | sed |
| KNOW | nō |
| ABOVE | əbəv′ |
| WOULD | wəd |
| FRIEND | frend |
| PEOPLE | pē′· pəl |
| BEAUTY | byüt′· ē |
| TONGUE | təng |
| BOMBER | bäm′· ər |
| ACHE | āk |
| CHALK | chȯk |
| DEBT | det |
| PSALM | säm, sȧm, sälm* |
| DEPOT | de′· pō, dē′· pō |
| YACHT | yät |
| FASTEN | fas′· ə n |
| CHORD | kô(ə)rd |
| CAFE | ka· fā′, kə· fā′ |
| ROUGH | rəf |
| BOUQUET | bō· kā′, bü· kā′ |
| DENY | di· nī′ |
| RECIPE | res′· ə· pē |
| DEBRIS | də· brē′, dā· brē′, dā′· brē |

| | |
|---|---|
| CAPON | kā′· pən, kā′· pon |
| CORPS | kôr, kôrz |
| QUICHE | kēsh |
| HEIR | ār |
| LINGERIE | lan′· zhə· rē′, lon′· zhə· rā′ |
| AISLE | īl |
| RECEIPT | ri· sēt′ |
| REIGN | rān |
| SUBTLE | sət′· ᵊl |
| SUAVE | swäv |
| NAUSEA | nȯ· zē· ə, nȯ· sē· ə, nȯ· zhē· ə, nȯ· shē· ə |
| SUEDE | swād |
| EQUIVOCAL | i· kwiv′· ə· kəl |
| COYOTE | kī· ōt′· ē, kī′· ōt |
| NAIVE | nī· ēv′ |
| GAUGE | gāj |
| THYME | tīm, thīm* |
| COURTEOUS | kər′· te· əs |
| APOSTROPHE | ə· pos′· trə· fe |
| GAOLED | jāld |
| LASAGNA | lə· zän′· yə |
| PROCREATE | prō′· krē· āt |
| SIEVE | siv |
| QUADRUPED | kwäd′· rə· ped |
| CATASTROPHE | kə· tas′· trə· fē |

SERGEANT sär'·jənt

CATACOMB kat'·ə·kōm

REIFY rā'·ə·fī, rē'·ə·fī

SUPERFLUOUS sù·pèr'·flü·əs

RADIX rād'·iks

COLONEL kərn'·ᵊl

ASSIGNATE as'·ig·nāt'

HORS D'OEUVRE ȯr'·dərv(r)'

GIST jist

HIATUS hī·ā·təs

ISTHMUS is'·məs

SIMILE sim'·ə·lē

RAREFY rãr'·ə·fī

CELLIST chel'·əst

IMPUGN im·pyün'

ZEALOT zel'·ət

ABSTEMIOUS ab·stē'·mē·əs

GOUGE gauj

INDICES in'·də·sēz

PLACEBO plä·chā'·bō, plə·sē'·bō

FACADE fə·säd'

EPITOME i·pit'·ə·mē

AVER ə·vər'

LEVIATHAN li·vī'·ə·thən

SUBPOENA sə·pē'·nə

AEON ē'·ən, ē'·än

DETENTE dā·tä(n)t

ENNUI än·wē', än'·wē, än'·wē'

GAUCHE gōsh

CAVEAT kav'·ē·at, kāv'·ē·at, kā·vē·at'**

DRACHM dram

IDYLL īd'·ᵊl, id'·il**

INDICT in·dīt'

BEATIFY bē·at'·ə·fī

BANAL bə·nal', ba·nàl', bā·nal', bān'·ᵊl

PARADIGM par'·ə·dim, par'·ə·dim

SIDEREAL sī·dir'·ē·al, sə·dir'·ē·al

PUERPERAL pyü·ər'·p(ə)·rəl

TOPIARY tō'·pē·er'·ē

PRAECIPE pres'·ə·pē, prēs'·ə·pē

DEMESNE di·mān', di·mēn

SYNECDOCHE sə·nek'·də·kē

CAMPANILE kam·pə·nē'·lē, kam·pə·nē'·lā, kam·pə·nē(ə)l*

LABILE lā'·bil, lā'·bəl

SYNCOPE sing'·kə·pē, sin'·kə·pē

PRELATE prel'·ət, prēl'·āt*

VIVACE vē·väch'·ā, vē·väch'·ē

GIGUE zhēg

CIDEVANT sēd·ə·vä(n)'

EPERGNE i·pərn', ā·pərn'

TALIPES tal'·ə·pēz

GUYOT gē'·ō

DUIKER dī'·kər

PUISNE pyü·nē

* Correct U.S. pronunciation only

** Correct Canadian pronunciation only

ACHE āk

DEBT det

PSALM säm

DEPOT dep'ō

CHORD körd

BOUQUET bōō k'ā, bōō kā'

DENY di-nī'

CAPON kā'-pn

HEIR ār

AISLE īl

SUBTLE sut'l

NAUSEA nö'si-ə, nöshi-ə, nō'zhə

EQUIVOCAL i-kwiv'ə-kl

NAIVE nā-ēv'

THYME tīm

COURTEOUS kûrt'yas

GAOLED jāld

PROCREATE prō'kri-āt

QUADRUPED kwod'rŏō-ped.

CATACOMB kat'ə-kōm, kat'ə-kōōm.

SUPERFLUOUS sōō-pûr'flŏō-əs,
RADIX sū-pûr'flŏō-əs
rā'diks, rā'dēks.

ASSIGNATE as'-ig-nāt

GIST jist

HIATUS hi-ā'təs

SIMILE sim'i-li

RAREFY rār'-i-fī.

CELLIST chel'ist

ZEALOT zel'ət

ABSTEMIOUS ab-stē'mi-əs

GOUGE gowj

PLACEBO plə-sē'bŏ.

FACADE fə-säd'

AVER ə-vûr'

LEVIATHAN le-vī'ə-thən

AEON ē'ən

DETENTE dā-tãt' (Fr)

GAUCHE gō sh

DRACHM dram

IDYLL īd'il, īd'əl.

BEATIFY bi-at'i-fī

BANAL bən-al'

SIDEREAL sī-dē'ri-əl

PUERPERAL pū-ûr'pər-əl

TOPIARY tō'pi-ə-ri

DEMESNE di-mān', di-mēn'.

CAMPANILE kam-pan-ē'lā

LABILE lā'bīl

SYNCOPE sing'kə-pi

PRELATE prel'it

## APPENDIX C

NAART Administration Procedure

The test is administered according to guidelines outlined in the New Adult Reading Test manual (Nelson, 1982).

The tester should thoroughly familiarize himself with all words before administering the test. Slight variations in pronunciation are acceptable when these are due to regional accents. However, it should be borne in mind that if the correct pronunciations are not adhered to then the accuracy of the test depends on the accuracy of the tester's interpretation of the subject's responses; for this reason the practice is not recommended for inexperienced testers. The word list is given to the subjects. The tester records errors made on the Scoring Sheet.

The following instructions are given: "I want you to read slowly down this list of words starting here [indicate 'COME'] and continuing down this column and on to the next. When you have finished reading the

words on this page, turn the sheet over and begin here [indicate 'SERGEANT']. After each word please wait until I say 'next' before reading the next word. I must warn you that there are many words that you probably won't recognize, in fact most people don't know them, so just guess at these, O.K.? Go ahead."

The subject should be encouraged to guess and all responses should be reinforced ("good", "that's fine", etc.). The subject may chage a response if he wishes to do so but if more than one version is given the subject must decide which is his final choice. No time limit is imposed.

# APPENDIX D

## NORTH AMERICAN ADULT READING TEST (NAART)
(Final Revision)

Scoring Sheet

| | | | |
|---|---|---|---|
| DEBT | det | SUBPOENA | sə·pē'·nə |
| DEBRIS | də·brē', dā·brē', dā'·brē | PLACEBO | plə·sē'·bō |
| AISLE | īl | PROCREATE | prō'·krē·āt |
| REIGN | rān | PSALM | säm, sälm* |
| DEPOT | dē'·pō, de'·pō | BANAL | bə·nàl', bā·nal', bān'·ᵊl |
| SIMILE | sim'·ə·lē | RAREFY | rãr'·ə·fī |
| LINGERIE | lan'·zhə·rē', lon'·zhə·rā' | GIST | jist |
| RECIPE | res'·ə·pē | CORPS | kor, korz |
| GOUGE | gauj | HORS D'OEUVRE | ȯr'·dərv(r)' |
| HEIR | ãr | SIEVE | siv |
| SUBTLE | sət'·ᵊl | HIATUS | hī·ā·təs |
| CATACOMB | kat'·ə·kōm | GAUCHE | gōsh |
| BOUQUET | bō·kā', bü·kā' | ZEALOT | zel'·ət |
| GAUGE | gāj | PARADIGM | par'·ə·dīm, par'·ə·dim |
| COLONEL | kərn'·əl | FACADE | fə·säd' |

| | | | |
|---|---|---|---|
| CELLIST | chel'·əst | PRELATE | prel'·ət, prēl'·āt* |
| INDICT | in·dīt' | QUADRUPED | kwäd'·rə·ped |
| DETENTE | dā·tä(n)t | SIDEREAL | sī·dir'·ē·al, sə·dir'·ē·al |
| IMPUGN | im·pyün' | ABSTEMIOUS | ab·stē'·mē·əs |
| CAPON | kā' pən, kā'·pon | BEATIFY | bē·at'·ə·fī |
| RADIX | rād'·iks | GAOLED | jāld |
| AEON | ē'·ən, ē'·än | DEMESNE | di·mān', di·mēn' |
| EPITOME | i·pit'·ə·mē | SYNCOPE | sing'·kə·pē, sin'·kə·pē |
| EQUIVOCAL | i·kwiv'·ə·kəl | ENNUI | an·wē' |
| REIFY | rā'·ə·fī, rē'·ə·fi | DRACHM | dram |
| INDICES | in'·də·sēz | CIDEVANT | sēd·ə·vä(n)' |
| ASSIGNATE | as'·ig·nāt' | EPERGNE | i·pərn', ā·pərn' |
| TOPIARY | tō'·pē·er'·ē | VIVACE | vē·väch'·ā, vē·väch'·ē |
| CAVEAT | kav'·ē·at, kāv'·ē·at, kā·vē·at'** | TALIPES | tal'·ə·pēz |
| SUPERFLUOUS | sù·pėr'·flü·əs | SYNECDOCHE | sə·nek'·də·kē |
| LEVIATHAN | li·vī'·ə·thən | | |

* Correct U.S. pronunciation only
** Correct Canadian pronunciation only

## APPENDIX E

Data for NAART Standardization Sample

Test Scores

| ID# | VIQ | PIQ | FSIQ | NART | NAART |
|---|---|---|---|---|---|
| 01 | 110 | 108 | 109 | 28 | 34 |
| 02 | 109 | 106 | 107 | 25 | 31 |
| 03 | 097 | 088 | 093 | 35 | 42 |
| 04 | 094 | 099 | 096 | 30 | 34 |
| 05 | 109 | 124 | 118 | 20 | 19 |
| 06 | 106 | 111 | 109 | 22 | 25 |
| 07 | 113 | 123 | 121 | 19 | 21 |
| 08 | 084 | 109 | 090 | 33 | 40 |
| 09 | 088 | 132 | 107 | 33 | 41 |
| 10 | 116 | 125 | 123 | 31 | 33 |
| 11 | 104 | 111 | 108 | 24 | 29 |
| 12 | 087 | 098 | 091 | 37 | 47 |
| 13 | 116 | 119 | 121 | 19 | 22 |
| 14 | 112 | 126 | 120 | 27 | 24 |
| 15 | 088 | 094 | 089 | 25 | 27 |
| 16 | 109 | 118 | 114 | 20 | 17 |
| 17 | 089 | 098 | 092 | 34 | 26 |
| 18 | 114 | 127 | 124 | 18 | 16 |
| 19 | 109 | 117 | 113 | 18 | 20 |
| 20 | 108 | 087 | 097 | 21 | 24 |
| 21 | 140 | 115 | 132 | 11 | 09 |
| 22 | 100 | 103 | 102 | 26 | 32 |
| 23 | 098 | 119 | 106 | 23 | 25 |
| 24 | 098 | 098 | 099 | 25 | 31 |
| 25 | 126 | 131 | 133 | 01 | 04 |
| 26 | 105 | 094 | 101 | 27 | 33 |
| 27 | 107 | 110 | 108 | 21 | 22 |
| 28 | 110 | 081 | 097 | 20 | 23 |
| 29 | 098 | 095 | 096 | 21 | 22 |
| 30 | 109 | 126 | 119 | 21 | 23 |
| 31 | 121 | 116 | 122 | 08 | 10 |
| 32 | 112 | 121 | 119 | 11 | 12 |
| 33 | 085 | 120 | 099 | 30 | 37 |

Test Data, Continued

| ID# | VIQ | PIQ | FSIQ | NART | NAART |
|---|---|---|---|---|---|
| 34 | 106 | 105 | 106 | 26 | 30 |
| 35 | 105 | 106 | 106 | 25 | 28 |
| 36 | 092 | 094 | 092 | 34 | 38 |
| 37 | 102 | 099 | 100 | 22 | 25 |
| 38 | 103 | 102 | 102 | 28 | 32 |
| 39 | 121 | 116 | 122 | 23 | 20 |
| 40 | 119 | 099 | 110 | 11 | 11 |
| 41 | 103 | 117 | 109 | 20 | 19 |
| 42 | 099 | 102 | 100 | 31 | 37 |
| 43 | 113 | 109 | 113 | 16 | 17 |
| 44 | 113 | 102 | 109 | 12 | 11 |
| 45 | 092 | 111 | 099 | 36 | 41 |
| 46 | 092 | 106 | 098 | 21 | 25 |
| 47 | 102 | 101 | 101 | 22 | 24 |
| 48 | 112 | 096 | 105 | 19 | 22 |
| 49 | 116 | 112 | 116 | 17 | 16 |
| 50 | 119 | 109 | 117 | 08 | 08 |
| 51 | 104 | 109 | 106 | 21 | 25 |
| 52 | 120 | 121 | 125 | 17 | 17 |
| 53 | 089 | 098 | 092 | 40 | 53 |
| 54 | 129 | 133 | 134 | 13 | 12 |
| 55 | 096 | 102 | 099 | 25 | 28 |
| 56 | 107 | 104 | 105 | 21 | 21 |
| 57 | 095 | 102 | 099 | 52 | 43 |
| 58 | 084 | 096 | 087 | 39 | 49 |
| 59 | 110 | 104 | 107 | 14 | 17 |
| 60 | 083 | 102 | 089 | 40 | 48 |
| 61 | 114 | 111 | 114 | 15 | 19 |
| 62 | 109 | 118 | 114 | 24 | 30 |
| 63 | 114 | 114 | 116 | 21 | 22 |
| 64 | 097 | 096 | 096 | 28 | 34 |
| 65 | 110 | 102 | 107 | 19 | 19 |
| 66 | 103 | 105 | 103 | 24 | 24 |

Demographic Information

| ID# | Age | Sex | Source | Hand | Occupation | Education |
|---|---|---|---|---|---|---|
| 01 | 31 | M | 1 | L | Public Relations | 17 |
| 02 | 20 | M | 1 | L | Student | 14 |
| 03 | 40 | F | 1 | R | Homemaker | 12 |
| 04 | 35 | F | 1 | R | Counselor | 12 |
| 05 | 35 | F | 1 | R | Resp. Therapist | 13 |
| 06 | 45 | M | 1 | R | Personnel Director | 12 |
| 07 | 21 | F | 1 | R | Student | 15 |
| 08 | 26 | F | 1 | R | Homemaker | 13 |
| 09 | 18 | F | 1 | R | Executive | 15 |
| 11 | 47 | F | 1 | L | Sales | 14 |
| 12 | 24 | F | 1 | R | Homemaker | 12 |
| 13 | 25 | M | 1 | L | Student | 15 |
| 14 | 18 | F | 1 | R | Student | 12 |
| 15 | 25 | M | 1 | R | Forklift Driver | 11 |
| 16 | 20 | F | 1 | R | Student | 14 |
| 17 | 22 | F | 1 | R | Waitress | 09 |
| 18 | 21 | M | 2 | L | Student | 15 |
| 19 | 24 | M | 2 | R | Student | 15 |
| 20 | 27 | F | 2 | R | Student | 12 |
| 21 | 23 | M | 2 | R | Student | 16 |
| 22 | 19 | F | 2 | R | Student | 12 |
| 23 | 27 | F | 2 | R | Student | 12 |
| 24 | 24 | F | 2 | R | Student | 12 |
| 25 | 46 | F | 2 | L | Student | 16 |
| 26 | 19 | F | 2 | R | Student | 12 |
| 27 | 26 | F | 2 | R | Student | 15 |
| 28 | 23 | M | 2 | L | Student | 14 |
| 29 | 34 | F | 2 | R | Student | 14 |
| 30 | 27 | M | 2 | R | Student | 14 |
| 31 | 38 | F | 2 | R | Student | 15 |
| 32 | 23 | M | 2 | R | Student | 15 |
| 33 | 20 | F | 2 | R | Student | 14 |

Demographic Information
Continued

| ID# | Age | Sex | Source | Hand | Occupation | Education |
|---|---|---|---|---|---|---|
| 34 | 42 | M | 2 | R | Counselor/Student | 10 |
| 35 | 24 | M | 2 | R | Student | 14 |
| 36 | 21 | F | 4 | R | Student | 12 |
| 37 | 32 | M | 4 | R | Student | 11 |
| 38 | 27 | F | 2 | R | Student | 14 |
| 39 | 26 | F | 2 | R | Student | 12 |
| 40 | 47 | F | 2 | R | Student | 15 |
| 41 | 24 | F | 4 | R | Student | 09 |
| 42 | 33 | F | 2 | R | Student | 10 |
| 43 | 24 | M | 2 | R | Sales/Student | 16 |
| 44 | 22 | M | 2 | L | Student | 13 |
| 45 | 22 | F | 2 | R | Student | 14 |
| 46 | 22 | F | 2 | R | Student | 12 |
| 47 | 29 | F | 2 | R | Student | 12 |
| 48 | 26 | F | 2 | R | Student | 14 |
| 49 | 24 | M | 4 | R | Student | 13 |
| 50 | 40 | F | 4 | R | Student | 12 |
| 51 | 24 | F | 2 | R | Student | 14 |
| 52 | 20 | M | 4 | R | Student | 12 |
| 53 | 27 | M | 4 | R | Student | 12 |
| 54 | 23 | M | 4 | R | Student | 11 |
| 55 | 22 | M | 4 | R | Student | 12 |
| 56 | 25 | M | 4 | R | Student | 14 |
| 57 | 29 | M | 3 | R | Student | 11 |
| 58 | 20 | F | 3 | L | Student | 11 |
| 59 | 27 | M | 3 | R | Clerical/Student | 16 |
| 60 | 26 | M | 3 | R | Student | 11 |
| 61 | 43 | M | 2 | R | Student | 16 |
| 62 | 23 | F | 2 | R | Student | 13 |
| 63 | 23 | M | 2 | R | Student | 16 |
| 64 | 27 | M | 3 | R | Student | 11 |
| 65 | 21 | M | 3 | R | Student | 15 |
| 66 | 29 | M | 2 | R | Student | 15 |

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Author [redacted]

JENNIFER R. BLAIR

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