The Effects of Extraversion on Performance on the Wechsler Intelligence Scale for Children-Revised

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The Effects of Extraversion on Performance on
the Wechsler Intelligence Scale for Children-Revised

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THE EFFECTS OF EXTRAVERSION ON PERFORMANCE ON
THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN - REVISED

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THE EFFECTS OF EXTRAVERSION ON PERFORMANCE ON THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN - REVISED

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A sample population of 139 fifth grade students, ranging in age from nine years to twelve years eleven months, was drawn from a data pool created from test results collected from four elementary schools in a south central Kentucky municipality. Tests used in the study were the Wechsler Intelligence Scale for Children - Revised (WISC-R) and Cattell's Children's Personality Questionnaire (CPQ).

These data were examined to determine the relationship of extraversion to performance on a standardized intelligence test.

Correlations for the experimental variables and extraversion ranged from .12 to .51.

The results indicated that extraverts had higher Performance, Verbal and Full-Scale I.Q.'s. No significant differences were found on extraversion scores for males vs. females.

Overall the general hypothesis that extraversion was positively correlated to performance on the WISC-R, was supported by the data.
INTRODUCTION

Intelligence, as a construct, was defined by Binet as the ability to judge, comprehend, and reason well. This included "(a) the ability to take and maintain a given mental set; (b) the capacity to make adaptations for the purpose of attaining a desired end; and (c) the power of auto-criticism" (Terman 1916 in Sattler 1974, p.92).

Later, David Wechsler conceived of intelligence as "the overall capacity of an individual to understand and cope with the world around him. . . . (It is) an overall or global entity, that is, a multidimensional and multifaceted entity rather than an independent, uniquely defined trait. . . . (and does not) single out any ability, however esteemed, as crucial or overwhelmingly important. . . (and avoids) equating general intelligence with intellectual ability" (1974, p.5).

Wechsler's view of intelligence as a hypothetical construct, characterized by the "capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (Matarazzo, 1972, p.79), is very similar to "crystallized intelligence" as posited by Cattell and Horn. Crystallized intelligence "is highly sensitive to each person's unique cultural, educational, and environmental experiences" (Ibid, p.56). Crystallized intelligence taps that "component which reflects material normally taught in school and which manifests itself in ability tests of vocabulary, synonyms, numerical skills, mechanical knowledge, a well stocked memory, and even habits of logical reasoning" (Ibid, p.56).

The underlying basis for crystallized intelligence is fluid intell-
intelligence which "corresponds to and reflects a pattern of neuro-physiological and incidental learning influences" (Ibid, p.55).

Fluid intelligence is further conceived of as "a general relation - perceiving capacity which is determined by each individual's unique endowment in cortical, neurological connection count development" (Ibid, p.56).

The measurement of this multidimensional tract is a complex task. Historically, the standardized intelligence test has supplied us with the necessary parameters for the determination of an "Intelligence Quotient." However, performance on an intelligence test is affected by a great many variables other than general intelligence, such as familiarity of the environment, fluctuations in physical health, race, and various personality variables, all of which fall into the category of non-intellective factors as conceptualized by Wechsler.

Wechsler (1974) stated that "intelligent behavior may also call for one or more of a host of aptitudes which are more in the nature of conative and personality traits than cognitive abilities. These traits involve not so much skills and know-how as drives and attitudes, and often may be described as sensitivity to social, moral, or aesthetic values. They include such traits as persistence, zest, impulse control, and goal awareness - traits which for the most part, are independent of any particular intellectual ability. For this reason, they are designated as nonintellective factors of intelligence. ... (They) serve to direct and to enhance (sometimes also to demean) the utilization of other capacities.

Nonintellective factors operate at all levels of intelligence, and may be expected to affect the capabilities of the superior as well as the poorly endowed individual. ... (Nonintellective factors) may account for
the large intertest and intratest variability observed in the performance of some individuals" (Wechsler, 1914, p.6).

Extraversion is one such nonintellective factor, and it is this factor's relationship to performance on the Wechsler Intelligence Scale for Children - Revised (WISC-R) that is the focus of this paper.

The concept of extraversion was introduced to modern psychology by Carl Jung, as cited by Morris (1979, p.6), who had developed "a complex theory of intrapsychic processes called analytical psychology. In developing the idea of many polarities existing within each personality, emphasis was placed on the opposing tendencies of extraversion and introversion. The basic difference between the two lies on persons' preferences for attending to the inner world of subjectivity with an emphasis on reflective, introspective cognitive activity (introversion) versus preferences for attending the outer world of objective events with an emphasis on active involvement in the environment (extraversion)." Eysenck (1955) also notes that Jung characterized extraverts as more prone to hysterical disorders while introverts to being seen as dysthyemic or psychathenic.

It was H.J. Eysenck, however, who, via factor analysis, gave introversion-extraversion its place in modern psychological research.

"Eysenck defined the basic difference between extraverts and introverts as biological, rooted in the reticular activating system of the brain. This is the system that monitors incoming neural impulses resulting from environmental stimulation and that either stimulates or inhibits responses of higher brain centers to the stimulation; the system that controls the arousal level of the cortex of the brain. Extraverts and introverts are held to differ in the relative strength of the opposing processes of excitation and inhibition such that introverts typically have higher levels of cortical arousal compared with extraverts. . . . It
follows that, introverts should most often be found seeking a reduction of external stimulation, inasmuch as external stimulation increases arousal, whereas extraverts should be found most often seeking an increase in stimulation from the environment" (Morris, 1979, p.7).

 Extraversion, as a concept, has generated much research in the field of personality and performance. The relationship of extraversion to academic achievement, has been widely researched in the past, yielding a variety of findings both supporting and rejecting the hypothesis that extraversion is positively correlated to achievement.

 The relationship between extraversion and performance on intelligence tests is a topic not as widely researched but one that also has yielded a variety of conflicting results. These relationships, between extraversion and achievement and extraversion and intelligence, will be more fully examined in the following review of the literature.
REVIEW OF THE LITERATURE

It should be noted that while the literature reviewed utilizes measures of extraversion primarily based on Eysenckian principles, there is support for the notion that the test chosen for this study, Cattell's Children's Personality Questionnaire, is comparable in its utility as a measure of extraversion.

"There is agreement between Eysenck and Cattell that the data show extraversion (exvia) and neuroticism (anxiety) to be the two dimensions in global personality assessment that account for the most variance. There is also basic agreement on the basic content of the two dimensions. However, Cattell emphasizes the multidimensionality of scales as well as the existence of at least eight second order factors. . . ." (Morris, 1979, p.29).

Carrigan (1960) supporting the hypothesis that extraversion is a multidimensional trait reported that "evidence from questionnaire studies (16 P F, Guilford, MMPI, Rorschach, etc.) shows that in general, repeated analysis of the same instrument yield similar appearing factors which on the basis of 'psychological meaning', can be identified with E-I. . . . Factor loadings vary from study to study and variables are sometimes added or dropped, but there remains in each of the questionnaires a core of variables which appear consistently on E-I factors. . . . Moreover evidence from several studies shows that the core variables from the various questionnaires are at least moderately interrelated" (p.355).

The interrelationship of Eysenck's extraversion and Cattell's exvia-invia is supported by Adcock (1965), who regards "Cattell and Eysenck as
being in substantial agreement in their measures of extraversion despite their different theoretical background. . ." (p.96). Adcock cites Eysenck and Cattell as well as a 1959 study by Becker in which the 16 PF second order factor and the Maudsley Personality Inventory (MPI) extraversion score had high loadings on a common factor (.82 & .68). These findings are further substantiated by Hundleby and Connor (1968), who found that the "16 PF second order factor of extraversion (F2) is essentially the same as the E scale of the MPI (f = .73). . . . Only 29% of the reliable variance of the E scale is not accounted for by F2" (p.156).

Kline (1967) found that for a population of Ghanian university students Eysenck's extraversion scale was significantly correlated to Cattell's exvia-invia (r = -.61, p < .01), indicating that both scales are measures of extraversion. Eysenck (1972) also supports the hypothesis that E-I and exvia-invia are comparable measures of extraversion. It is apparent from the literature that the substitution of Cattell's measure of extraversion for Eysenck's is permissible in that the instruments ostensibly measures the same trait and are correlated.

H.J. Eysenck, in his theory of introversion-extraversion, proposes that there is no significant correlation between intelligence and extraversion (Eysenck, 1964, 1971). This hypothesis has been tested by numerous investigators, some refuting Eysenck's claim and others substantiating it. By reviewing the results of this mass of studies on the effects of extraversion on performance on achievement tests and intelligence measures it is hoped to generate hypotheses specific to performance on the Wechsler Intelligence Scale for Children - Revised.

Ley et al (1966) found that in adults, average age 45, extraversion was positively correlated with intelligence (r = .171, p < .05).
Ruston (1966) determined, based on data obtained from the Children's Personality Questionnaire and Moray House attainment tests, that stable extraverts at the ages of 10 through 11 achieve at a higher level than introverts ($r = .110$, $p < .05$ mathematics, $r = .130$, $p < .05$). Ridding (1967) found that, in a sample of 600 children ages 12 and above, extraversion was correlated to overachievement in general (no $r$ value reported).

In finding that "extraverted boys and girls do better scholastically and on verbal reasoning tests than do introverted boys and girls, (and that the relation is linear) and may be expressed by a product moment correlation of .20 or thereabouts," Eysenck and Cookson (1969, p. 119) lend credence to Ley's, Rushton's, and Ridding's findings. A study by Mehryar et al (1973) lends further support for the above findings. Mehryar et al, in their study of 878 secondary school students ages 18 and 19, found a small but consistently positive correlation between measures of intelligence and extraversion. Correlations in this study range from .11 to .14. That "extravert qualities tend to associate with more rapid acquiring of crystallized intelligence (r = .29)" (Cattell, 1971, p. 79) for fourth and fifth grade students further indicates support for Ley, Rushton and Ridding. Finally, Honess and Kline (1974) reported that in a group of black Ugandans mean age 14, extraversion was "almost invariably related to academic success especially among girls, where three of five correlations are significant" ($p < .05$).

Orpen (1976) found that while extraversion was negatively correlated with academic success for South African university students, extraversion
was positively correlated with success for school children ages 14-16. 
\( r = .27, p < .05 \) white males, \( r = .32, p < .05 \) black males, \( r = .28, p < .05 \) black females, and \( r = .20, \text{n.s. for white females} \).

Crookes et al (1981) found a small but positive correlation between extraversion and intelligence in a group of 802 pupils ages 15 to 16 
\( r = .093, \text{n.s. males } r = .106 \text{n.s. female } r = .102, p .01 \text{ total group} \).

This body of evidence decidedly favors the hypothesis that extraversion is positively correlated with achievement as well as performance on various I.Q. tests. However, there does exist a substantial body of literature supporting the opposite claim.

Lynn (1959) in a study of 400 university students, mean age 19 years, reported that extraversion had a negative effect on attainment.

This is supported by Bendig's 1969 study of extraversion, neuroticism, and student achievement in introductory psychology. Bendig found that extraversion, as measured by the Maudsley Personality Inventory, was significantly and negatively related to achievement as indicated by a product-moment coefficient of \( r = -.17 \).

Lynn and Gordon (1961) also found that extraversion was not significantly correlated with intelligence. They indicated that extraverts fatigued easily and had a tendency to give up more quickly than introverts as seen in their performance on the Mill Hill Vocabulary test, scales A and B, and Raven's Progressive Matrices, 1938.

Callard and Goodfellow (1962) in their series of studies encompassing 3,559 subjects ranging in age from 11 to 14 years found only "two significant correlations...between Extraversion and Intelligence. The second form "A" (more intelligent) group of the two secondary modern schools and one of the Non "A" (less intelligent) third forms showed significant negative correlations between Extraversion and Intelligence"
(both at 5 per cent level). Although over half of all the forms showed a slight tendency for Extraversion and Intelligence to be positively correlated, the correlation for the two schools combined showed a very slight negative correlation. No significant correlation was found in the grammar school sample between Extraversion and Intelligence. However, there was a slight tendency for Extraversion and Intelligence to be positively correlated in the 11 year and 12 year old Non "A" (less intelligent) group" (p. 247). Extraversion was significantly and negatively correlated to intelligence for the combined "A" group at age 12 years to 12 years 11 months \( (r = -.26) \). In general, despite some positive trends, these results indicate a negative relationship between extraversion and intelligence. Child, in his 1964 study of 138 children ranging in age from 11 through 15, reported that extraversion is negatively correlated to scholastic attainment \( (r = -18, p < .05) \). Savage (1962) reported that in a university population of 168, "the correlation between the mean extraversion score for each group (tested) and academic success \( (r = -.9) \) was significant at the 5 per cent level" (p. 252). Farley (1968) reports that in a sample of 215 males ages 15 through 18, given the Eysenck Personality Inventory and an intelligence test, "the correlation between E (extraversion) and intelligence over the total sample of 215 subjects was .149 (ns), while the comparable correlation between N (neuroticism) and intelligence was .012 (ns)" (p. 228).

In a 1970 study utilizing the Junior Eysenck Personality Inventory to determine extraversion, Finlayson found that in a sample of 128 subjects, ages 12, 13, and 14, introverts obtained higher marks in yearly exams than extraverts \( (F = 9.702, p < .01 \) age 12, \( F = 14.666, p < .01 \)
Seddon (1975) found that for a sample of 741 students in the 15 to 19 age range, extraversion was not significantly related to performance on an intelligence test (the AH5). This finding was substantiated by a follow-up study by Seddon (1976).

Walsh and Walsh (1978) found a significant negative correlation ($r = -0.33, p < 0.05$) between extraversion and intelligence in their study of 53 ninth graders 14 to 16 years old.

Magus (1980) reported a significant negative association between extraversion and achievement as measured by Raven's Progressive Matrices and the Common Entrance Examinations for 160 male Nigerian students ages 12 years 4 months to 13 years 7 months.

In contrast, Barton, Barsch, and Cattell (1974) presented findings which indicated that both extremes of extraversion and introversion were related to high achievement.

The studies which have generally been interpreted as not supporting the positive relationship of intelligence and extraversion have typically used a measure of achievement such as school success as an indication of intelligence, or have interpreted non-significant findings as a lack of support. The one exception is the Walsh and Walsh study (1978). Alternate explanations for the relation of school success and introversion, even a weak one, are possible but will not be pursued in this paper.

Another explanation for the variance in the experimental findings is that Eysenckian extraversion has been found to increase from 7 to 13 years and decrease from there to middle age. (This is consistent with R.B. Cattell's conceptualization of fluid intelligence, which, he indicated, grows until age 14, plateaus and declines after age 22). These findings have been corroborated by Honess and Kline (1974), Eysenck & Cookson (1969),
Elliot (1972), and Anthony's 1973 review of the literature. However, Anthony introduces the idea that while "normal development of Eysenckian extraversion... appears to consist of an increase of up to 13 or 14 years, followed by a decrease into middle age and beyond... this 'normal' peak is derived from the average of many individuals. A child who is consistently early in this development would at first be more extraverted than his age-mates, but he would reach his peak sooner than they, and in later years he would be less extraverted than his age-mates. Similarly, a consistently late developer would, in early years, be more introverted than his age-mates, but in descending, late, from the peak, he would in these later years be more extraverted than his age-mates" (p. 224). This is confirmed by Anthony's 1977 analysis of Rushton's data.

If a population is within the age range in which Eysenckian extraversion is positively correlated with performance and does not follow the normal curve in terms of development (i.e. early, normal, late), but is skewed toward one extreme, the results of the research will reflect this skewness. The early developer who reaches his peak of extraversion before the age of 13 or 14 will show a negative correlation with extraversion when his peers reach their peak, whereas the late developer will show a negative correlation in his early years while reaching his 'peak' after his peers.

For the purposes of this study, the subject population will be assumed to have a normal distribution of development. Assuming this, and finding that the subjects are in the circumscribed age range, it is hypothesized that extraversion will correlate positively with Full Scale I.Q. (FSIQ).
The next section will be devoted to relating the literature to specific subtests of the WISC-R in order to formulate experimental hypotheses for the relationship between extraversion and each subtest.

The first subtest to be considered is the Information subtest which measures remote memory, comprehension, and the capacity for associative thinking. In a review of the literature M.W. Eysenck (1976 A) hypothesizes that while extraverts perform better on tasks involving short-term memory, introverts will excel at tasks requiring the use of long term memory, indicating that for the Information subtest extraversion should be negatively correlated to performance. However, Riding (1979), in an effort to determine the relationship of extraversion on recall, found via a four-way analysis of variance that "while extraversion did not have a significant main effect on recall, the interaction between extraversion and detail content was highly significant (F = 3.65, p < .05)" (p.229). Riding concludes that extraverts best represent information in memory in the verbal mode. He also concluded that extraverts respond better to questioned recall as opposed to free recall. These findings support Cattell's (1971) finding that extraversion was positively correlated to the acquisition of crystallized intelligence and lead us to hypothesize that extraversion will be positively correlated to performance on the Information subtest.

The next subtest to be considered (in order of actual presentation to the subject) is the Picture Completion subtest, a measure of visual identification of an object and it's essential and non-essential elements. This is a timed test allowing 20 seconds for each response to the 26 items. The Picture Completion subtest also involves an element of recall in that each stimulus presentation requires the subject to search for a referent
and match it to the stimulus and then determine what is missing from the stimulus card. To the extent that introverts take longer to access data in memory (M.W. Eysenck, 1976), or perhaps are more cautious, extraverts carry out timed tasks more quickly than introverts. This conclusion is supported by Jensen (1964) as cited in Eysenck (1967, p.92). Jensen reported a correlation of -.47 between time spent on a given test and extraversion. Gray and McLean (1973), in a study whose findings were disputed by Gibson (1973), reported that extraversion did not relate to speed or accuracy on an intelligence test (AH5) for a population of 139 male graduate students average age 26 years. Taking these data into account it is reasonable to hypothesize that extraversion will be positively correlated to performance on the Picture Completion subtest.

The Similarities subtest, an untimed subtest consisting of 17 items, measures remote memory, associative thinking, and the ability to work with abstract relationships between concepts which are, on the surface, dissimilar.

In discussing the Similarities subtest it is, again, pertinent to reference M.W. Eysenck (1976) and his hypothesis that introverts are superior in accessing remote memory in general. However, the experimental evidence cited by Riding (1979) and Rushton (1966) indicates that on tasks involving questioned recall and verbal reasoning ability extraversion is positively correlated to performance. The hypothesis of a positive relationship of extraversion with the Similarities subtest is also advanced.

The Picture Arrangement subtest, a timed test of perception, visual comprehension, planning ability and the synthesis of causal and sequential events, is next in the sequence. Hebron reported, in a 1962 factorial
study of the relationship of learning a number system of attainment, intelligence, and temperament, that "...extravert attitudes in learning favor the assimilation of the first elementary facts of the new situation while introverts are more apt, when this stage is passed, in applying these facts in more complex problems" (Hebron, 1962, p.44). This finding is applicable to the Picture Arrangement subtest in that principles used in the first trial may be applied in later consecutively more difficult trials.

Mohan and Kumar (1976) reported that on the Standard Progressive Matrices, extraverts had more incomplete or not attempted items while introverts did significantly better in general due to passage of time and increasing level of difficulty. In addition, Lynn and Gordon (1961) reported that extraverted subjects tended to fatigue earlier and give up more easily than introverted subjects, and Jensen (1964, cited in Eysenck, 1967) and Goh (1974) reported that extraverts work significantly faster than introverts.

The results of these studies suggest that we must hypothesize that extraversion will be positively correlated to performance on the Picture Arrangement Subtest.

The Arithmetic Subtest, a timed 18 item test of the ability of the subject to utilize abstract concepts, numbers, and numerical operation, appears next in the sequence. Maqsud (1980) found that extraversion was negatively associated with subject's marks in arithmetic ($F = 8.75$, $p < .01$). This substantiates Riddings (1967) finding that extraversion was correlated to underachievement in arithmetic, in a sample of 600 twelve year old children. However, Rushton (1966) reported that extraversion was positively correlated to achievement in mathematics ($r = .110$, $p < .05$).
Eysenck and Cookson (1969) supported these results. The Junior Eysenck Personality Inventory was administered to a population of 4000 eleven year old students along with two Moray House tests of verbal reasoning. Extraversion showed "positive correlations with intelligence and achievement test, ranging from .13 to .19 for the boys, and from .22 to .19 for the girls" (p.117). Extraversion was also positively correlated to achievement on mathematics \([r = .19, p < .001 \text{ (females)}; r = .20, p < .001 \text{ (males)}]\).

Finally, Jensen (1973), in his study of scholastic achievement in three ethnic groups, found that extraversion was positively correlated to students performance when their average performance in mathematics was examined for grades four through eight. The average performance on Arithmetic Concepts yielded correlations of \(r = .13, p < .01\) for white students, \(r = .08, p < .05\) for black students, \(r = .08, p < .01\) for Mexican students. While on the Mechanical Arithmetic segment only the black group showed a significant positive correlation \(r = .09, p < .05\). The Applied Arithmetic section yielded \(r\) values of .09 \((p < .05)\) and .13 \((p < .01)\) for the black and Mexican groups respectively. These correlations were more significant in the lower grades while in the eighth grade the association became negative. These findings support not only Rushton and Eysenck and Cookson, but also lend further credence to Anthony's hypothesis that extraversion is related to chronological age. It follows from the preceding discussion that our hypothesis concerning the Arithmetic subtest of the WISC-R is that extraversion will be positively correlated to performance.

The Block Design subtest of the WISC-R tests the subject's visual-motor coordination and non-verbal concept formation by requiring him/her to perceive, analyze, synthesize and reproduce abstract designs. The Block Design subtest is a timed subtest.
As cited on page 15 Mohan and Kumar (1976) indicated that given passage of time and increase in task difficulty extraverts will, essentially, give up on individual items and may not attempt others. This supports Lynn and Gordon's (1961) contention that extraverts tend to fatigue easily and give up on a task more readily.

However, Eysenck (1967), Goh (1974), and Goh and Farley (1977) reported that extraverts perform better on tasks requiring speed, as does Block Design. Goh and Farley also indicated that extraverts work better under stress than do introverts. As bonus points are awarded for speed and the subject is aware that he/she is being timed, extraverts may tend to perform better than introverts.

Also, the nature of the Block Design subtest is such that the subject has before him/her a "correct" answer for each item. This referent may reward the extravert for his speedy approximation of the stimulus item, reducing the tendency to "give up." With this in mind it is hypothesized that extraversion will be positively correlated to performance on the Block Design subtest.

The Vocabulary subtest is an untimed test of general intellectual functioning. Eysenck (1967) cites and lends support to Farley's (unpublished) finding that introversion was positively correlated to vocabulary \( r = .48 \) for a population of forty-seven normal subjects. As cited previously (M.W. Eysenck, 1976 A) introverts also perform better on tasks involving long term recall. Riding (1979) supports the premise that introverts also perform better on free recall tasks. Considering this evidence and the unlimited time span permitted for the subject to access stored information, we hypothesize that extraversion is negatively correlated to performance on the Vocabulary subtest.
The Object Assembly subtest, the next to be considered, is a timed test of perception, visual-motor coordination, assembly skills, and the ability to draw whole-part relationships into a meaningful whole as well as the ability to see spatial relationships.

Again, it is appropriate to cite Hebron (1962), and while extraverts might have an advantage in speed [Goh (1974), Goh and Parley (1977), M.W. Eysenck (1977)], that advantage may be balanced by the relatively long period of time each item is presented to the subject. Introverts may have an advantage in that they have superior long-term recall which is needed to establish a referent for each problem presented to the subject in order to develop a whole, but the time issue probably prevails. It is hypothesized regarding the Object Assembly subtest, that extraversion is positively correlated to performance.

The Comprehension subtest measures the subject's practical judgement, ability to utilize past experience and the ability to verbalize.

Eysenck and Cookson (1969) and Rushton (1966) found that extraversion was positively correlated to verbal reasoning ($r = .19$ and $r = .16$ respectively). Riding (1979) also lends support to this hypothesis with his conclusion that extraverts respond better on questioned recall tasks as opposed to free recall tasks. The only indication that extraverts might not perform as expected is based upon the finding that introverts are superior in accessing long-term memory, as cited previously.

Weighting these considerations it is hypothesized that extraversion is positively correlated to performance on the Comprehension subtest.

Visual-motor dexterity, ability to absorb new material in an associative context and speed as well as accuracy in making associations are all measured by the Coding subtest of the WISC-R. Coding is a timed 120
second subtest in which the subject is told to work as quickly as he/she can without making mistakes. Geen (1976) reporting on the physiological basis of extraversion states that "during constant monitoring of stimuli, it may be assumed that reactive inhibition builds up and, because the observer is not given a chance to rest and stop attending, this inhibition is balanced against excitatory processes and transmission in the relevant sensory neuron stops. Such stoppage of excitation is called involuntary rest pause (IRP). If a stimulus to be detected happens to coincide with the IRP the subject's will fail to perceive it and an error of omission will result. Since extraverts are presumed to develop reactive inhibition more rapidly than introverts, they should be more prone to frequent IRPs and consequent omission errors." (p. 261-262).

Eysenck (1974) indicated, however, that given a short recall time which would not allow inhibition to build to an IRP, extraverts should be superior to introverts in a test situation. Goh and Farley (1977), Goh (1974), and Eysenck (1973) all reported that extraverts perform faster on tasks involving speed. Goh (1974) also found that extraverts performed better in a stress situation than did introverts. Hebron (1962), although indicating that introverts are superior in applying newly learned concepts on later more difficult tasks, also found that extraverts are superior at initially assimilating these concepts.

Although extraverts may tend to make errors of omission, they will also perform significantly faster than introverts and should make the necessary associations faster, therefore it was hypothesized that extraversion will be positively correlated to performance on the Coding subtest.

On the Digit Span subtest, a measure of immediate auditory recall, extraversion is hypothesized to be positively correlated to performance.
This hypothesis is supported by H.J. Eysenck (1961, 1973) and M.W. Eysenck (1976, 1977), both of whom found that extraverts were superior on tasks requiring the utilization of short-term memory.

Planning ability, visual-motor coordination, speed, and accuracy are all measured by the Mazes subtest of the WISC-R, a timed subtest. While extraverts will perform faster on these timed items (Goh, 1974; Goh and Farley, 1977; and Eysenck, 1967), they may be less accurate (Eysenck, 1967). This inaccuracy will result in low scores for extraverts due to items receiving only partial credit or no credit as a result of the number of errors committed. Hebron's (1962) study also gives us reason to believe that introverts will be better able to apply principles, learned on the earlier less difficult items, on the later more difficult trials.

It can be hypothesized from this, that extraversion will be negatively correlated to performance on the Mazes subtest.

The Verbal I.Q. of the WISC-R is comprised of the sum of the scaled scores for the following subtests: Information, Similarities, Arithmetic, Vocabulary, and Comprehension (Digit Span is not included in the derivation of Verbal I.Q.). Considering the hypothesized relationships between extraversion on each of the subtests we find that the Vocabulary subtest is the only test for which a negative relationship is predicted, therefore, it follows that for the WISC-R extraversion will be positively correlated to Verbal I.Q.

The WISC-R Performance I.Q. is derived from the sum of the scaled scores of the following subtests: Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Coding (Mazes is not included as it is a supplementary test). The hypothesized relationships between all
five subtests and extraversion are positive, indicating the prediction that extraversion will be positively correlated to the WISC-R Performance I.Q.

The ability to attend to or concentrate on the environment is measured by the factor score of Freedom from Distractibility, (F-D). This factor score is derived from the Arithmetic, Digit Span, and the Coding subtests.

Lincoln, (1974), cited in the Dissertation Abstracts International, indicated that introverts function better under distraction on conceptual material and extraverts do better on perceptual-motor tasks. However, in light of the hypothesized positive correlation between extraversion and the three component tests of F-D and literature supporting these hypotheses, it must be hypothesized that extraversion will be positively correlated to F-D.

Eysenck and White (1964) utilizing the logic of reciprocal inhibition state "... extravers would show greater reactive inhibition, and consequently fall off in performance during the last quarter of the test (Morrisby Compound Series Test) as compared with the first three quarters" (p. 197). Lynn and Gordon (1961) reported that extraverted subjects tended to fatigue earlier and to give up more easily than introverted subjects.

With this in mind, the variables WISC-R A and WISC-R B were developed. WISC-R A consists of the collective scores of the first six subtests, while WISC-R B consists of the final six subtests in order of presentation (three verbal, three performance). Four of the five subtests in each case have been hypothesized to be positively correlated to extraversion, indicating that extraversion should be positively correlated to performance on WISC-R A and WISC-R B, in spite of the fatigue factor.
Our last hypothesis concerned sex differences on extraversion scores. The literature offered conflicting findings with regard to sex and extraversion. Riding (1967) reported that females were more extraverted than males at age 12.

Entwistle and Welsh (1969) found that for females more than males, extraversion was correlated to success. Three of five correlations were significant and positive for females, while only one of five was positive and significant for males.

In Orpen’s (1976) study it was discovered that while all correlations between extraversion and academic success were significant and in the positive direction, the correlations for males were slightly higher, though not significantly so. No sex differences were found in studies by Riding (1979); Crookes; et al (1982); Mohan and Kumar (1976); and Eysenck and Cookson (1976). Studies by Lewis and Ko (1973) and Mehryar et al (1973) indicated that extraversion was negatively correlated to performance for females and positively correlated to performance for males.

Taking into consideration the conflicting nature of the literature and the general hypothesis that extraversion should be positively correlated to performance on the WISC-R, the hypothesis here was that there will be no significant differences between the sexes on extraversion scores.

In summary we have hypothesized that extraversion will be positively correlated to all subtests of the WISC-R with the exception of the Vocabulary and Mazes subtests. This positive relationship is hypothesized to extend to FSIQ, PIQ, VIQ, F-D, WISC-R A and WISC-R B. No significant difference was predicted for extraversion by sex.
METHOD

SUBJECTS

The sample population was composed of 139 fifth grade students selected from four elementary schools in a south-central Kentucky municipality.* There was a subjective effort to match the schools with the general population demographics of the county school systems, and the population was seen as being reflective of the schools in the system.

The sample included 82 males and 57 females ranging in age from 9 years 0 months, to 12 years, 11 months. The mean age of the sample was approximately 10 years, 6 months. Included within this group were 102 whites, 30 blacks, and 7 students for which no race was indicated.

TESTS

WISC-R

The Wechsler Intelligence Scale for Children - Revised is an individually administered intelligence test consisting of twelve subtests. Originally developed by David Wechsler in 1949 as the Wechsler Intelligence Scale for Children, this current revision (1974) remains basically the same in content as the original. The test yields scaled scores on each of 12 subtests having a mean of 10 and standard deviation set at 3.

Normative data were obtained from a sample of 2,200 children ages 6½ through 16½ years drawn from the 1970 United States Census, including

* The data pool used was created over a period of several years by Dr. David A. Shiek formerly of Western Kentucky University, along with several graduate students under his direction. Standardized presentation of the WISC-R and CPQ are assumed.
whites and non-whites in proportion to the population.

The reliability coefficients for the individual subtests within the age range defined by the data set range from a low of .62 on the Mazes subtest to a high of .89 on the Block Design subtest. For the Verbal, Performance, and Full Scale I.Q.'s the reliability averages .94, .90, and .96 respectively. (Wechsler, 1974, p. 28)

Stability coefficients for the Full Scale IQ (FSIQ), Verbal IQ (VIQ), and Performance IQ (PIQ) also indicate that the measures are stable over time, with coefficients of .95, .93, and .90 respectively. (Wechsler, 1974, p. 33)

One factor score, Freedom from Distractibility (F-D), was investigated in this study. F-D is derived from the Arithmetic, Digit Span, and Coding subtests and measures the subjects ability to attend to or concentrate on the environment.

CPO

The Children's Personality Questionnaire (C.P.Q.) one of four factorially derived inventories developed by R.B. Cattell was chosen as the measure of extraversion for the purposes of this study.

All four of Cattell's questionnaires, the Early School Personality Questionnaire, the C.P.Q., the Jr.-Sr. High School Personality Questionnaire and the Sixteen Personality Factor Questionnaire, share a common theoretical background and measure personality factors central in human personality according to Cattell.

The C.P.Q. is a group administered test for children ranging from 8 to 12 years 11 months of age. The C.P.Q. is comprised of 14 scales and 3 second order factors. It is the second order factor of exvia-invia that is of interest here. The scales that compose the exvia-invia factor (A, F, and H) have reliabilities that range from .50 to .82. There are
no data available on the reliability and validity of the exvia-invia scale itself.

Answers are marked directly on the test booklets, and raw scores are computed and converted to "staves" or a 5 point standard score with a mean of 3 and a standard deviation of 1. Scores are also corrected for age and sex. Norms are based on a sample of 1,476 cases, 735 males and 741 females; ranging in age from 8 to 12 years with a median of 10 years.

The exvia-invia factor is derived by multiplying each of the stave scores of scales A, F, and H. (Cyclothymia, Surgency and Parmia) and adding them together. Therefore, a score of 3 on the exvia-invia factor will be low, 9 average, and 15 high on a scale of 3 to 15.

PROCEDURE

During the summer of 1978 a data bank was established from test protocols collected over several years by graduate students under the direction of Dr. David Shiek. Standardized presentation of the instruments was assumed.

The Frequencies procedure of the Statistical Package for Social Sciences, 2nd Edition (SPSS) (Nie, Hull, Jenkins, and Bent, 1975) was utilized to generate descriptive statistics for all variables.

Pearson Product-Moment correlation coefficients were generated for all measures using the SPSS subroutine Scattergram, Option 7. This subroutine yields the following statistics: $r; r^2; P$ values; standard error of the estimate; slope; and intercept; and generates a scattergram automatically scaled using the highest and lowest values found in the data.

The differences between normally distributed sample means for extraversion by sex and WISC-R A and WISC-R B for extraverts and introverts, were calculated using SPSS subroutine T-test which yields means, standard deviations, standard error, T value, degrees of freedom and 2-tail probability values.
RESULTS

Table 1 contains the Pearson correlation coefficient (r), \( r^2 \), and the alpha level for each of the eighteen variables examined.

Extraversion, as predicted, was found to be significantly and positively correlated to performance on the Information subtest, \((r = .41, p < .001)\). The Similarities subtest was also found to have a positive relationship to extraversion \((r = .47, p < .001)\). Extraversion was positively correlated with ability to deal with abstract concepts, numerical ability, and numerical concepts as measured by the Arithmetic subtest, \((r = .40, p < .001)\). The correlation between extraversion and performance on the Comprehension subtest was also positive and significant at the .001 level \((r = .39)\). The prediction that extraversion would be negatively correlated to performance on the Vocabulary subtest was not supported. This relationship was, in fact, significant in the direction opposite that predicted \((r = .41, p < .001)\), negating the superiority of introverts in this area.

Extraversion, as predicted, was significantly correlated to performance in the Digit Span subtest, supporting the contention that extraverts perform better on tasks involving short-term recall.

There was no significant difference in the performance of extraverts and introverts on the Picture Completion subtest, \( r = .13, \) ns.

Extraversion and performance on the Picture Arrangement subtest were positively correlated, with an alpha level of .001 \((r = .26)\).
**TABLE 1**

CORRELATIONAL RELATIONSHIP BETWEEN EXTRAVERSION AND WISC-R VARIABLES (n =139)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predicted Direction</th>
<th>r</th>
<th>r²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information 1</td>
<td>+</td>
<td>.41</td>
<td>.16</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Similarities 2</td>
<td>+</td>
<td>.47</td>
<td>.22</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Arithmetic*3</td>
<td>+</td>
<td>.40</td>
<td>.16</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Comprehension 5</td>
<td>+</td>
<td>.39</td>
<td>.15</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Vocabulary 4</td>
<td>-</td>
<td>.41</td>
<td>.17</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Digit Span 11</td>
<td>+</td>
<td>.28</td>
<td>.08</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Picture Completion *6</td>
<td>+</td>
<td>.13</td>
<td>.02</td>
<td>ns</td>
</tr>
<tr>
<td>Picture Arrangement*7</td>
<td>+</td>
<td>.26</td>
<td>.07</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Block Design *8</td>
<td>+</td>
<td>.27</td>
<td>.07</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Object Assembly *9</td>
<td>+</td>
<td>.25</td>
<td>.06</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Coding*10</td>
<td>+</td>
<td>.12</td>
<td>.02</td>
<td>ns</td>
</tr>
<tr>
<td>Mazes*12</td>
<td>-</td>
<td>.20</td>
<td>.04</td>
<td>&lt; .01</td>
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<tr>
<td>VIQ (1,2,3,4,5)</td>
<td>+</td>
<td>.51</td>
<td>.26</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>PIQ (6,7,8,9,10)</td>
<td>+</td>
<td>.31</td>
<td>.10</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>FSIQ (1-10)</td>
<td>+</td>
<td>.48</td>
<td>.23</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>P-D (3,10,11)</td>
<td>+</td>
<td>.36</td>
<td>.13</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>WISC-R A (1-6)</td>
<td>+</td>
<td>.45</td>
<td>.21</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>WISC-R B (7-12)</td>
<td>+</td>
<td>.45</td>
<td>.20</td>
<td>&lt; .001</td>
</tr>
</tbody>
</table>

* timed
TABLE 2

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>d f</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>82</td>
<td>8.6707</td>
<td>137</td>
<td>.37</td>
<td>.710</td>
</tr>
<tr>
<td>Female</td>
<td>57</td>
<td>8.5439</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

TABLE 3

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>d f</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>WISC-R A</td>
<td>66</td>
<td>51.3636</td>
<td>65</td>
<td>-1.10</td>
<td>.274</td>
</tr>
<tr>
<td>WISC-R B</td>
<td>66</td>
<td>52.4697</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 4

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>d f</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>WISC-R A</td>
<td>73</td>
<td>62.7397</td>
<td>72</td>
<td>-.44</td>
<td>.644</td>
</tr>
<tr>
<td>WISC-R B</td>
<td>73</td>
<td>63.1370</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( t \) STATISTICS COMPARING WISC-R A TO WISC-R B FOR INTROVERTED SUBJECTS

\( t \) STATISTICS COMPARING WISC-R A TO WISC-R B FOR EXTRAVERTED SUBJECTS
Performance on Block Design, a test of visual motor-coordination and non-verbal concept formation, had a significant positive relationship with extraversion \( (r = .27, p < .001) \). Visual-motor coordination along with perception, assembly skills, and the ability to draw whole-part relationships as measured by the Object Assembly subtest, are positively correlated to extraversion \( (r = .25, p < .01) \).

There was no significant difference in the performance of extraverts versus introverts in the Coding subtest \( (r = .12, \text{ ns}) \).

The relationship between performance on the Mazes subtest and extraversion was opposite the direction predicted and significant at the .01 level \( (r = .20) \).

Performance in Verbal IQ (VIQ), which is comprised of the sums of the scaled scores for the Information, Similarities, Arithmetic, Vocabulary, and Comprehension subtests, was significantly and positively correlated to extraversion, \( (r = .51, p < .001) \).

Subjects' performance on the Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Coding subtests comprise the Performance IQ (PIQ). Extraversion, in this study, was positively correlated with performance in PIQ \( (r = .31, p < .001) \). The relationship of extraversion to the sum of the subtests in VIQ and PIQ or Full Scale IQ was positive and was significant at the .001 level \( (r = .48) \).

Extraversion was positively correlated to performance in Freedom from Distractibility which is comprised of the Arithmetic, Coding and Digit Span subtests \( (r = .45, p < .001) \).

Performance to both the first six subtests (WISC-R A) and the last six subtests (WISC-R B) was positively correlated to extraversion in this population, \( (r = .45, p < .001 \text{ for both}) \).
Table 2 contains the mean scores for extraversion by sex of subject. Males had a mean of 8.6707, females 8.5439. There was no significant difference between the sexes in extraversion, \( t = .37, df = 137 \).

Table 3 provides the mean scores for introverts on WISC-R A versus WISC-R B (51.3636 and 52.4697 respectively) indicates that there was no significant difference in these mean scores, \( t = -1.10, df = 65 \). Similarly, mean scores on WISC-R A and WISC-R B, (62.7397 and 63.1370 respectively) as illustrated in Table 4, were not significantly different for extraverted subjects, \( t = -.44, df = 72 \).

In summary results of the present study indicated a highly significant positive relationship between extraversion and performance on all WISC-R variables measured.

A word of caution is necessary in interpreting \( r \) values for the following variables: FSIQ, VIQ, PIQ, WISC-R A, WISC-R B and F-D. Each of these variables is comprised of the sum of the scaled scores of the various subtests of the WISC-R and the possibility of a probability pyramiding effect cannot be ruled out. Although all of these variables were significant at the .001 level, they must be subjected to further analysis in order to determine whether or not that significance is a true measure of the relationship between extraversion and performance on the WISC-R, or is a function of chance outcome. This analysis was considered beyond the scope of the present study.
DISCUSSION

The findings of the present study supported the hypothesis that there exists a positive correlation between extraversion and performance on the WISC-R. Significantly, this held true where a negative relationship had been predicted.

These findings may be a result of a number of factors. First, as cited previously, Eysenckian extraversion increases in children from ages 7 through 13 and decreases from there until middle age (Eysenck and Cookson, 1969; Elliot, 1972; Anthony, 1973; Honess and Kline, 1974; and Anthony 1977). The population in our sample ranged in age from 9 years 0 months to 12 years 11 months, indicating that the overall positive relationship between extraversion and performance may be related to chronological age.

At the purely physiological level, the administration of the WISC-R with its pauses between and within subtests may prohibit the build up of cortical inhibition in the extravert whose performance would normally be disrupted by an involuntary rest pause (IRP). This absence of the IRP may in part be responsible for the superior performance of extraverts.

Another factor entering into the superior performance of extraverts is their ability to perform under stress as indicated by Gray and McLean (1973) and Goh and Farley (1977). Seven of the twelve WISC-R subtests are timed, which may create stress in the test situation.

As predicted there were no differences in extraversion scores when sex of the subjects was taken into account. This may be related to the chronological age of the sample. Anthony's theory (1973) indicates that,
for this age group, extraversion is an integral part of the developmental pattern regardless of sex.

One of the primary traits associated with extraversion, as conceptualized by Eysenck, is sociability. The presence of this trait indicates that the nature of the test situation itself must be examined. The question may be asked "Does the interaction of the testor with the subject during the administration of the WISC-R favor those subjects who are extraverted?"

Riding (1979), as previously cited (p. 13), supports this conjecture indicating that on tasks involving questioned recall, as opposed to free recall, extraverts are superior in their performance. In a slightly different vein, Entwistle, as cited by Eysenck and Cookson (1969), in discussing the "age effect" on the relationship of extraversion and performance, notes that introverts lack the social motivation to achieve in their early years. This at least partially accounting for the positive relationship between extraversion and performance up to the age of approximately fourteen.

It becomes apparent that the introvert, with his high arousal level, may respond negatively to the social stimulation of an individually administered IQ measure such as the WISC-R.

The effects of this "social stimulation" may contribute a significant amount of the variance in the variables studied by biasing performance in the direction of extraversion. This may also, in part, explain the contradictory findings presented in the literature review. Those criterion measures which were obtained in test situations relatively free of social interaction should show little difference in the performance of extraverted and introverted subjects, while those such as the
WISC-R, with social interaction an integral part of the test situation, should find that extraversion is positively correlated to performance.

In order to test this hypothesis a variation in the presentation of the WISC-R involving the subject reading the instructions for the subtests and eliminating prompts might be attempted.

In general the results of the present study indicate that, while the WISC-R does in fact measure intelligence as a global construct, non-intellective factors play a significantly larger role in the determination of IQ scores than had previously been supposed. It must be noted here that these results are specific to the age range studied and do not presume a cause and effect relationship. In order to accurately assess the nature of the relationship between extraversion and performance on the WISC-R, much more specific variables must be determined. Carrigan (1960) and Howarth and Browne (1972) point out the multi-dimensionality of extraversion as a personality trait. In examining both Eysenck's and Cattell's conceptualizations of extraversion several factors are found to be common to both; social activity, social facility, risk taking, and preference for action. In relating extraversion to performance several questions arise: (1) Does one of these factors assume more importance than the others? For example, does social facility correlate more significantly to performance on the Vocabulary subtest than does the trait of extraversion itself? (2) Do various combinations of these factors affect the outcome of the test? (3) Does an extraverted individual who is high on risk-taking score better on the Mazes subtest than an individual who is high in social facility and only a moderate risk taker? These questions must be answered before we can be sure we are measuring what we purport to be measuring.
Conversely, each subtest of the WISC-R measures a complex of aptitudes and abilities. For instance, the Information subtest measures remote memory, comprehension, and capacity for associative thinking. If extraversion correlates positively to performance on the Information subtest, does that imply that extraversion is positively correlated to all these component abilities, or are some of these abilities more critical to performance than are others? How do these characteristics relate to extraversion? Are we really correlating social facility to associative thinking?

Another question arises in the form of the role of memory and its relationship to extraversion and performance on the WISC-R. M.W. Eysenck (1976 A) discusses the effects of arousal on the biasing of the subjects search process toward readily accessible information. Riding (1979) on the other hand indicates that there are "three basic forms of representing information in memory and these are verbal, numerical and imaginal (or spatial) modes. The efficiency of these modes varies with arousal. . . ." (p. 301). It must be determined whether the WISC-R and other intelligence measures are biased in terms of creating high cortical arousal and thus handicapping introverts as far as their performance on certain subtests. Just as there are protestations of cultural bias, are we creating a bias based on personality traits?

Entwistle (1972) and Elliot (1972) bring to light yet another concern. Where Anthony (1973, 1977) and others have pinpointed chronological age as a determining factor in the relationship between extraversion and performance, Entwistle and Elliot indicated that perhaps mental age would be more appropriate in determining this relationship than chronological age.
Finally, the relationship between extraversion, neuroticism and I.Q. was deemed to be beyond the scope of this paper but figures prominently in the literature. In further assessing the relationship between extraversion and performance on the WISC-R variables such as neuroticism must be included in order to get a more accurate representation of that relationship.

The design of the present study did not lend itself to answering such questions, however. If we are to be able to predict human behavior based on these tests, a more in depth analysis is necessary. Eysenck (1967) established guidelines that apply today. He suggests that "(1) analysis of performance should always take into account individual items rather than tests. .... Such analysis should be made in terms of latencies .... as well as of errors, persistence before abandoning items, and other similar differential indicators of response style. (2) Investigators should pay more attention to laboratory studies of learning and memory functions, of speed of information processing, and other experimental measures in the testing of specific hypothesis regarding the nature of intellectual functioning. .... (3) Investigators should experiment with variations in experimental parameters, such as rest pauses, time from end of learning to recall, rate of presentation, degree of motivation, etc. ...." (p. 96).

Applying these guidelines to the current study the following recommendations are made: (1) That the WISC-R be analyzed item by item as to its correlation to extraversion. (2) That mental age be substituted for chronological age. (3) That subjects be divided into neurotic and stable groups. (4) That a clear dichotomy between extraverts and introverts be established, eliminating ambiverts from the sample population. (5) That
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