Cognitive-Neuropsychological Abilities and Related Psychological Disturbance: A Factor Model of Neuropsychological, Rorschach, and MMPI Indices

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Cognitive-Neuropsychological Abilities and Related Psychological Disturbance: A Factor Model of Neuropsychological, Rorschach, and MMPI Indices

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This article examines the relationship between cognitive-neuropsychological abilities and related psychological disturbance, as measured by the Rorschach and the Minnesota Multiphasic Personality Inventory (MMPI). Psychiatric patients typically have a long-standing history of emotional disturbance as well as neuropsychological dysfunction, but how the two domains are integrated is not clearly understood. We hypothesized that, through the use of factor analysis, indices of neuropsychological and personality assessment would form distinct, but not orthogonal, constructs. The historical roots, past research, theoretical formulations, and implications for future research in the area of neuropsychology of personality assessment are presented.

Neuropsychology has enjoyed tremendous growth since Donald Hebb (1949) first published his classic, *The Organization of Behavior: A Neuropsychological Theory*. More recently, the announcement of the "Decade of the Brain" points to the emergence of a *Zeitgeist* in which a new appreciation has developed for understanding the structure and functioning of the brain. This increase in research attention did not occur in isolation, but was directly related to developments in other fields, including behavioral neurology, biological psychiatry, and radiology. The precise manner in which neurological diagnosis, personality indices, and neuropsychological testing results are integrated and interpreted, however, remains ambiguous. Furthermore, no specific guidelines for a useful neuropsychological paradigm have emerged that would allow researchers to integrate symptom-based psychiatric classifications with neural correlates of behavioral and cognitive variables. Yet, behavioral scientists continue to recognize their limitations and struggle to integrate constructs of personality in their work. A potential major advance in neuropsychological and personality assessment may, therefore, lie in the integration of these two fields.

This article reviews the history of the neuropsychology of personality as well as several important relevant developments in modern medicine, clinical

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neuropsychology, and clinical psychology. Theoretical formulations of this "cross-over" issue, including a factor model of the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1967), Rorschach (1942), and neuropsychological measures, are presented.

Historical Perspectives

The neuropsychology of personality has a long past, but a short history. Attempts to integrate relationships between the mind and the body and the relative contributions to health and well being extend back to the time of Plato, Descartes, and Kant. In fact, it was Descartes' philosophy that left us with a very unsatisfying canonical dualism between "matter" and "spirit." The practice of utilizing psychological tests, neuropsychological tests, or both, to differentiate "organic" from "functional" etiologies is a more recent concept, but one that relies heavily on a philosophical dualism. Ever since psychology was defined as a field of study psychologists have struggled with this dualism. For example, it is not well known that early in his career, Freud wrote a critical and speculative monograph on aphasia in which he introduced the term agnosia (Bauer & Rubens, 1985). Freud, who was trained as a neurologist and was influenced by Wertheimer and localization theorists, went on to focus on intrapsychic events. But he never ventured too far away from his neurological roots, as demonstrated in his work, *On Narcissism* (1959), in which he suggested that all provisional ideas on psychology will one day be explained on the basis of organic substrates.

Perhaps the first person to make inferences about how the personality of an individual is related to brain functions was Freud's protége, Carl Jung. Jung (Jones, 1955) disagreed with Freud that early childhood experiences and sexuality were exclusively responsible for the development of personality. Instead, Jung suggested that innate, brain-based mechanisms were responsible for the symbolic representation of personality. Although this disagreement was, in part, responsible for Jung's break with his mentor (see Jones, 1955; Jung & Jaffé, 1989), the placing of the "psyche" within the evolutionary process of the central nervous system was Jung's preeminent achievement. Jung (1959, Jung & Jaffé, 1989) suggested that the mind, through its physical counterpart the brain, determines the ways in which a person will react to life's experiences; thus, Jung's typology of personality is based on a theory of inherited organic substrata (viz., archetypes, primordial images, and a collective unconscious). Jung also pioneered the concept of personality testing with the Word Association Test (1918), but it was not until Hermann Rorschach (1942) developed the inkblot test that personality tests were used for the differential diagnosis of brain impairment. Rorschach, like Jung, worked at the Swiss Burghölzli psychiatric clinic under Eugene Bleuler (Ellenberger, 1989). Rorschach suggested that the inkblot technique was a test of perception arising from three processes, sensation, memory, and association. At first, Rorschach used his inkblots as empirical means of approaching theoretical questions, but "after a further period of development," he declared that it was useful in making diagnoses: "It should be possible...in almost every case to come to a definite conclusion as to whether the subject is normal, neurotic, schizophrenic, or has organic brain disease" (1975, p. 120).

During the decades following Rorschach's (see Exner, 1993) untimely death, psychologists working on neurology and psychiatry wards were routinely asked to separate organic from psychological etiologies. Thus, the early history of Rorschach assessment reflects a strong interest in attempting to diagnose brain impairment from personality tests. One early pioneer was Molly Harrower who, as a research fellow of neurologist Wilder Penfield at the Montreal, Canada, Neurological Institute in the 1930s, was asked on a regular basis to evaluate "organic" patients (M. Harrower, personal communication, October 9, 1994). In her (1991) autobiographical essay, "Inkblots and Poems," she writes that, "As personality tests proved increasingly meaningful, I was assigned to examine all incoming patients suspected of tumor, with retesting 14 days postoperatively. Thus, a technique like the Rorschach, which could show a demonstrable pattern reflecting the psychological counterpart of cerebral pathology, was very favorably looked on" (pp. 141-142). The interest in the differential diagnosis of brain damage was also a focus of

Zygmunt Piotrowski's work (1950), which outlined 10 specific "organic personality signs" using the Rorschach inkblots.

The study of the relationships between personality tests and organicity was not limited to the Rorschach. The MMPI, introduced in the early 1940s, more than 20 years after the Rorschach, was also used extensively to diagnose "organicity." Starke Hathaway, one of the coauthors of the MMPI, was among the vanguard of clinical psychologists working in medical settings and was eager to standardize interviews for use in neurological and psychiatric examinations (cited in Popplestone & McPherson, 1994). On the MMPI, he identified several clusters of items that were relevant to general neurological functioning, including 19 assigned to a "general neurologic" category, 11 related to "cranial nerves", and 6 assigned to "motility and coordination" (see Colligan, Osborne, Swenson, & Offord, 1983). One of the first attempts at formal "organicity" scale construction was developed by Hovey (1964), who used a 5-item scale to detect organically impaired patients. Others include the Caudality Scale (*Ca*), to differentiate between patients with frontal lobe and parietal lobe brain damage (Williams, 1952), the Organic Symptom Content Scale (*ORG*), to identify individuals with neurological disorders (Wiggins, 1969), Watson's (1984) 80-item Schizophrenia-Organicity Scale (*Sc-O*), to differentiate between those patients with schizophrenia and those with organic etiologies, and the 56-item Psychiatric-Organic scale (*P-O*) to aid in separating brain-damaged from psychiatric patients. These "organicity" scales have not held up to empirical scrutiny, demonstrating little, if any, validity in terms of measuring what they were intended to measure (Pennington, Peterson, & Barker, 1979; Wooten, 1983).

In addition to special scale development, a great volume of research has focused on the prevalence of specific MMPI clinical scale code-type elevations as they relate to brain-damaged patients. For example, Gilberstadt and Duker (1965) suggested that the *1-3-9* code-type was associated with brain damage in male veterans. Gynther, Altman, and Sletten (1973) indicated a similar association in *9-8* code-types among state hospital patients, and Lachar (1974) noted that a variety of code types (e.g., *9-8*, *1-9*, *2-9*, and *1-3-9*) were associated with brain-damaged patients. Dikmen and Reitan (1977) suggested that elevations of the Lie scale (*L*), the *F* scale (sometimes called the Frequency scale), the Paranoia scale (*PA* or *6*), and the Schizophrenia scale (*8*) were related to an impairment of verbal and intellectual skills in head-injured patients, and Watson, Plemel, and Jacobs (1978) proposed that the difference between the Hypochondriasis (*1*) and Psychasthenia (*7*) scales of the MMPI was a fairly effective means of separating organics from a variety of functional patients. Despite all of this research activity, the consensus on the use of personality assessment instruments was summarized by Wooten (1983) in his extensive review of the MMPI in brain-impaired populations; "...the issue of the relationship between the severity of brain dysfunction and the severity of emotional problems is a complex one not adequately addressed..." (p. 405; also see Farr & Martin, 1988).

Thus, after years of research, there was little convincing evidence that either the Rorschach or the MMPI could definitively identify specific neuropathological processes (Caspy, Reisler, & Mendelson, 1987; Dikmen & Reitan, 1974; Gass & Russell, 1987; Vogel, 1962). As a result, very few investigators today use the Rorschach or the MMPI to diagnose neurological conditions.

Recent Developments in Neuropsychology and Personality Assessment

With the advent of modern medical diagnostic procedures, including single-photon emission computerized tomography (SPECT), magnetic resonance imaging (MRI), computed transaxial tomography (CT), positron emission tomography (PET), angiography, and evoked potential, the use of behavior-based assessments to diagnose organic-functional etiologies has become less essential. However, clinical neuropsychologists continue to figure prominently in uncovering the behavioral syndromes that correspond to impaired brain regions and neuronal circuits (e.g., Cummings, 1993; Damasio, 1991; Fuster, 1991; Goldman-Rakic & Friedman, 1991; Liddle &

Barnes, 1990; Stuss, 1992). Similarly, and related to the work of clinical rehabilitation specialists, there has been a greater focus on intervention, remedial methods for rehabilitation, and deposition planning. It has become less important for neuropsychologists and psychologists to act in the capacity of "lesion detectors," and more important to document the precise effects of brain dysfunction on behavior for purposes of remediation and treatment (Yosawitz, 1986). As a result of the interaction between personality and ability factors in determining rehabilitation progress and ultimately psychosocial adjustment, neuropsychologists have increasingly added measures of personality to their assessment. This has prompted Rourke (1991) to predict that, "There will be an intense interest in the investigation of the socio-emotional and personality correlates of brain disease" (p. 5).

For example, clinical neuropsychologists have noticed that the consequences of a maladaptive personality adjustment, as a result of brain injury, may be equally as important as, if not actually overshadowing, the cognitive sequelae of brain dysfunction. In one study, Diamond, Barth, and Zillmer (1988) administered the MMPI and a comprehensive neuropsychological battery to 50 mild head trauma patients (i.e., loss of consciousness < 20 minutes, no evidence of medical injury requiring hospitalization) and 50 patients, matched for age and education, with known neurological disease. Results revealed that at 3 mon postinjury the mild head injury group demonstrated significant emotional distress similar to those individuals with long-standing neurologic damage, although the mild head trauma group was less neurologically and neuropsychologically impaired than the comparison group. The most important findings were related to difficulties in returning to school or work. The differentiation of those individuals with problems in resuming their preinjury activities from those who were able to return to work and school was analyzed using a discriminant function analysis. Results indicated that ratings of neuropsychological impairment used in *conjunction* with the MMPI as an objective measure of emotional adjustment was more highly indicative of difficulties in returning to the tasks of preinjury activity than was either measure used individually. These findings support a growing literature on the effects of brain disease or trauma on emotional adjustment in mild head injury (e.g., Barth et al., 1983; Boll, Heaton, & Reitan, 1974; Klonoff, Costa, & Snow, 1986), hypoxemia (e.g., Barth, Findley, Zillmer, Gideon, Surrat, 1993; Grant, Prigatano, Heaton, & McSweeny, 1987; Prigatano, Wright, & Levin, 1984), chemical poisoning (e.g., Zillmer, Lucci, Barth, Peake, & Spyker, 1986; Zillmer, Montenegro, Wiser, Barth, & Spyker, in press), alcoholism (e.g., Løberg, 1986), stroke (e.g., Gass & Lawhorn, 1991; Sundet, Finset, & Reinvang, 1988), migraine headaches (e.g., Burker, Hannay, & Halsey, 1989), and Lyme disease (e.g., Bundick, Zillmer, Ives, Beadle-Linsay, in press).

With the realization that many disturbances that were previously thought to be "psychological" may, in fact, be related to neuropsychological dysfunction; there has also been an increasing interest among personality researchers in the study of brain-behavior relationships. For example, clinicians learned that neuropsychological testing can often add to the understanding of psychological and psychiatric disorders to an extent that personality testing alone could not achieve. This has been demonstrated in the neuropsychology of schizophrenia (Heinrichs, 1993), Gilles de la Tourette's syndrome (Newman, Barth, & Zillmer, 1986), borderline personality disorder (Sacchetti et al., 1993), pseudo-seizures (Vanderzant, Giordani, Berent, Dreifuss, & Sackellares, 1986), violence (Brown & Linnoila, 1990), dementia (Zillmer & Ball, 1989), sociopathic behavior (Damasio, Tranel, & Damasio, 1990), and psychiatric disorders (e.g, Heaton et al., 1979; Heaton & Crowley, 1981; Zillmer, Fowler, Newman, & Archer, 1988; Zillmer, Ball, Fowler, Newman, & Stutts, 1991).

In other research, neuropsychology has shaped how psychiatric disorders are being conceptualized. For example, it is now being recognized that the processing of verbal-auditory material in individuals with psychopathy may explain, in part, the personality style that defines this disorder (Hare & McPherson, 1984). A further example is found in the schizophrenia literature where Liddle (1987) identified three distinct syndromes—"psychomotor poverty," "reality distortion," and "disorganization syndrome"—which are associated with specific patterns of neuropsychological impairment and different neuropathological processes. Similar investigations of the relationships between cognitive deficits, personality functioning, and neural pathways have been suggested for Alzheimer's disease (Huber & Shuttelworth, 1990), Huntington's disease (Boll et al., 1974; Cummings, 1986), and Parkinson's disease (Freedman, 1990).

Theoretical Considerations

At the basis of the neuropsychology of personality lies the thesis that personality is dependent upon brain functions. All interactions in daily life, whether adaptive or maladaptive, have a neurological equivalent. Thus, the division between neuropsychology and personality is an artificial, but not particularly useful, dichotomy. Nevertheless, personality researchers differ in their opinion, "...whether or not they include the full range of basic tendencies within the domain of personality" (Costa & McCrae, 1994, p. 28). For example, Cattell (Cattell, Eber, & Tatsuoka, 1970) listed intelligence as the first of 16 basic factors of personality, Block (1961) included verbal fluency in his Q-sort description of personality, Baumeister (1994) examined the issue of cognitive patterns such as selective attention in personality, and Archer (1992) outlines the influence of cognitive maturation in assessing adolescent psychopathology.

There is a growing body of research that suggests that results from both neuropsychological and personality evaluation may contribute to a better understanding of an individual than either procedure alone. What is needed, however, is a framework in which the neuropsychology of personality assessment is integrated and in which different approaches to this interface issue can be compared. A practical starting point is to examine the test pattern usage of personality assessment instruments among neuropsychologists. U.S. members (N = 1,000) of the International Neuropsychological Society (INS) and National Academy for Neuropsychologists (NAN) were surveyed to determine their test usage pattern (Zillmer, 1994). Of the 32% that responded (average years of experience = 7.7, 69% of clinical activity devoted to neuropsychology), the MMPI was the most frequently used assessment procedure within the context of a neuropsychological examination (i.e., 48% reported using the MMPI "frequently"). The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), the Rorschach test (Rorschach, 1942; Exner, 1993), the revised edition of the Symptom Checklist-90 (SCL-90-R; Derogatis, 1983), Projective Drawings, the Sentence Completion Test (SC: Loevinger & Wessler, 1970), and the Thematic Apperception Test (TAT; Murray, 1943) were used "occasionally" and, with the exception of the SCL-90-R, significantly more frequently in private practice. These results confirmed earlier studies with neuropsychologists (Seretny, Dean, Gray, & Hartlage, 1986) and were also similar to test usage patterns among clinical psychologists performing traditional psychological evaluations among adults (e.g., Lubin, Larsen, Matarazzo, & Seever, 1985) and adolescents (Archer, Maruish, Imhof, & Piotrowski, 1991). In this respect, clinical neuropsychologists and clinical psychologists did not differ substantially in their selection and use of personality assessment procedures.

How findings from neuropsychological and personality tests are integrated, however, is not clear, and specific guidelines on the interpretation of this synergy issue have not emerged in the literature. Furthermore, there is little consensus about which personality assessment procedures are useful in complementing neuropsychological procedures because they were not designed for that specific purpose. Consequently, there has been little research investigating how personality measures are best assessed within the context of neuropsychology, and vice versa. Therefore, some obstacles need to be navigated if personality assessment is to make neuropsychological sense.

As a first step towards integrating these two approaches, we turn to the systematic study of the structural relationships between indices of neuropsychology and personality. An appropriate starting point could be the exploration of the relationship between psychological disturbance, as measured by the MMPI and the Rorschach, and related cognitive-neuropsychological abilities. Psychiatric patients typically have a longstanding history of emotional disturbance as well as neuropsychological dysfunction, but how the two domains are related to each other is not clearly understood. We hypothesized that, through the use of factor analysis, indices of personality and neuropsychology assessment would form distinct, but not orthogonal, constructs.

Method

Participants

The participants were 225 psychiatric inpatients who were consecutively referred over a 2-year period for routine psychological evaluation. From this initial population, 21 records with a low number of Rorschach responses (*R*) were excluded from the study ($R < 14$; Exner, 1993), as were 14 participants with invalid MMPI profiles (i.e., *F* scale *T*-score > 100; Greene, 1991). For the remaining 190 patients, the mean age was 38.1 years (SD = 15.4 years), 53% were men, 93% were right-handed, and 82% were Caucasian. Average education was 10.9 years (SD = 3.2 years), and 77% were being prescribed some form of psychotropic medication at the time of evaluation. Based on the revised, third edition and the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-III-R*; *DSM-IV*; American Psychiatric Association, 1987, 1994) criteria, 38% were suffering from schizophrenia, 29% displayed major affective disorders, 8% had disorders of a neurological nature, 9% had a history of substance abuse, 8% exhibited personality disorders, and 8% had multiple diagnoses.

Personality and Cognitive Measurements

All participants were administered the MMPI and the Rorschach technique. The Rorschach was scored independently by two experts in accordance with the Exner Comprehensive System (1990, 1993). Interrater agreement among all the responses of the records exceeded 90%, ranging from 86% for Determinants to 98% for Pair responses. In addition, the following neuropsychological instruments were given: the revised edition of the Wechsler Adult Intelligence Scale (WAIS-R; Wechsler, 1981), portions of the Halstead-Reitan Neuropsychological Test Battery (i.e., Finger Tapping Test, Grip Strength, and Trail Making Test, Reitan & Wolfson, 1993; the Short Category Test, Wetzel & Boll, 1986; the Grooved Pegboard Test, Matthews & Klove, 1964; the Peabody Individual Achievement Test–Reading Comprehension, Dunn & Markwardt, 1970; and the Russell-Modification of the Wechsler Memory Scale, WMS-R; Russell, 1975). All procedures were administered by trained psychology technicians and scored according to standard neuropsychological procedures.

Factor Analysis

Factor analysis provides a mathematical model for examining the pattern of multivariate data by sorting variables into relatively homogeneous and independent clusters that may describe unique and specific dimensions of psychological functioning (see Zillmer & Vuz, 1995, for a review of factor analysis with complex data such as the Rorschach). Thus, factor analysis provides a clearer interpretation of the original data set, a process Thurstone (1954) refers to as "simple structure." The application of factor analysis to the study of the neuropsychology of personality can provide a springboard for systematically identifying, sorting, and defining different constructs or abilities. Historically, research on the neuropsychology of personality assessment has been concerned with research designs where the "brain" is the independent variable and behavior, the dependent variable (e.g., the effects of brain lesions on cognitive behavior). In contrast, factor analysis makes no distinction between independent and dependent variables, but rather treats all variables as a dependent set.

Researchers should be forewarned that factor analysis is complicated, because many variables do not meet the measurement requirements and, as such, cannot be included in any form of correlational analyses (i.e., related to colinearity, low base rates, atypical skewness, or kurtosis; see Zillmer & Vuz, 1995). This is particularly true for Rorschach data; for example, Exner (1990) identifies those codes in the normative sample that are not normally distributed by placing standard deviations in brackets, and he suggests that the use of those variables for any kind of parametric statistic is questionable. The selection of all variables was based on meeting the statistical assumptions for factor analysis and, thus, several variables were not included that did not meet those criteria. Among the neuropsychological tests, the Trail Making Test A and the Grooved Pegboard were exceedingly positively skewed and displayed high values of kurtosis. Those two variables did not approximate a normal distribution and, therefore, they were not included in the factor analysis.

In order to reduce the number of variables and control the artificial introduction of colinearity, only 4, rather than all 11, WAIS-R variables were included in the analysis. Furthermore, finger tapping and grip strength were averaged for both hands, and immediate and delayed recall were averaged for the WMS memory tests. As a result, 11 neuropsychological variables, 8 clinical scales from the MMPI, and 8 Rorschach indices were subjected to exploratory factor analysis. MMPI scales were analyzed with and without *K* correction because the addition of *K* may result in an increase in colinearity because many of the clinical scales share common variance related to this scale. The total number of 27 variables is conservative in view of the current sample size that is required for obtaining reliable factor analysis results. Gorsuch (1983), and also Bentler (1985), suggest an absolute minimum ratio of five individuals per variable, but no less than 100 individuals for any analysis.

The 27 x 27 data matrix was submitted for exploratory factor analysis because confirmatory modeling assumes substantial knowledge about specific models that at this point are not available with these types of data sets. When satisfactory models have been described across a wide range of different populations, we can then proceed to test them with confirmatory work. After computation of the initial (i.e., orthogonal) factor matrices, the number of factors extracted was determined by using eigenvalues (Kaiser, 1960), the Scree Test (Cattell, 1966), total percent of variance explained (Stevens, 1986), the chi-square goodness-of-fit test, as well as the overall interpretability of the factor model. The solutions were then rotated to simple structure according to varimax (i.e., orthogonal) and direct oblimin (i.e., oblique) criteria. An oblique rotation can be advantageous in neuropsychology and personality psychology because it does not arbitrarily impose the restriction that the factors be uncorrelated.

Results

Table 1 presents descriptive data for selected neuropsychological, Rorschach, and MMPI variables. In general, this heterogeneous sample of psychiatric inpatients fell within the low average range of intellectual functioning and, with the exception of simple motor tasks, demonstrated below average, often impaired, performances on measures of neuropsychological functions. On the Rorschach, this sample produced somewhat lower response sets (mean $R = 18.9$) compared with Exner's (1990) norms for inpatient schizophrenics, inpatient depressives, and nonpatient adults. The composite MMPI profile for this sample revealed an *8-6-4* codetype, which is a common configuration for psychiatric inpatient settings (Greene, 1991).

Prior to factor analysis, the suitability of the correlation matrix for such analysis was determined by computing Bartlett's Test of Sphericity ($\chi^2 = 1{,}584$, $p < .0001$), the Kaiser-Meyer-Olkin index of variables' sampling adequacy (.75), and by performing a count of the number of off-diagonal elements in the anti-image covariance matrix greater than 0.09 (7%; Dzuiban & Shirkey, 1974), all of which fell within normal limits (Zillmer & Vuz, 1995). Oblique, maximum likelihood analysis revealed a 6-factor solution that accounted for 65% of the total variance. *K* correction did not alter the final solution, and was perhaps related to the low scores on this scale. The dimensions displayed in Figure 1 can be described by the following: Factor 1, MMPI Somatic/Neurotic, primarily composed of MMPI scales *3*, *1*, *2*, and *4*; Factor 2, Rorschach Response Process, principally defined by loadings from Rorschach variables organizational activity (*Zf*), whole responses (*W*), number of responses (*R*), and human movement (*M*);

Table 1
Descriptive Statistics for Selected Neuropsychological, Rorschach, and MMPI Indices

Variable	*M*	*SD*	Median	Skewness	Kurtosis
Wechsler Adult Intelligence Scale—Revised					
Information	7.6 (38)[a]	3.1	7.0	.32	-.34
Vocabulary	7.6 (40)[a]	3.1	7.0	.53	.00
Block design	7.2 (36)[a]	3.1	7.0	.74	.73
Object assembly	6.6 (40)[a]	2.9	7.0	.35	.53
Verbal IQ	86.8 (33)[a]	14.1	85.0	.50	.22
Performance IQ	82.3 (30)[a]	13.1	80.0	.88	1.06
Full Scale IQ	84.0 (30)[a]	13.4	82.0	.70	.81
Halstead-Reitan Test Battery					
Category Test, Short Form (errors)	34.6 (40)[c]	16.7	35.5	.38	.70
Trail Making Test A[b] (seconds)	49.7 (34)[a]	34.4	40.0	3.60	20.10
Trail Making Test B (seconds)	126.1 (36)[a]	71.1	106.5	1.10	.40
Grip strength (kg) (dominant)	34.8 (48)[a]	13.8	33.5	.26	-.66
Grip strength (kg) (ND)	31.3 (49)[a]	12.7	29.5	.24	-.64
Finger tapping (dominant)	45.7 (45)[a]	8.3	45.5	-.17	-.35
Finger tapping (ND)	40.5 (44)[a]	7.2	41.0	.15	.58
Other Tests					
Pegboard grooved[b] (dominant)	98.7 (28)[a]	51.4	80.0	2.50	6.60
Pegboard grooved[b] (ND)	110.1 (27)[a]	57.5	88.5	2.00	3.50
WMS-R verbal (immediate)	6.7	3.5	6.0	.51	-.48
WMS-R verbal (delay)	4.9	3.3	4.5	.63	-.36
WMS-R spatial (immediate)	6.5	3.7	6.0	.11	-.93
WMS-R spatial (delay)	4.9	3.7	4.0	.47	-.66
PIAT–Reading comprehension (years)	9.6	3.0	9.8	-.21	-.96
Rorschach					
R (# of responses)	18.9	5.7	17.0	1.14	.32
P (Popular responses)	4.6	1.7	4.0	.07	-.41
Zf (Organizational activity)	10.5	4.3	10.0	1.17	1.88
W (Whole responses)	9.0	4.6	8.0	1.30	2.92
M (Human movement)	2.1	1.9	2.0	1.14	1.10
X+% (Conventional form)	51.7	15.8	53.0	-.16	-.06
X–% (Distorted form)	21.5	12.3	20.0	.79	.84
F+% (Conventional pure form)	53.6	24.4	53.0	-.23	-.01
MMPI (*K* Corrected *T* scores)					
L (Lie Scale)	52.7	9.0	51.5	1.05	1.80
F (*F* scale)	68.7	13.8	65.0	.49	-.79
K (*K* scale)	51.6	10.1	50.5	.13	-.12
1 (Hypochondriasis)	60.8	13.9	58.0	.94	.79
2 (Depression)	69.0	16.1	67.5	.28	-.67
3 (Hysteria)	63.7	12.6	61.5	.74	.29
4 (Psychopathic Deviate)	73.5	14.0	71.0	.11	-.72
5 (Masculinity-Femininity)	57.5	13.2	57.0	.08	-.45
6 (Paranoia)	70.0	13.1	70.0	.18	.15
7 (Psychasthenia)	66.5	16.2	64.5	.16	-.29
8 (Schizophrenia)	74.4	17.9	72.5	.36	-.71
9 (Hypomania)	65.5	13.0	65.0	.29	.28
0 (Social Introversion)	56.7	10.9	56.0	.31	-.33

Note. ND = nondominant. *N* = 190.
[a]*T* scores adjusted for gender, education, and age in parentheses. From Heaton, Grant, & Matthews, 1991. [b]These variables were not submitted to factor analysis because of high values of skewness and kurtosis. [c]*T* score. From Wetzel & Boll, 1986.

Factor 3, MMPI Severe Disturbance, characterized by loadings for MMPI scales *8*, *6*, *7*, and *9*; Factor 4, Motor/Visuospatial-Learning, defined by loadings for the Trail Making Test B, Object Assembly and Block Design (i.e., from the WISC-R), Finger Tapping, WMS-R spatial (i.e., immediate and delayed), Grip Strength, and the Short Category Test; Factor 5, Verbal-Comprehension, which encompassed loadings from Vocabulary and Information (i.e., from the WISC-R), PIAT Reading Comprehension, and WMS-R verbal (i.e., immediate and delayed); and, Factor 6, Rorschach Perceptual Accuracy principally composed of conventional form (*X+%*), popular responses (*P*), distorted form (*X–%*), and conventional pure form (*F+%*). These dimensions are easily recognized cognates of others that have appeared separately in the literature on neuropsychological ability (e.g., Fowler, Zillmer, & Newman, 1988; Lezak, 1995; Zillmer, Fowler, Waechtler, Harris, & Khan,

	Factor 1 MMPI Somatic-Neurotic	Factor 2 Rorschach Response Process	Factor 3 MMPI Severe Disturbance	Factor 4 Motor/ Visuospatial-Learning	Factor 5 Verbal-Comprehension	Factor 6 Rorschach Perceptual Accuracy
MMPI Scale *3*[a]	1.03					
MMPI Scale *1*[a]	0.81					
MMPI Scale *2*[a]	0.61		0.26			
MMPI Scale *4*[a]	0.42		0.33			
Zf[c]		1.00				
W[c]		0.77				
R[c]		0.55				
M[c]		0.41				
MMPI Scale *8*[a]			0.85			
MMPI Scale *6*[a]			0.83			
MMPI Scale *7*[a]	0.47		0.74			
MMPI Scale *9*[a]			0.56			
Trail Making Test B[d]				–0.81		
Object Assembly[b]				0.66		
Block Design[b]				0.64		
Finger Tapping[d]				0.61		
WMS-R Spatial				0.59		
Grip Strength[d]				0.47		
Short Category Test				–0.47		
Vocabulary[b]					0.91	
Information[b]					0.90	
PIAT Reading Comp.					0.75	
WMS-R Verbal					0.60	
Conventional form (*X+%*)[c]						0.84
Popular responses (*P*)[c]						0.62
Distorted form (*X–%*)[c]						–0.60
Conventional pure form (*F+%*)[c]						0.60

Note. Factor loadings < .25 have been omitted; PIAT = Peabody Individual Achievement Test. WMS-R = Russell-Modification form of the Wechsler Memory Scale. [a]Minnesota Multiphasic Personality Inventory (MMPI). [b]Revised edition of the Wechsler Adult Intelligence Scale (WAIS-R). [c]Rorschach. [d]Halstead-Reitan Neuropsychological Test Battery (Reitan & Wolfson, 1993).

Figure 1. Oblique 6-factor pattern matrix.

1992) and personality processes (e.g., Anderson & Dixon, 1993; Mason, Cohen, & Exner, 1985; Meyer, 1992; Shaffer, Duszynski, & Thomas, 1981).

The average intercorrelation among these six factors was .18 (see Table 2). The correlations ranged from an absolute value of .44 (between Verbal-Comprehension and Motor/Visuospatial-Learning) to .01 (between MMPI Severe Disturbance and Rorschach Perceptual Accuracy). The Rorschach Response Process factor was one of the few personality constructs that displayed a modest relationship to neuropsychological constructs, specifically the Motor/Visuospatial-Learning dimension ($r = .39$) and the Verbal-Comprehension factor ($r = .36$). The MMPI factors (Factors 1 and 3) were only related to each other ($r = .35$).

Discussion

The present findings demonstrate that neuropsychological and personality assessment indices measure separate, relatively unrelated domains. The obtained factors are familiar ones and should reassure clinicians that common neuropsychological, neurocognitive, and personality measures maintain strong internal consistency, even when used with neuropsychiatric inpatients. These findings also highlight several areas that need to be considered by clinicians who integrate neuropsychological and personality assessment data. Foremost, the inappropriateness of using personality assessment measures to diagnose neurological conditions, second, the importance of using multiple measures when assessing either neuropsychological status or personality functioning, and finally, the notion that the integration of the fields of neuropsychology and personality assessment is a complex one requiring methodological refinement.

Taken in isolation, the results from the MMPI illustrate the potential misapplication on the part of those clinicians who use personality assessment instruments to identify organicity. In our study, the MMPI factors had little in common with measures of neuropsychological functioning. Additionally, the two MMPI dimensions shared only 12% of the total variance with each other and were not correlated to the selected Rorschach indices. The current results suggest that the MMPI is primarily a measure of psychopathology and not neuropsychological functioning. In this sense, we agree with Pennington et al. (1979), who evaluated the use of the MMPI within a neuropsychological context and suggested that "...it is not the MMPI, per se, that produces ambiguous findings, but rather the manner in which it may be used and how the results are interpreted" (p. 484).

The present findings also speak to the importance of using several measures when assessing neuropsychological and personality functioning. For example, in the current study, the MMPI and Rorschach interrelationships were minimal. This is consistent with the findings of Archer and Krishnamurthy (1993), who reviewed the literature from 37 studies that reported interrelationships between the MMPI and the Rorschach in

Table 2
Factor Correlations Matrix for ML Method Oblique Rotation

	Factor					
	1	2	3	4	5	6
Factor 1 (MMPI Somatic-Neurotic)	1.00					
Factor 2 (Rorschach response process)	–.04	1.00				
Factor 3 (MMPI severe disturbance)	.35	.14	1.00			
Factor 4 (Motor/visuospatial learning)	.03	.39	.04	1.00		
Factor 5 (Verbal-comprehension)	.06	.36	–.07	.44	1.00	
Factor 6 (Rorschach perceptual accuracy)	.13	–.01	–.01	.07	.10	1.00

Note. ML = Maximum Likelihood.

adults. Their findings suggested that despite the MMPI and Rorschach's common functions of assessing personality and psychopathology, these two tests were weakly correlated.

The Rorschach variables separated into two factors, namely the Rorschach Response Process factor and the Rorschach Perceptual Accuracy factor. The Rorschach Perceptual Accuracy factor was relatively unrelated to the other factors (see Table 2). This factor, which is composed of variables *X*+%, *P*, *X*–%, and *F*+%, reflects scoring categories that correspond to the accuracy of the response to the form of the inkblot. That is, do the participant's responses occur statistically more frequently in nonpsychiatric populations than in psychiatric populations. For example, *X*+% and *F*+% reflect ordinary or superior percepts that a majority of individuals would have no difficulty seeing. Some responses are so frequent that they are called Popular and are scored *P*. The scoring code *X*–% reflects unconvincing, ill-conceived, distorted, and statistically rare use of form fit.

The Rorschach Response Factor, which is composed of variables *Zf*, *W*, *R*, and *M*, is of interest to the current study because it correlated mild to moderately with the two neuropsychological dimensions (see Table 2). Briefly, *Zf* refers to the frequency with which organizational activity occurs in the Rorschach protocol. This provides important information concerning the extent to which the respondent has organized the stimulus field (i.e., the inkblot) and whether that effort has been efficient (Exner, 1990). The *W* code refers to the location of the blot, in this case, the whole blot, or *W*. The use of the whole blot area, compared with a smaller detail area, indicates the respondent's cognitive orientation, that is, whether the individual integrates or separates experiences, deals more in the abstract, is limited to conventional categories, or is drawn to the trivial and unusual (Zillmer, Harrower, Ritzler, & Archer, 1995). The scoring code *R* reflects the number of responses that a respondent has offered. Human movement responses (e.g., two people talking) are scored *M* and are of particular interest to the Rorschach clinician because the 10 inkblots are obviously immobile. Thus, by responding with movement to a static stimuli, the respondent is going beyond the given, which may reflect a capacity for fantasy and inner reflection. Of course, there is not complete agreement among clinicians regarding the strict interpretation of these four Rorschach indices. But most "Rorschachers" would agree that this factor measures the capacity for abstraction, complexity, and integration. Thus, it may not be that surprising that this Rorschach factor correlated with factors composed of neuropsychological variables.

To understand the process that is involved in forming a Rorschach response, one has to be aware that there are numerous cognitive-psychological operations that may occur before a single response is actually delivered. In effect, the nature of the Rorschach technique forces the respondent to convert the inkblot into something that it is not. As a result, a problem-solving situation is created that requires some violation of reality on part of the respondent. At the same time, the respondents are concerned about their own personal integrity. Thus, the situation posed by the need to "misidentify" the Rorschach stimulus cards requires many cognitive-psychological operations, including scanning, the encoding of the stimulus and its parts, the rank ordering of the many potential responses created, making decisions as to which of the answers to verbalize and which to discard, and the selection of some of the remaining responses based on state and trait influences (Exner, 1993; Zillmer et al., 1995). Thus, the question to the Rorschach examinee, "What might this be?" initiates a series of complex cognitive operations that sets the stage for considerations of the test from the perspectives of neuroscience and neuropsychology (Acklin, 1994). As a result, deficits in the area of visuospatial skills will influence the scanning and perceptual process, and limitations in verbal-comprehension will affect the verbal articulation involved in the delivery of a Rorschach response. If one were to interpret the Rorschach in isolation, without assessing the individual's neuropsychological status, a series of invalid inferences and attributions would likely be generated.

In the current study, the neuropsychological variables also separated on different, although familiar, factors that we labeled Verbal-Comprehension and Motor/Visuospatial-Learning. The lack of a strong relationship between these two factors, again, addresses the need for employing multiple measures when addressing cognitive dysfunction.

One potentially confounding issue underlying the current factor model is the degree to which the observed factor pattern may reflect shared method variance. Cronbach (1946) has stated that the assumption is generally made that what a test measures "...is determined by the content of the items. Yet the final score...is a composite of effects resulting from the content of the item and effects resulting from the form of the item used" (p. 475). Different tests almost inevitably elicit systematic variance. This has often been referred to as response set or method variance, which almost always interferes with inferences from test data. For example, the MMPI is a paper and pencil test, but the Rorschach technique yields a respondent's verbalizations. Thus, the relative independence seen between those two measures may be related, in part, to method variance that is different to those two measures. That the current factor model is primarily related to the trait content of each factor, rather than the measurement features of the tests, is justifiably the case for factors 4 and 5, because there is convergent and discriminant validation of different measures on separate factors (see Figure 1). Justification as to why the other factors identify novel trait measures include the observation that both the Rorschach and the MMPI separated on two factors, which can be meaningfully differentiated from other traits (Campbell & Fiske, 1967).

The current factor pattern is not affected in a clear-cut fashion by method variance across all factors. The absence of convergence by other measures on the MMPI factors and the relative independence of this factor from other constructs, however, does suggest that irrelevant method variance contributed to the factors obtained. Thus, the MMPI factors may have "artificially divorced" themselves from the other factors because of method variance unique to the MMPI and related to the fact that there is "built-in" redundancy among the MMPI scales (e.g., many items on the MMPI are scored on different scales, which elicits systematic variance unique to the method used). Thus, the above interpretations utilizing the MMPI may be tempered by method variance unique to that instrument, although the extent of such method variance is difficult to estimate. Ultimately, the distinction between trait and method is relative to the test developer's intent. For example, what is an unwanted response set for one test developer may be an important trait for another who wanted to "...measure unusual ways of answering test items" (Greene, 1991, p. 108), as is the case for the *F* scale.

In summary, these results suggest a relative independence between both the MMPI and the Rorschach as measures of personality and between neuropsychological and personality assessment measures. Thus, using a converging measures strategy can provide the clinician with additional "coverage" when explaining personality, psychopathology, or neuropsychological dysfunction.

Using multiple measures of assessment may also help us to uncover new and potentially important brain-behavior relationships that, in turn, may assist in how we conceptualize neuropsychological and clinical variables. For example, an integrationist approach provides us with new ways of examining the Rorschach and the relationship between neuropsychological and personality functioning. Thus, if we were to conceptualize the Rorschach as a "problem-solving" instrument, then we can posit that respondents' verbal comprehension skills influences their test-taking strategies and provides limits to the types of responses offered on the Rorschach.

Not everyone may agree, however, that the absence of a strong correlation between two composite measures (e.g., the MMPI and the Rorschach, or the MMPI and neuropsychological indices) suggests that both factors are contributing important information, and the current study did not provide validation of the different factors. However, the proposed mathematical model indicates that the factors are relatively unique and measure separate variance. Thus, we suggest that, in some clinical cases, it may be more useful to know how a patient did on the "Can't tell the forest for the trees" construct (i.e., the Rorschach Response Process factor), and in some instances it may be more useful to examine the neuropsychological tests that compose the Motor/Visual-Spatial Learning dimension. We strongly suggest that, in many cases, a strategy that approaches test results from an integrationist perspective can provide clinicians with a better understanding of an individual's overall functioning, which may assist in refining diagnosis, treatment, and discharge planning.

Although the present findings need to be validated with other samples and with more measures (e.g., only a limited number of variables from the Rorschach were used), the current study is a first step towards developing a dynamic understanding of the neuropsychology of personality. Toward this end, the current factor model represents one comprehensive method of studying the brain and its behavioral product. A variety of alternative methodological approaches are also viable. Those include the examination of personality correlates of brain function and trauma, the investigation of neuropsychological aspects of psychiatric disorders, and novel approaches to interpreting traditional assessment tools. Common to all of these approaches is the understanding that behavior and personality is a product of brain functioning.

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