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CEREBRAL IMPAIRMENT: A NEW CONTENT SCALE FOR THE MMPI-2

by

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
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in the Department  
of  
Psychology

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## ABSTRACT

The purpose of the present research was to devise a traumatic brain injury (TBI) content scale for the Minnesota Multiphasic Personality Inventory - 2 (MMPI-2). Subjects were from one of four groups: TBI, injured (but not TBI), university students, and psychiatric in-patients. With excellent reliability ( $KR20 = .930$ ), the 55-item scale was able to discriminate statistically between TBI and student subjects, but not between TBI and injured subjects or TBI and psychiatric subjects. Principal components analysis extracted five factors that together accounted for 37 percent of the scale score variance. Discriminant function analysis accurately classified 79 percent of all subjects. The question of statistical versus clinical significance is considered, followed by a discussion of future refinements that might be made to the scale.

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## Cerebral Impairment: A New Content Scale for the MMPI-2

The incidence of survival after traumatic brain injury (TBI) has increased at a remarkable rate with the advent of new medical technologies (Kraus et al., 1984). Although victims are now recovering physically, they often meet with other difficulties long after making a complete physical recovery. These other difficulties typically are of a cognitive, emotional, and psychosocial nature. This research addressed these issues in relation to a new scale for discriminating those patients who are suffering sequelae of TBI from those who are not.

### Sequelae of TBI

The impact of TBI is often felt by victims and their families in several diverse areas of life long after physical recovery has apparently concluded. In general, the sequelae experienced may be of a cognitive, affective, or psychosocial nature, or any combination of these. Given diffuse cerebral damage, which tends to occur in traumatic injuries, memory problems are the most frequently mentioned disturbance. Also commonly reported are cognitive deficits in mental speed, attention and concentration, cognitive efficiency, high-level concept formation, and complex reasoning abilities. Further, many patients display impaired initiative and apathy, fatigue, social withdrawal, defective social judgment, childishness and selfishness, lack of concern, impulsivity or asponaneity, irritability, inflexibility, and low frustration tolerance (Binder, 1986; Brooks & Aughton, 1979; Miller, 1986; Tate, Fenelon, Manning, & Hunter, 1991). These sequelae can occur even with very mild injuries (Binder, 1986) and can continue to be reported several years post-injury (Thomsen, 1984).

Authors report deficits in several areas, and although memory and cognitive dysfunction occur very frequently, personality and emotional changes occur just as frequently. Miller (1986) stated that overall, personality changes and emotional disorders were "frequently reported by relatives and rehabilitation staff as the greatest obstacles to full restoration within the family and the community" (p. 365). Because personality and affective sequelae are so common, it is reasonable to expect that TBI patients would achieve atypical scores on tests that tap the domains of personality and affective functioning. One such test that is commonly used is the Minnesota Multiphasic Personality Inventory-2 (MMPI-2). Items on this inventory do indeed tap the areas described as being common TBI sequelae, but not in a way that can be easily used by the clinician working with the TBI patient.

#### MMPI and MMPI-2 Scales Types

In 1989, Butcher, Dahlstrom, Graham, Tellegen, and Kaemmer revised the Minnesota Multiphasic Personality Inventory (MMPI), one of the most widely-used and researched personality measures. In the revision process, some of the inventory items were changed to better reflect today's social mores, other items were deleted, and new items were added.

The MMPI has typically been scored on four types of scales: clinical scales, validity scales, supplementary scales, and content scales. The clinical, supplementary, and content scales have been the subject of a great deal of research concerning brain-damaged patients.

#### Clinical Scales

The first and primary scales of the MMPI to be constructed were the clinical scales. These were constructed in several steps (Hathaway &

McKinley, 1940, 1942; McKinley & Hathaway, 1940). First, Hathaway and McKinley selected over 1000 personality statements from sources such as case histories, textbooks, and earlier published scales of personal and social attitudes. They deleted duplicates and irrelevant items, resulting in a group of 504 items which were categorized into 25 content groups.

Next, the authors selected criterion groups of normal and clinical subjects. The normal groups consisted of 724 relatives and visitors of patients in the University of Minnesota Hospitals, 265 pre-college students, and 265 skilled workers. The group of clinical subjects consisted of University of Minnesota Hospital psychiatric patients from specific diagnostic categories. Patients were selected for inclusion only if they had a pure diagnosis according to the American Psychiatric Association's *Classification of Mental Disorders* without comorbidity of other illness.

After the original 504 MMPI items had been administered to all subjects, Hathaway and McKinley (1940) conducted item analyses to identify those items that significantly differentiated between each target clinical group, other clinical groups, and the normal group. Their criterion was that the endorsement frequency difference be at least twice the standard error. This criterion was purely empirical and was unrelated to the meaningful content of the items. This work resulted in the construction of eight clinical scales: Scale 1, hypochondriasis, Scale 2, depression, Scale 3, hysteria, Scale 4, psychopathic deviate, Scale 6, paranoia, Scale 7, psychasthenia, Scale 8, schizophrenia, and Scale 9, hypomania. These scales were then cross-validated on new groups of normal and clinical subjects.

Later, two more clinical scales were constructed: Hathaway (1956) created Scale 5, Masculinity-Femininity and Drake (1946) created Scale 0, Social-Introversion. Today these 10 scales make up the basic MMPI and MMPI-2 profile.

TBI and the Clinical Scales. Because many of the MMPI and MMPI-2 items describe symptoms that are commonly reported following TBI, researchers have attempted to use the MMPI to describe this group of patients and have illustrated that there is a common MMPI profile pattern that tends to be associated with TBI. Wooten (1983) and Lezak (1983) reviewed studies of the MMPI profiles of TBI patients. Both reviewers found that TBI typically results in elevated scores on scales 1, 2, 3, and 8. Under usual circumstances, elevations on these scales suggest both neuroticism and psychoticism. Such interpretations, however, are not accurate given a patient who has experienced a TBI.

As discussed earlier, TBI often results in patients experiencing cognitive and emotional difficulties, as well as social withdrawal and apparent motivational deficits. TBI patients have experienced a physical and possibly life-threatening trauma, have been absent from work, and have become isolated from their peers as a result. These events alone would lead to elevations on scales 1, 2, and 3, which suggest health concerns, depression, and physical reactions to stress. Further, because of the nature of TBI, these patients are also very likely to report symptoms usually associated with thought disorders, as demonstrated by the scale 8 elevations. Given the ordeal that TBI patients typically undergo, it is not surprising to see elevations on these clinical scales, which are heavily loaded with items tapping phenomena often associated with TBI.

In contrast, it would be very unusual to see elevations on scales 1, 2, 3, and 8 in a patient who had not undergone this type of ordeal. Rather than being the predictable result of a known trauma, this profile would suggest serious emotional difficulties involving hypochondriasis, depression, and somatization, coupled with thought disorder. Because patients without TBI exhibiting such symptoms are treated very differently from those with TBI, it is important to distinguish the TBI patients from other patients so that appropriate treatment is recommended. For TBI patients and their families, normalization of the emotional experiences is very important, and so it is paramount that the clinician be able to recognize these elevations as the typical profile associated with TBI.

Other Nervous System Problems and the Clinical Scales. Some work concerning the MMPI has also been done with patients suffering from other injuries or diseases of the nervous system. One population that shares some similarity to a TBI population is that of spinal cord injury (SCI) patients. Both groups suffer permanent physical damage that may be irreparable and that is due to a traumatic event. Taylor (1970) compared the MMPI results of SCI males and a group of matched controls and found that the SCI patients had higher elevations on Scales 1, 4, 2, and 3, and lower scores on Scale 5. He discovered 12 items on which the groups significantly differed and which his nine experts considered to be "somatically relevant".

Kendall, Edinger, and Eberly (1978) used factor analysis with the MMPI to separate out items contributing to a physical rather than psychological description. They looked for items that distinguished SCI patients from (a) hospitalized, nonSCI patients and (b) hospital

employees. Factor analysis of the two sets of items resulted in a common factor of 10 items, seven of which were the same as those chosen by Taylor's (1970) experts. These researchers corrected the profiles of their subjects and found that both groups were still significantly elevated on Scales 1, 2, 3, 4, and 8 compared to the hospital employees group. The work of both Taylor and Kendall et al. illustrates that scales 1, 2, 3, and 8 are associated simply with having a physical trauma and its accompanying phenomena. This work suggests that TBI patients who display elevations on these scales may be reacting to the physical manifestations of their situation rather than developing a psychological disorder of unknown origin.

Multiple sclerosis (MS) is similar to TBI and SCI in that it involves the nervous system, but unlike the other two conditions, MS is a progressive disease. Meyerink, Reitan, and Selz (1988) had experts identify MS-related items on the MMPI. They found that in MS patients, endorsement of symptom-related items resulted in T-score elevations of five to 15 on scales 1, 3, and 8, and of three to four on scale 2. Further, Marsh, Hirsch, and Leung (1982) also found elevations on scales 1, 2, and 3 with MS patients. From the work done with TBI, SCI and MS patients, it is apparent that Scales 1, 2, 3, and 8 include items that are sensitive to a range of medical problems with nervous system involvement.

In addition to the specific medical problems described above, elevations on these scales also tend to be associated with Worker's Compensation claimants with a variety of injuries (Hersch & Alexander, 1990; Repko & Cooper, 1983). Interestingly, the process of litigation may mitigate some of the depression and anxiety with this population in that

litigation may serve as a coping mechanism for stressors associated with filing a Workers' Compensation claim (Tait, Chibnall, & Richardson, 1990).

Overall, clinical scales 1, 2, 3, and 8 are associated with several types of medical difficulties. Although elevations on these scales are to be expected from TBI patients, these clinical scales are not maximally informative in terms of illumination of the particular difficulties of the individual.

### Supplementary Scales

The MMPI supplementary scales are scales that were later created from the original MMPI item pool to enhance profile interpretability or to highlight the possibility of a specific clinical manifestation. A sizeable body of literature exists on attempts to create various types of MMPI supplementary scales to discriminate patients with organic brain damage from functional patients.

Caudality (CA). The first instance of a supplementary scale pertaining to brain damage was Williams's (1952) Caudality (CA) scale, which was designed to discriminate patients with focal injuries to the frontal lobes from those with focal injuries to the parietal lobes. Williams selected MMPI items that separated frontal from parietal patients with the probability criterion of 10 percent. With this scale he was able to correctly classify 78 percent of his subjects. The items on the CA scale came from ten MMPI scales, with the greatest number of items from scales 2, 3, 7, and 8.

Hovey's five-item scale. Later work focused on the creation of scales whose purpose it was to distinguish patients with brain damage from those without brain damage but with symptoms associated with



brain damage, rather than to localize damage. An initial attempt at this type of scale was made by Hovey (1964). Unlike most subsequent researchers, Hovey did not include "cases with clear-cut neurological symptoms of brain damage" because he felt that the test "would be more useful if...validated on cases initially presenting diagnostic challenges rather than cases with conspicuous deficits" (p. 78). Hovey's (1964) chi-square analysis revealed that 29 items differentiated between the groups at the .05 level. Upon visual inspection of the chi-square values he noted that five items, numbers 51 (F), 159 (T), 192 (F), and 274 (F), "towered above the rest" (p. 78). Using only these items he was able to correctly predict group membership of 86 to 92 percent of his subjects, depending on their scores on the K scale. Subjects with lower K scores were accurately classified at a lower rate than were subjects with higher K scores.

Upper and Seeman (1968) attempted to validate Hovey's (1964) scale with three groups: organic brain damaged patients with damage of mixed origin, paranoid schizophrenics, and hospital patients from medical or surgical wards. These researchers administered the MMPI in its entirety as well as a short form consisting of Hovey's five items plus 15 items randomly selected from the MMPI. Both forms differentiated the brain-damaged group from the normal and the schizophrenic groups, which did not significantly differ from each other. The false negative rate for diagnosing brain damage was unacceptably high at 40 percent; however, the use of paranoid schizophrenics was not entirely appropriate since the scale was originally intended to differentiate between patients with and without identifiable brain damage. Watson (1971) replicated

this part of their study and was also unsuccessful in achieving differentiations between organic and schizophrenic subjects.

The Pseudo-Neurologic Scale (P-N). Shaw and Matthews (1965) used the same scale construction method as did Hovey (1964). These researchers looked for items to differentiate between two heterogeneous groups: subjects with "pseudoneurologic" symptoms without positive identification of brain damage, and subjects with symptoms unequivocally attributable to organic brain-damage. In this study, as in Hovey's, all subjects who presented with relevant symptoms but for whom brain damage could not be neurologically identified were given psychiatric diagnoses. Shaw and Matthews found significant differences between the groups on clinical scales 1, 3, and 4. Their chi-square analyses yielded 17 items from these three scales that discriminated between the groups at the .05 level. These 17 items together were labelled the Pseudo-Neurologic Scale (P-N). In their cross-validation study, the scale correctly identified 67 percent of patients, misclassifying 22 percent of brain-damaged individuals.

There have been several attempts to cross-validate the Shaw and Matthews (1965) P-N scale. Puente, Rodenbough, and Horton (1989) found that it failed to differentiate between somatoform and brain-damaged patients. Marsh et al. (1988) attempted to identify their MS patients using the P-N scale, achieving a hit rate of 70 percent. Hovey's (1964) scale proved even less useful, correctly identifying only 45 percent of the MS patients.

Psychiatric Organic Scale (P-O). Following Hovey (1964) and Shaw and Matthews (1965), Watson and Plemel (1978) created the Psychiatric-Organic (P-O) scale, the purpose of which was to separate brain-damaged

from functional psychiatric patients. All subjects presented with symptoms typical of brain damage. As in the previous studies, those subjects for whom damage was not detectable through neurological evidence were considered part of the functional group. The authors conducted chi-square analyses on each MMPI item and found that 56 items significantly differentiated between the groups; these items were used to form the Psychiatric-Organic (P-O) Scale. The authors also calculated correlations between the P-O Scale and each of the clinical scales. The largest correlations were with the validity scales and with scales 7 and 8. All correlations were significant at the .05 level except with scales 1 and 3, although no Bonferroni procedures were applied. In cross-validation, differences between the heterogeneous organic group (alcoholism, trauma and alcohol, and other organic causes) and the functional group on the P-O scale were significant at the .005 level.

In a second cross-validation study with the P-O scale (Watson & Plemel, 1978), organic subjects scored significantly differently from neurotic, alcoholic, character disordered, affective psychotic, and schizophrenic subjects. In a later study the scale failed to differentiate between TBI subjects and victims of cerebrovascular accidents (CVAs) (Horton, 1983). Because this scale was not intended to discriminate between these specific groups, however, these results are as expected.

Puente et al. (1989) attempted to replicate Watson and Plemel's (1978) results with the P-O scale, with outpatients. Their subject groups included patients diagnosed with somatoform disorders, brain damage, schizophrenia without brain damage, and schizophrenia with brain damage. Both of the brain-damaged groups in this study were heterogeneous, consisting primarily of patients with TBI and CVA, as well

as alcoholism, seizure disorders, and others. Puente et al. found significant differences between schizophrenic subjects and brain-damaged subjects on P-O and between schizophrenic subjects and brain-damaged schizophrenic subjects on scale 8.

Schizophrenia-Organic Scale (Sc-O). Watson (1971) attempted to create a scale to differentiate between organic and schizophrenic patients. With all-male samples of schizophrenic and organic subjects diagnosed with "chronic brain syndrome", he performed chi-square analyses on all of the MMPI items. Eighty items differentiated between the groups at the .05 level. These 80 items made up Watson's first Schizophrenia-Organic (Sc-O) scale (Long). His second scale (Long, weighted) consisted of the same 80 items but with differential weights assigned to each item by significance level. His third scale (Short) consisted of the 30 items taken from the original 80 that differentiated between the groups at the .01 level or better, differentially weighted by significance level. At cross-validation, hit-rates for the three scales ranged from 61 percent to 75 percent, with the Long form being the most accurate and the Short form the least. Watson included females in his cross-validation sample and found that the hit-rates for females were not above chance levels.

Sand (1973) compared Hovey's (1964) scale to Watson's (1971) three versions of the Sc-O scale. Her subjects were chronic pain patients, spinal cord injury patients, and organic brain damage patients, primarily with CVAs and some TBI. There were no significant differences between groups for all three versions of the Sc-O scale, whereas the Hovey scale identified 20 percent of spinal cord injury patients and 45 percent of chronic pain patients as organic. Rather than pointing to the

questionable validity of these scales, however, these results exemplify the care researchers must take to use scales only with the populations for which they were intended. In fact, neither of these scales was designed to make the discriminations required here.

Halperin, Neuringer, Davies, and Goldstein (1977) attempted to cross-validate the Sc-O scale using the Halstead-Reitan and a standard neurological examination as measures for brain damage. Since they did not state which version of the scale they used, it is likely that they used the Long, Unweighted version. These authors found that the brain-damaged subjects and schizophrenic subjects did not score significantly differently on the Sc-O scale. In contrast, Puente et al. (1989) found that brain-damaged subjects scored significantly higher on the Sc-O scale than did schizophrenic subjects, but only after subjects had been matched on age, gender, race, and education.

Several other authors have conducted validation research on the P-O and Sc-O scales. Watson (1984) reviewed this research and concluded that results concerning the Sc-O scale were relatively encouraging, although the scale had still not been validated on women. Although much less work had been done with the P-O scale, Watson concluded from Horton's (1983) results that the P-O scale is more sensitive to frontal than caudal damage, although further research has not supported this claim.

Gass's correction factor. Gass (1991) attempted to identify neurologically relevant MMPI items and to determine their impact on the clinical scale profile. His first step in this endeavor was to compare the frequency of item endorsement on the MMPI in his sample of 75 TBI patients with "that of the 1138 normal adult men that composed the

contemporary national normative sample on which the MMPI-2 is based" (p. 28). Since the TBI subjects in this study completed the MMPI and not the MMPI-2, the only items available for analysis were those that appear both on the MMPI and the MMPI-2. Gass selected for further analysis the 23 items that discriminated between the groups at the .001 level or better and that were endorsed by at least 25 percent of the sample.

Gass (1991) then conducted a principle-components factor analysis. This resulted in two factors, which he labelled "neurologic complaints" and "psychiatric complaints". The first factor, which accounted for 24.8 percent of the variance, consisted of 14 items; the second factor of five items accounted for only 3.7 percent of the variance. Gass pointed out that the items of Factor 1, taken together, could produce T-score increments of at least 10 on any or all of Scales 1, 2, 3, 7, and 8. His recommendation was that these items be used to prorata these five clinical scales downward to remove the effect of TBI, which would then allow for a more standard interpretation of the MMPI profile.

Configural Rules and TBI. The research discussed to this point has been carried out with individual item-analysis as the primary method of scale construction. Rather than construct separate scales in this manner, a second approach to differentiating between brain-damaged and schizophrenic patients has been through the use of keys for the MMPI. In general, this involves establishing rules based on existing scale scores to make diagnostic decisions. Watson and Thomas (1968) attempted to distinguish between schizophrenic subjects and a heterogeneous group of subjects diagnosed with chronic brain syndrome. In terms of the clinical scales, the schizophrenic group scored significantly higher than the brain damage group on scales 1, 2, 5, 7, 8,

and 0. The authors used this information to develop their four diagnostic signs or rules. For example, the first rule was that if there were a peak on scales 2, 5, or 8, the person should be diagnosed as schizophrenic, and if there were a peak on either scale 4 or scale 9, the person should be diagnosed as organic. Of the four rules, two were moderately effective with hit rates of 69 to 79 percent for males. Their results with females, however, were abysmal.

Russell (1975) used this approach "to separate the reactive depression profile common in brain-damaged patients from the more disturbed schizophrenic profile" (p. 659). Russell's key was derived on the basis of clinical experience. It is actually a decision-making tree with various cut-offs on scales F and 8, as well as a comparison between the two scales. In cross-validation with a heterogeneous brain-damaged group, Russell's key proved to be accurate 76 percent of the time, correctly identifying 80 percent of schizophrenic and 72 percent of brain-damaged patients. The hit rates were even higher at a second attempt at cross-validation (Ryan & Souheaver, 1977).

Other than Watson and Thomas's (1968) initial study, very little work has been done in this vein with females. Carpenter and Le Lieuvre (1981) compared the Watson and Thomas key with Russell's (1975) key using only female subjects. Unfortunately, these researchers looked at the efficacy of the four Watson-Thomas rules taken separately but not together, as they were designed to be used. Using the rules separately, they were able to achieve hit-rates ranging from seven to 100 percent for brain-damaged subjects and three to 80 percent for schizophrenic subjects. Similar hit-rates came from attempts with Russell's key.

Clearly, further work must be done before any solid conclusions can be drawn about the usefulness of these keys with females.

#### Clinical Scales, Supplementary Scales, and Configural Rules Compared

Three studies have involved comparisons of the three basic scale construction approaches to differentiating schizophrenic from organic subjects. Golden, Sweet, and Osmon (1979) attempted to differentiate between three groups of males: schizophrenic patients without neurological dysfunction, hospitalized patients without brain or psychiatric dysfunction, and a heterogeneously brain-damaged group (identified via medical procedures or a history of head injury). When the clinical scales were used to make the discriminations, scales 3, 4, 6, 7, 9, 8, and 0 all significantly differentiated between the three groups. The largest differences between groups were observed on scale 8. Using the clinical scales, the overall hit rates were 70 percent or better.

The authors then considered the various supplementary scales. Watson's (1971) Sc-O scale correctly identified 73 percent of psychiatric and 53 percent of brain-damaged patients in that comparison and 63 percent of brain-damaged and 40 percent of normal patients in a second comparison. The Watson and Plemel (1978) P-O scale fared slightly better, with overall hit rates of 67 percent when discriminating between schizophrenic and brain-damaged subjects, and 73 percent when discriminating between brain-damaged and normal subjects.

Finally, Golden et al. (1979) looked at the configural rule or key approach. Watson and Thomas's (1968) rules predicted group membership only at the chance level. Russell's (1975) key was more accurate, classifying 63 percent of brain-damaged subjects and 30 percent of schizophrenic subjects as brain-damaged. Unfortunately, it



also classified 97 percent of normal subjects as brain-damaged. Golden and his colleagues concluded that none of the special scales or rules showed any advantage over the standard clinical scales.

Trifiletti (1982) conducted a study similar to that of Golden et al. (1979). Trifiletti compared the efficacy of the validity scales, clinical scales, and Russell's (1975) key for distinguishing brain-damaged from schizophrenic and depressed subjects. His results were similar to those of Golden et al. in that he found significant differences between the groups on scales F, 4, 6, 7, 8, and 9. Although he did not conduct pairwise comparisons, visual inspection of his results leads to the observation that for all of the clinical scales, the schizophrenic group's scores look higher than those of the other two groups, whose scores seem relatively close.

When Trifiletti used Russell's key, 85 percent of brain-damaged and 90 percent of schizophrenic subjects were correctly classified. When depressed subjects were included in the analysis, however, the overall hit-rate was only 68 percent. Again, it is important that researchers pay close attention to the use for which assessment devices are intended. Given that Russell's key was originally designed to discriminate only between brain-damaged and schizophrenic subjects, these results support, rather than negate, the construct validity of this tool.

Finally, Sillitti (1982) conducted a review of all published scales whose purpose was to identify brain-injured patients. He hypothesized that a combination of measures might result in higher hit-rates than those for any single scale. There is no indication that he actually conducted this analysis, although he did provide a comprehensive comparison of the various methods. He compared organic patients (with

no signs of schizophrenia) to schizophrenic patients (with no signs of organicity), with equal numbers of males and females in each group. The overall hit rates ranged from 45 percent to 76 percent, with the scales' accuracy levels ascending in the following order: Russell's key (1975), Watson's Sc-O (1971, Short), Watson and Thomas's key (1968), Shaw and Matthews P-N (1965), Hovey's five-item scale (1964), Watson and Plemel's P-O (1978), Watson's Sc-O (Long), Watson's Sc-O (Long weighted), and clinical scale 8. The last two were virtually equivalent in terms of accuracy. One of the most surprising findings in this study was that most of the measures discriminated better for females than for males. This result is striking given that nearly all of the instruments were standardized primarily on males and that the scant research on females persistently shows much lower hit rates for females than males.

Overall, although most of the supplementary measures yield decisions at levels that are better than chance, these scales do not appear to have been overwhelmingly successful. In general, the hit rates achieved have been at best approximately 75 percent, which has also been the average hit rate for using only Scale 8. The supplementary scales, therefore, have not provided any incremental means for decision-making. However, it may be that because medical techniques have recently improved in sophistication, the scales might be more effective than originally thought if applied to a population whose brain disorder was more accurately characterized. That is, poor classification of subjects may have contributed to less accurate predictions.

TBI, the MMPI, and Cognitive Ability Tests. Rather than simply using an MMPI scale to screen for brain-damage, another group of researchers has looked into combining MMPI scales with cognitive ability

tests. Arsuaga, Higgins, and Sifre (1986) found no significant differences between their organic and schizophrenic groups on either the Smith Symbol Digit Modalities Test (SDMT) (Smith, 1973) or Watson's P-O scale. However, when they combined the two tests, they were able to achieve an overall hit-rate of 67.5 percent, with 80 percent of brain-damaged and 55 percent of schizophrenic subjects correctly identified.

Watson, Gasser, Schaefer, Buranen, and Wold (1981) also used the SDMT and the P-O scale in combination. They tried to differentiate between a heterogeneous brain-damaged group and five groups: never married schizophrenics, married or previously married schizophrenics, affective psychotics, alcoholics, and neurotic personality-disordered subjects. Using both measures the authors correctly identified 79 percent of the non-organic subjects and 90 percent of the organic subjects. With the P-O scale alone, these numbers were reduced to 45 and 73 percent, respectively. Arsuaga et al. (1986) and Watson et al., then, have shown that the use of cognitive ability test scores can significantly increase the accuracy of prediction of the psychopathology scales.

### Content Scales

The third type of scale derived from the MMPI is the content scale. Whereas the MMPI clinical scales and most of the supplementary scales were empirically derived (meaning that scale membership depends only on the discriminative ability of each item in an empirical comparison of contrasted groups), content scales are constructed on the basis of the meaningful content of the items.

There have been three approaches to interpreting content for the MMPI. One approach has been through the use of critical items. These

are items whose content is considered indicative of serious psychopathology (Graham, 1987). Each item is effectively a scale on its own, so reliability is less than that of the standard scales. Graham recommended that endorsement of any of these items should lead the clinician to further investigate the area of concern with the client but cautioned clinicians against over-interpretation. Critical items are considered individually and do not actually form scales.

The first attempt at creating true content scales involved breaking each clinical scale down into subscales according to content areas, using a purely intuitive and rational examination of each item (Harris & Lingoes, 1955).

A second effort at creating content scales for the MMPI was made by Wiggins (1966, 1969). A noted empirical researcher, Wiggins also believed that a personality inventory is perceived by clients as an opportunity to communicate to the psychologist, and that clinicians should attend to what clients are trying to say. In essence, we should take the item endorsements at face value as meaningful self-report.

Wiggins (1966) used as a starting point for his scales the original categories listed by Hathaway and McKinley (1940) in their description of the content areas of the inventory. He then revised these categories into 15 scales through purely intuitive and rational methods.

Because Wiggins's (1966) rationale for creating the content scales was to compose a set of homogeneous, easily interpretable scales, his first priority was internal consistency of the scales. Split-half reliability coefficients (with odd-even splits) ranged from near zero to the mid .80s. To increase reliability, he calculated point-biserial correlations between each item and the total for each of the 15 content scales. An item

retained scale membership if its correlation coefficient with that scale was greater than or equal to .30 and exceeded its correlation coefficient with the 14 other scales. This resulted in scales with Cronbach's alpha ranging from .56 to .84 for the derivation sample.

These levels of internal consistency were maintained when tested in the validation sample. Further, the content scales were able to discriminate between six groups: (a) brain disorders, (b) affective psychoses, (c) schizophrenic psychoses, (d) psychoneurotic disorders, (e) personality disorders, and (f) sociopathic disorders. Wiggins, Goldberg, and Applebaum (1971) later provided a further demonstration of the criterion validity of the scales. Wiggins's (1966) content scales have been a widely used addition to the original clinical scales.

One consequence of the revision of the MMPI was that the items on many of Wiggins's content scales were changed or deleted, so those scales do not exist on the MMPI-2. Rather than trying to update Wiggins's (1966) scales, Butcher, Graham, Williams, and Ben-Porath (1990) decided to create a new group of content scales for the MMPI-2. Butcher et al. felt that the new items introduced significantly changed the content domain of the test, and that the Wiggins content scales would not represent the entire test after its revision.

Content Scales and TBI. Two of Wiggins's (1966) original scales were the Organic Symptoms (ORG) scale and the Poor Health (HEA) scale. Wiggins described the ORG scale as follows: "High ORG admits to symptoms which are often indicative of organic involvement. These include headaches, nausea, dizziness, loss of motility and coordination, loss of consciousness, poor concentration and memory, speaking and reading difficulty, muscular control, skin sensations, hearing and smell."

(p. 13). In sum, this scale consists of two categories: neurological symptoms and higher cognitive functioning. In contrast, a high score on the HEA scale indicates concern "about his health and has admitted to a variety of gastrointestinal complaints centering around an upset stomach and difficulty in elimination." (p. 13). These two scales thus target different aspects of health, with the ORG scale targeting items associated with neurological and cognitive functioning and the HEA scale tapping visceral functioning.

Although the MMPI-2 no longer has the ORG scale, Butcher et al. (1990) did develop a Health Concerns content scale (HEA). Their description of this scale is as follows: "Individuals with high scores on HEA report many physical symptoms across several body systems. Included are gastrointestinal symptoms (such as constipation, nausea and vomiting, stomach trouble, neurological problems (convulsions, dizzy and fainting spells, paralysis), sensory problems (poor hearing or eyesight), cardiovascular symptoms (heart or chest pains), skin problems, pain (headaches, neck aches), and respiratory trouble (coughs, hay fever, asthma). These individual worry about their health and feel sicker than the average person." (p. 37). This scale, then, consists of the following three categories: neurological symptoms, other physical symptoms, and pain.

Clearly, the HEA scale for the MMPI-2 is an amalgamation of the ORG and HEA scales for the MMPI. The result is that there is no single content scale on the MMPI-2 to specifically identify the possibility of neurological problems.

### Scale Construction Methods

The purpose of the present research is to construct a new scale for the MMPI-2 that would be sensitive to symptoms commonly reported after TBI. This scale could be created using one of three basic methods: deductive/content, inductive, or empirical. In the empirical approach, the researcher presupposes that people can be classified into specific groups. The task is then to use purely statistical means to find items that differentiate most effectively between the presupposed groups. This is the strategy by which the original MMPI items were grouped into the eight original clinical scales, two of the validity scales - F and K, and many supplementary scales.

Less often used than the empirical approach is the inductive approach. This approach involves letting the item data be sorted into scales through statistical means alone without using predefined subject groups (Burisch, 1984). The researcher does not make any presuppositions concerning which scales might exist within the inventory or which items belong in different scales. This method requires a very high number of subjects and is therefore often impractical, particularly if factor analysis is used as the statistical procedure. For this reason, this approach has not often been used.

The content scales composed by Butcher et al. (1990) were constructed using a strategy similar to Burisch's (1984) deductive approach. Similar approaches have been variously referred to by others as a sequential strategy (Koss, 1979), sequential system (Jackson, 1970), and rational approach (Hase & Goldberg, 1967). The most significant commonality between these approaches is that the researcher, rather than the computer, plays the greatest role in item selection; only after

the researcher has actually selected the items on a rational and theoretical basis are statistical means employed to refine the scale.

Given that these three basic construction strategies are so fundamentally different, it may be surprising to discover that not one of them is superior to the other two. In pioneer work in this area, Hase and Goldberg (1967) looked at the ability of these three different scale construction strategies to provide scales that would predict certain personality variables such as sociability, responsibility, and psychological-mindedness. All strategies resulted in scales of equivalent effectiveness. More recently, Burisch (1984) completed a review of over 15 studies in which such comparisons were examined. Burisch evaluated the scales in terms of their criterion validity or effectiveness, which he defined as the correlation between a personality scale and the target variable. His final conclusion was that there were no effects due to scale construction method.

Because the nature of the present research necessitates the presupposition of specific, distinct, existing groups of people, the inductive approach is inappropriate. The question, then, is whether the empirical or the deductive/content approach is better suited to the purpose described here.

The content approach to scale construction does provide some advantages over the empirical approach. First, content scales tend to be shorter and easier to construct than empirical scales.

Second, and more importantly, content scales allow for more straightforward interpretation. Empirically-derived scales often contain items that do not make intuitive or theoretical sense and that have low item-scale correlations. This makes for a heterogeneous scale which can



only be used to state whether or not an individual is more like one group than another. In interpreting an empirical scale, the clinician is forced to rely solely on normative data which may or may not be appropriate for the particular client. When an individual provides a very high score, this is not a problem, because then the results simply describe the individual's similarity to the pre-defined group.

The problem lies in interpreting moderate and low scores. The lack of homogeneity of meaning in the items prevents the clinician from interpreting the individual as having only moderate levels of psychological qualities, given that the scale can only match the person to a group, not to a specific psychological quality. Although it is true that no single item should carry great weight, it is helpful for the clinician to be able to look at the content of item endorsements to form a clinical picture. Furthermore, in communicating with other professionals, a clinician using a content scale is better able to present the clinical picture from test results and meaningfully augment it with other information, such as that obtained during the interview.

### Present Research

The aim of the present research was to create a content scale for the MMPI-2 to specifically identify TBI patients. Because of the recent revision, there is currently no scale to serve this purpose on the MMPI-2. Numerous items on the MMPI-2 are describe sequelae typically suffered by TBI patients, and a content scale would help illuminate exactly which symptoms are most troublesome for the individual patient.

### Hypotheses

1. The new content scale, the Cerebral Impairment scale (CI), would discriminate TBI patients from patients with other injuries (INJ),

from normals (uninjured student subjects), and from psychiatric patients.

(a) TBI subjects would attain higher scores on the CI scale than INJ, normal, and psychiatric subjects.

(b) The scores of INJ subjects and psychiatric patients might or might not be significantly different but would both fall between the scores of TBI and normal subjects.

2. Exploratory factor analysis would be conducted to consider whether the factor structure is related to separate content areas within the CI scale.

## Method

### Subjects

Subjects were traumatically brain-injured people (TBI,  $n = 180$ ), normals (volunteer university students,  $n = 142$ ), people with injuries other than head injuries (INJ,  $n = 50$ ), and psychiatric patients ( $n = 423$ ). The TBI subjects and the students were randomly assigned to either a derivation sample or a validation sample. INJ and psychiatric subjects were used only in the validation part of the study.

Data for TBI subjects came from several sources: (a) claimants seen for neuropsychological testing at the Workers' Compensation Board and (b) patients seen for neuropsychological testing by one of five individual neuropsychologists in private practice in Vancouver, BC.

Because the MMPI-2 is relatively new, all TBI patients who had completed the test were considered for the study. In cases where the individual's having sustained a TBI was questionable, that individual was included as a subject only if there had been a loss of consciousness. Individuals were excluded from further consideration as subjects on the

basis of four criteria: (1) any indication of substance abuse, epilepsy, or any other neurological disorder; (2) T-score greater than 120 on the F scale of the MMPI-2; (3) raw score greater than 26 on the  $F_b$  scale of the MMPI-2; and (4) any prospective item from the CI scale was omitted. The first criterion for exclusion helped insure that the scale provide a pure measure for TBI, rather than for brain damage of any type. The second and third criterion were set because high F or  $F_b$  scores point to test results of questionable validity, in which case responses to individual items necessarily could not be considered characteristic of the individual subject and therefore of the entire sample. Finally, the fourth criterion guarantees accurate results that truly reflect characteristics of the sample.

University students enrolled in psychology courses were invited to participate in order to earn research participation credit toward their grade in the course. Because the only scale that was scored for the students was the CI scale, the only criterion by which students were not included as subjects was the omission of any prospective CI items.

The third group, INJ, consisted of injured claimants seen in the Psychology Department of the Workers' Compensation Board. These claimants are people who were referred to the Psychology Department because of a psychological reaction to their injury. These psychological reactions were typically of an emotional or adjustment nature. Subjects were randomly picked from the Department files and were considered for inclusion in the study using the same four criteria outlined above for TBI subjects. All TBI and INJ subjects were involved in compensation/litigation cases.

Finally, the psychiatric patients from the standardization sample of the MMPI-2 were used as a psychiatric comparison group.

### Other Measures

Information concerning severity of injury (for TBI subjects only; see Appendix A), marital status, medication use, and psychiatric history was also collected for TBI, student, and INJ subjects.

### Procedure

Ethics approval for this study was given by the Ethics Review Committee at Simon Fraser University. The main ethical concern, which was that subject data not be identifiable, was addressed by the researcher inputting coded data directly into a computer file with no identifying information, as discussed below.

Data collection. Data regarding TBI and INJ subjects were obtained from existing files containing completed MMPI-2 answer sheets. To ensure anonymity, each subject's responses and demographic data were coded and transferred directly to a computer file. The computer files contained no identifying information other than a subject number, which does not appear anywhere in the subject's institutional file.

The university students were asked to complete the MMPI-2 in its entirety under standard administration procedures. All university students were also asked to sign a consent form and complete a short demographic questionnaire, including a brief medical history (see Appendices B and C). After completing the test material, subjects were given a debriefing letter explaining the nature of the study and directions for obtaining the results if desired (see Appendix C).

### Scale Construction

Initial Item Selection. Items were selected for inclusion on the CI scale in three steps. First, items from the Wiggins's (1966) ORG scale that are also available on the MMPI-2 formed the initial basis for the scale. Next, additional items were selected by the author such that each item tapped a symptom area reported in the literature to be associated with TBI. All of the potential CI items were then reviewed by three expert judges, all neuropsychologists. An item was retained only if two of the three neuropsychologists recommended that item. This procedure resulted in a scale of 55 items. Exceptions were made for items from Gass's (1991) supplementary scale for discriminating between closed-head-injury patients and normal adults, in that two appropriate items from Gass's first factor (which he defined as neurological items) were retained regardless of the number of neuropsychologists recommending them. This entire process resulted in an initial CI scale of 57 items. These items may be seen in Appendix E, where they have been listed according to content area.

Reliability. Before considering differences between groups, reliability was measured in the form of internal consistency. Data from the derivation sample were used for this part of the study. Although the TBI group was the obvious target group for this analysis, the derivation sample consisted of both TBI and normal subjects (university students). The rationale behind this sample composition was that it would minimize the possibility of artificially low correlations that would result if only TBI subjects were used, as they might provide a restricted range of scores on the CI scale. Item-scale correlations were calculated for

each item of the CI scale and items with a correlation of less than .15 were dropped at this point.

## Results

### Subjects

Data were collected for 180 TBI subjects. The derivation sample consisted of 132 subjects; the remaining 48 subjects were assigned to the validation sample. Age and education information for both TBI samples are shown in Tables 1 and 2. Mean time since injury was 26.9 months (SD = 27.8) and 22.1 months (SD = 23.1), in the derivation and validation samples, respectively. Severity of injury was measured using Bowman's (1991) three-point scale (see Appendix A). Mean severity ratings for the derivation and validation groups were equivalent at 2.0 (SD = .8), which represents a moderate injury in terms of post-traumatic amnesia and loss of consciousness.

Data were collected for 50 INJ subjects, all of whom were assigned to the validation part of the study. Age and education information regarding these subjects is available in Table 2.

In total, 142 students participated in the study, 95 of whom were assigned to the derivation sample; the remaining 47 students were assigned to the validation sample. Age and education information for the derivation and validation samples, are shown in Tables 1 and 2.

Table 1

Means and SD's for demographic variables - derivation sample

	<u>n</u>	Age (yrs.)		Education (yrs.)	
		Mean	SD	Mean	SD
TBI	132	36.5	12.2	11.9	1.9
Males	106	36.5	11.4	11.8	1.9
Females	26	36.9	15.2	12.5	2.0
Students	95	20.6	3.0	13.3	1.4
Males	47	21.3	2.6	13.9	1.7
Females	48	19.9	3.3	12.7	0.8

Table 2

Means and SD's for demographic variables - validation group

	<u>n</u>	Age (yrs.)		Education (yrs.)	
		Mean	SD	Mean	SD
TBI	48	35.6	12.0	11.1	2.4
Males	40	35.9	10.7	10.9	2.0
Females	7	34.0	17.8	12.0	3.9
Students	47	20.4	2.8	13.1	1.1
Males	22	20.8	2.8	13.5	1.3
Females	25	20.1	3.0	12.7	0.8
Injured	50	38.7	10.3	11.6	2.7
Males	43	38.7	10.2	11.1	2.9
Females	7	39.3	12.1	11.7	1.8

The psychiatric group from the MMPI-2 standardization sample consisted of 191 females and 232 males with a combined mean age of 32.6 years (SD = 12.1) and mean educational level of 12.3 years (SD = 2.3). Diagnoses for the sample were schizophrenia, 20%; depressive disorders, 26%; other psychotic disorders, 16%; adjustment disorders, 10%; bipolar disorders 9%; substance-abuse disorders, 8%; and other disorders, 11% (Butcher et al., 1989).

### Demographic variables

Because the intent of the scale is not to measure differences on any of the demographic variables, initial screening was done to look for confounding effects of gender, age, or education. Although severity of injury (TBI groups only) and time since injury (TBI and INJ groups only) were not expected to have any effects, the males and females from the appropriate groups were compared on these variables as well.

Derivation sample. T-tests were conducted to look for sex differences in terms of demographic variables (see Table 1). In the TBI group, there were no significant differences between males and females in terms of age or education. However, in the student group, males were significantly older ( $p < .02$ ) and had significantly more education ( $p < .001$ ) than females. Further, students on the whole were significantly younger than TBI subjects ( $p < .001$ ) and had significantly more education ( $p < .001$ ). To correct for these differences, subsequent analyses amalgamate data from male and female students using age and education as covariates.

In terms of severity of injury, TBI males and females both had a mean score of 2.0 (SD = .8) on Bowman's (1991) three-point scale, which indicates moderate injury. Further, there was no significant difference in



time since injury between TBI males ( $M = 27.2$  months,  $SD = 29.3$ ) and TBI females ( $M = 25.5$ ,  $SD = 20.9$ ).

Validation sample. Demographic data for the validation groups are described in Table 2. In the TBI and INJ groups, there were no significant sex differences for age, education, or time since injury. For students, although there was no sex difference for age, males did have a higher education level ( $p < .05$ ) than females. As in the TBI derivation group, there was no sex difference for severity of injury. Males' mean severity rating was 2.1 ( $SD = .9$ ); that of females was 1.5 ( $SD = .5$ ).

#### Data Source

In order to detect any effect due to data source, an ANOVA was conducted for each of age, education, severity, and time since injury by data source. With respective F values of  $F_{4,174} = 1.231$ ,  $F_{5,172} = 1.265$ , and  $F_{5,174} = .677$ , there were no significant effects on age, severity or time since injury due to data source. In contrast, the ANOVA of education by data source was significant; however, a Tukey test revealed that of all possible pair-wise comparisons, the only significant difference occurred between two of the samples from private psychologists. Because inclusion of data from all sources resulted in a reasonably normal education curve (skewness = .25), data from all of the different source were amalgamated into a single data set.

#### Internal Consistency of CI Scale

Because MMPI-2 items are dichotomous, internal consistency was measured with Kuder-Richardson Formula 20 (as recommended by Golden, Sawicki, & Franzen, 1984). This analysis on the derivation sample yielded an internal consistency reliability of  $KR20 = .927$ . To maximize internal consistency of the scale, two items with an item-scale

correlation of less than .15 were dropped from the scale, marginally increasing KR20 to .930.

### Planned comparisons

The group means on the CI scale from the validation sample can be seen in Table 3.

Table 3

### Mean CI scores

Group	<u>n</u>	Mean	SD
TBI	48	23.9	10.9
Students	47	11.8	6.0
INJ	50	20.8	12.3

Because the data for the psychiatric sample from the MMPI-2 manual was provided in the form of proportions, inferential statistics could not be conducted using this group. The psychiatric group mean on the CI scale was 22.63; no measure of dispersion could be calculated due to the nature of these data.

An omnibus ANOVA with TBI, students, and INJ validation groups with age and education as covariates resulted in  $F_{4,139} = 7.433$ ,  $p < .001$ . Oneway ANOVA's were then conducted between the TBI and student groups and between the TBI and INJ groups. For the analysis between students and TBI, age and education were used as covariates. This test resulted in  $F_{3,91} = 15.028$ ,  $p < .001$ . For the analysis between the INJ and TBI groups, age and education were not used as covariates given that the groups were not significantly different on these variables. The analysis yielded an  $F_{1,96} = 1.717$ ; the difference was not significant. No

inferential statistics could be calculated using the psychiatric group; however, given that the mean score for this group was between that of the TBI and INJ groups, which were not significantly different from each other, it is reasonable to assume that the psychiatric group did not score significantly differently from the other two.

### Discriminant Function Analysis

In a further attempt to differentiate between the TBI and INJ groups, I conducted a direct discriminant function analysis using data from the validation sample, which included TBI, student, and INJ subjects. Two discriminant functions were calculated, with a combined  $\chi^2_{42} = 208.34$ ,  $p < .001$ . Removal of the first function left a strong association between groups and predictors,  $\chi^2_{20} = 90.61$ ,  $p < .001$ .

These two discriminant functions accounted for 59 percent and 41 percent, respectively, of the between-group variability. Examination of the canonical discriminant functions evaluated at the group centroids revealed that the first discriminant function separated student subjects from TBI subjects and that the second discriminant function discriminated between TBI and INJ subjects.

The discriminant functions correctly classified 115 (79 percent) of the 147 subjects in the validation sample. As seen in Table 4, student subjects were classified with the greatest accuracy, followed by TBI subjects. INJ subjects were classified with the lowest level of accuracy.

Table 4

Classification results from discriminant function analysis

Actual Group	n	Predicted Group		
		Students	TBI	INJ
Students	47	44 93.6%	2 4.3%	1 2.1%
TBI	48	6 12.5%	37 77.1%	5 10.4%
INJ	50	9 18.0%	7 14.0%	34 68.0%

Percent of all cases correctly classified: 79.3%

Factor Analysis

Principal components factor analysis with varimax rotation was performed on the 55-item CI scale using data from all subjects, with the exception of the psychiatric group. Five factors were extracted, all of which had eigenvalues greater than 1.5. With a cut-off of .30, two items did not load on any factor.

Loadings of variables on factors and percents of variance are shown in Table 5. Loadings under .30 are replaced by blanks. A list of items organized into factors, as well as factor labels, is provided in Appendix F. Items are ordered by strength of correlation with the factor in both Table 5 and Appendix F.

Table 5

Rotated and sorted factor matrix

No.	F1	F2	F3	F4	F5
165	.72				
533	.69				
565	.68				
325	.66				
147	.61				
472	.60				
475	.60				
341	.56				
299	.55				
043	.53				
309	.50				
031	.50				
106	.46		.33		
308	.45				
180	.43		.32		
204	.37	.32			
173	.32				
176		.69			
040		.67			
101		.64			
164		.53			
149		.50			
057		.49			
536		.48			
159		.44			
091		.44	.43		
255	.37	.44			
018		.41	.34		
247			.64		
295			.58		
179	.30		.50		
177			.43		
182			.43		
175		.30	.41		
476			.36		
229			.34		
142			.31		
367				.65	
491				.56	
364				.48	
353				.46	
525				.44	
376		.36		.43	
109				.41	
233		.35		.41	
172			.31	.40	

(table continues)

No.	F1	F2	F3	F4	F5
542					.69
513					.66
037					.61
372					.51
116					.34
168			.31		.33
093					.31
404					
170					
% var.	22.2	4.9	4.1	3.2	2.9

### Discussion

The research presented here demonstrates that TBI subjects can be distinguished from other subjects through use of the CI scale. As predicted in Hypothesis 1 (a), the TBI subjects did attain higher scores on the CI scale than did other subjects; this difference was significant only when the comparison was made between the TBI and the student groups. This result suggests that the scale is capable of making the most important, albeit most gross, distinctions that it was designed to make.

According to Hypothesis 1 (b), the scores of the INJ subjects and psychiatric patients would fall between the scores of the TBI and student subjects. As the scores of the INJ subjects did not significantly differ from the TBI subjects, this hypothesis was not supported; nonetheless, discriminant function analysis was able to correctly assign to groups 79 percent of all validation sample subjects. This is an improvement over most of the supplementary scales that were designed for similar purposes, which typically had hit rates below 75 percent. Moreover, the analysis revealed that of the two discriminant functions calculated, the primary purpose of one of the functions was to discriminate between the TBI and INJ groups, making it clear that the possibility for better

separation of these groups exists with further refinements to the scale. Further, compared to supplementary scales that did achieve similarly high hit rates, the CI scale has the advantage that all good content scales have, which is the opportunity for rational, as opposed to purely statistical, interpretation, particularly of mid-range scores.

The classification results bring to the fore the issue of clinical versus statistical significance. Although the CI scale was not able to make statistical differentiations between the TBI and INJ groups, the high degree of accuracy in classification does suggest that the scale could be of considerable clinical utility.

Still, the fact that statistical significance was not achieved may suggest the existence of a confounding variable. It may be that the CI scale taps issues common to all people who have been involved in compensation or litigation due to an injury, or who have been subjected to physical trauma. Although very few of the subjects were formally diagnosed with post-traumatic stress disorder (PTSD), symptoms of this disorder may have had a contaminating effect. Sixteen of the items on the CI scale are also on at least one of the two MMPI-2 PTSD scales, PK (Keane, Malloy, & Fairbank, 1984) and PS (Schlenger & Kulka, 1989). It would be reasonable to assume that both TBI and INJ subjects might suffer some of the symptoms of PTSD depending on the circumstances surrounding their injury, even if they did not meet all of the diagnostic criteria to warrant diagnosis of this disorder. All of the 16 CI items that also appear on the PTSD scales had relatively high corrected item-total correlations (i. e.  $\geq .40$ ), suggesting that they were tapping areas central to the underlying dimensions of the scale.

The items overlapping with the PTSD scales came from all five of the factors extracted in the factor analysis. The five factors, Memory/Concentration, Neurological Symptoms, Muscular Control, Passivity/Apathy, and Anger/Impulsivity closely matched categories of symptoms commonly reported as TBI sequelae. Even so, there are PTSD items in each of the five factors. Therefore, PTSD symptomology seems to be a relatively common occurrence after traumatic injury of any kind. Further research into whether PTSD symptoms can be clearly separated from TBI is required.

In terms of the psychiatric subjects, the proximity of their mean CI score to those of the TBI and INJ groups suggests that their CI scores would probably not have been statistically different from those of the TBI group. One possible explanation is that the psychiatric sample used in the development of the MMPI-2 was not representative of the population from which a clinician would typically attempt to distinguish TBI cases. Specifically, only 46 percent of the subjects in the psychiatric sample were diagnosed with either schizophrenia or depressive disorders, which are the disorders TBI most resembles on the MMPI-2. Research with data from individual psychiatric subjects must be undertaken before any true definitive statements concerning this group can be made.

In general, more research will be required before the Cerebral Impairment scale can be used on a broad basis. Future directions for this research should follow three main paths. First, it is of primary importance that the scale be refined in order to make distinctions between TBI patients and patients suffering from psychiatric disorders. In particular, attention must be paid to patients with schizophrenia or depression. Second, emphasis must be placed on examining the role of



PTSD in recovery from TBI. One possibility consists of the inclusion of a PTSD subscale, which might be an avenue through which clinicians gain an understanding of the individual patient's difficulties. Finally, after these refinements have been accomplished, additional work must be done concerning test-retest reliability, cross-validation, and construct validation.

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## Appendix A

Trauma Severity Scale

<u>Rating</u>	<u>Severity</u>	<u>Operational Definition</u>
1	mild	no loss of consciousness, or duration of post-traumatic amnesia (PTA) $\leq$ one hour
2	moderate	brief loss of consciousness ( $\leq$ 24 hours), or duration of PTA $\leq$ 24 hours
3	severe	prolonged loss of consciousness ( $>$ 24 hours), or duration of PTA $>$ 24 hours



## Appendix B

Consent Form**PERSONALITY OF THE UNIVERSITY STUDENT**

This study is being conducted in an effort to describe people's perception of the personality of a head-injured person compared to an uninjured person. To this end, you will be completing a standardized personality inventory, the Minnesota Multiphasic Personality Inventory - 2 (MMPI-2).

What is required of you at this time is that you first complete the attached information sheet. Then read the instructions at the beginning of your MMPI-2 booklet and simply fill out the questionnaire. Please note that this sheet is detached from the sheet on which you mark your responses and will remain so to maintain the confidentiality of your responses.

Although the questionnaire looks long, you will find that it goes very quickly - you may be able to finish it within an hour. No matter how long it takes, you will receive research participation credit for two hours. Remember, you should give the first answer that comes to your mind and not spend too much time on any one question. If for some reason you find you cannot or do not want to complete the questionnaire, please bring it to the researcher. You will still receive two hours of research participation credit.

I, \_\_\_\_\_, on this day \_\_\_\_\_,  
(Signature) (date)

have read the above and understand that I may discontinue my participation in this research at any time.

Appendix C

Demographic Questionnaire

**Information Sheet**

Sex: m \_\_ f \_\_

Age: \_\_

Marital status:      Single \_\_      Common-Law \_\_      Married \_\_  
                                 Separated \_\_      Divorced \_\_      Widowed \_\_

Completed years of university: \_\_\_\_\_

Have you ever had a head injury/concussion? \_\_\_\_\_

If yes.      (a) were you knocked unconscious? \_\_\_\_\_

                                 (b) for how long? \_\_\_\_\_

                                 (c) what medications, if any, were you given?

\_\_\_\_\_  
\_\_\_\_\_

Are you currently taking any medications on a regular basis? \_\_\_\_\_

If so, please list:

\_\_\_\_\_  
\_\_\_\_\_

Have you ever been diagnosed with a psychiatric illness? \_\_\_\_\_

If so, please describe

\_\_\_\_\_  
\_\_\_\_\_

## Appendix D

Debriefing Letter\***THE CEREBRAL IMPAIRMENT SCALE**

Thank you for your participation in the creation of the Cerebral Impairment scale of the MMPI-2. The purpose of this study is to create a scale on the MMPI-2 to look for cerebral impairment. This involves using a number of groups, including two consisting of university students as well as a head-injured group. The two groups are called the normal group and the pretending group; you were a part of one of these two. The normal group was asked to complete the MMPI-2 according to the standard instructions and the pretending group was asked to complete the MMPI-2 as if they had had a head injury. The task for the researcher is to determine which items on the MMPI-2 will differentiate between these two groups and the head-injured group.

If you are interested in learning more about this research or would like to be advised of the results, please contact one of the people listed below either directly or by leaving a message in the Psychology General Office (291-3354).

Gloria Jacobucci, M. A. Candidate

Marilyn Bowman, Ph. D., Senior Supervisor

Roger Blackman, Ph. D., Departmental Chair

**\*Note:** Although this letter suggests that there was also a malingering group consisting of university students, that group was dropped from the design after data had been collected from the normal group.