UNIVERSITY OF SOUTHERN QUEENSLAND

AN INVESTIGATION OF THE EXISTENCE OF DISTINCTIVE MMPI-2 PROFILES IN THREE DIAGNOSTICALLY DIFFERENT FORENSIC SAMPLES

A dissertation submitted by

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CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analysis, and conclusions reported in this dissertation are my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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ENDORSEMENT

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Dr. Graeme Senior (Supervisor) Date:

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ABSTRACT

Medico-legal examination of people who have suffered physical or psychological injuries usually involves the assessment of psychological adjustment post-injury. An assumption that appears prevalent in the research literature, is that individuals with the same organic or psychological disorders will form relatively homogeneous groups, and hence exhibit similar patterns of test performance. In essence this assumption underlies the notion that clinical group means accurately reflect the behaviour of the individuals that constitute different diagnostic groups.

Four studies were undertaken in this study. The first study examined the cluster patterns of MMPI-2 test performance in a medico-legal sample (n = 197) of individuals suffering Chronic Pain. Study two investigated MMPI-2 cluster patterns in a medico-legal sample of individuals (n = 200) who had suffered a Traumatic Brain Injury. The third study examined distinctive MMPI-2 cluster profiles in a medico-legal sample of individuals (n = 132) suffering Post Traumatic Stress Disorder. The final study compared the results of the previous investigations to determine whether there was any communality in the cluster profiles found in the three diagnostically different samples. Both hierarchical (Ward's Method), and k-means cluster analysis procedures were employed to identify the number of clusters, and common patterns of MMPI-2 test performance in the three aforementioned forensic samples.

Results indicated that multiple profiles (three to four) exist within the each of the three different diagnostic groups. The profiles, however, indicated that a single pattern of MMPI-2 performance **does not** appear to be characteristic of a particular disorder. The notion of homogeneity of test patterns (as far as the MMPI-2 is concerned) within a

diagnostic group was not supported. The MMPI-2 profiles identified in each of the clinical classifications were not found to be specific to these forensic samples, and **commonly occurred across the three diagnostic groups.**

Cluster analysis appeared to be a useful methodology to determine commonly occurring profiles within a specified population. A considerable number of elevated responses, however, were noted for the Within Normal Limits (WNL) profiles. This classification may be somewhat of a misnomer, due to high numbers of individuals still indicating difficulties. The current findings highlight the complexity of attempting to classify individual patterns of MMPI-2 test performance in terms of a single diagnostic category, and directly challenge the utility of the MMPI-2 as an effective tool in this regard.

CHAPTER 1

Current Issues with the Interpretation of MMPI-2 Group Profiles

1.1 Overview

Increasingly, people with physical and psychological injuries are becoming involved in civil litigation, with the consequent demands for assessment of psychological adjustment that this entails (Babitsky & Mangraviti, 1993). Psychological evaluation of the issues of personal injury claimants typically centre on difficulties related to depression, anxiety, adjustment to stress, impact of physical injuries, reality orientation, aggression, and social interaction to name a few. The most frequently used measure to assess these issues in the forensic setting is the second edition of the Minnesota Multiphasic Personality Inventory (MMPI-2) (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989).

1.2 Forensic Use of the MMPI-2

Regarded as a psychometrically sound instrument for assessing personality (Archer 1992), the MMPI-2, "has a substantial track record of use with chronic pain and other psychological assessment applications that have direct bearing on forensic testimony" (Butcher, 1995, p.180). Ben-Porath and Graham (1995) assert that the MMPI-2 is well suited for the purpose for which it was designed, that of drawing out differences in clinical groups, and providing objective means of assessing abnormal behaviour.

Arbisi (2006) suggests that the use of the MMPI-2 in disability or personal injury evaluations decreases the subjective component of clinical judgement, and provides a standardized measure upon which the examiner can base an opinion. Arbisi (2006)

further suggests that individual MMPI-2 profiles can be compared with the mean profiles of individuals suffering from similar injuries, or psychiatric conditions, to measure the level of distress associated with a claimed condition, and to determine whether the profile is consistent with profiles produced by others suffering from the claimed condition.

The relative paucity of studies regarding the forensic uses of the MMPI-2, however, raises concerns about the applicability of the test, and its traditional interpretive guidelines, when used in the medicolegal arena. For example, a search of the PsychINFO data base conducted in December 2005 revealed 22 research articles published between 1992 and 2005, which focus on the use of the MMPI-2 and personal injury claimants.

Of those 22 articles, more than half (15/22) related to the use of validity scales (see Arbisi & Butcher, 2004; Lees-Haley & Fox, 2003; Larrabee, 2003) in the medico-legal context, five debated MMPI-2 base rates of personal injury litigants (see Butcher & Ben-Porath, 2004, Senior & Douglas, 2004; Less-Haley, 2001), one article investigated the attention seeking behaviour of personal injury claimants (Lanyon, & Almer, 2002), and one examined the nature of symptoms, and assessment of Post Traumatic Stress disorder (Veraldi, 1992).

Personal injury claimants assert that psychological damage or distress results from traumatic incidents or events. The popularity of the MMPI-2 in assessing these claims stems perhaps from the wide range of MMPI-2 scales and code-types. The MMPI-2 is a 567-item, true-false, self-report questionnaire. In its current form it represents a

re-standardisation of the MMPI and was designed to provide current norms for the inventory, develop a nationally (U.S.) representative sample, provide appropriate representation of minority groups, and update item content (Greene, 1991).

The MMPI-2 was standardised on a sample of 2,600 individuals (1138 males; 1462 females) selected to reflect 1980 United States national census parameters on age, marital status, ethnicity, education, and occupational status. Unlike its predecessor, the MMPI, the MMPI-2 is to be used only with adults 18 years of age and older. In order to retain the basic structure of the MMPI, as well as continued application of interpretive guidelines, the items on the validity and clinical scales of the MMPI were essentially unchanged on the MMPI-2, except for the elimination of 13 items based on item content, and the rewording of 68 items. Raw scores were converted into uniform or linear T-scores, with a T-score of 65 customarily applied as the criterion for indicating clinical elevation (Butcher et al., 1989), a level attained by only 6.5% of the normal population.

There are essentially four types of scales employed in analysing the MMPI-2: Validity scales, Basic scales, Content scales, and Supplementary scales. The MMPI-2 provides several validity scales, described in Table 1.1, to assess the test-taking attitude of the respondent.

The validity scales consist of measures that relate to the integrity of the test data (Cannot Say, VRIN, TRIN), and to biased responding (L,F,K,Fb,Fp). These scales are designed to determine the extent to which interpretative guidelines can be confidently applied, but do not constitute a clinical interpretation in their own right (Greene, 2000).

Table 1.1

MMPI-2 Validity Scales

Scale		No. of Items	No. keyed true/false	Elevations represent
Cannot Say (?) Scale		Total number of items that the respondent omits		A high number of omissions
VRIN	Variable Response Inconsistency	67 Item response pairs		Inconsistent item endorsement
TRIN	True Response Inconsistency	23 Item response pairs		Responding "true or false" to items regardless of their content
L	Lie	15	0/15	Overly positive self-presentation. Raises the concern of symptom under-reporting
K	Correction	30	1/28	Statistical correction scale associated with a notion of psychological well-being
F	Infrequency	60	41/19	The tendency to admit to a wide range of psychological problems, or symptom exaggeration. Item content restricted to first half of test
Fb	Back Infrequency	40	37/3	Analogous to F scale except items come from the second half of the test
Fp	Infrequency Psychopathology	27	18/9	Analogous to F scale. Infrequent items are selected from an acute psychiatric sample. Designed to be used with F to distinguish between severe psychopathology or symptom exaggeration.

Source: Greene (2000)

The Basic scales (see Table 1.2) are the oldest of the MMPI scales, and form the basis of most analyses of the MMPI-2. Butcher (1996) asserts that the Basic scales tend to represent two different psychological concepts, those of distress (Scales 1-4: e.g., reported depression, anxiety, and agitation), and disturbance (Scales 6-9: e.g., disturbed thinking, perturbations in life-style, and pathology as judged by mental health professionals). For example an MMPI-2 profile characterised by clinical elevations on Scales 1-4, and sub-clinical scores on Scales 6-9, would be best described as a High Distress / Low Disturbance (HDs/LDb) profile. Profiles characterised by clinical elevations on Scales 1-4 and 6-9, would be best described as High Distress / High Disturbance (HDs/HDb) profiles. Those profiles with no clinical elevations are considered Within Normal Limits (WNL) profiles.

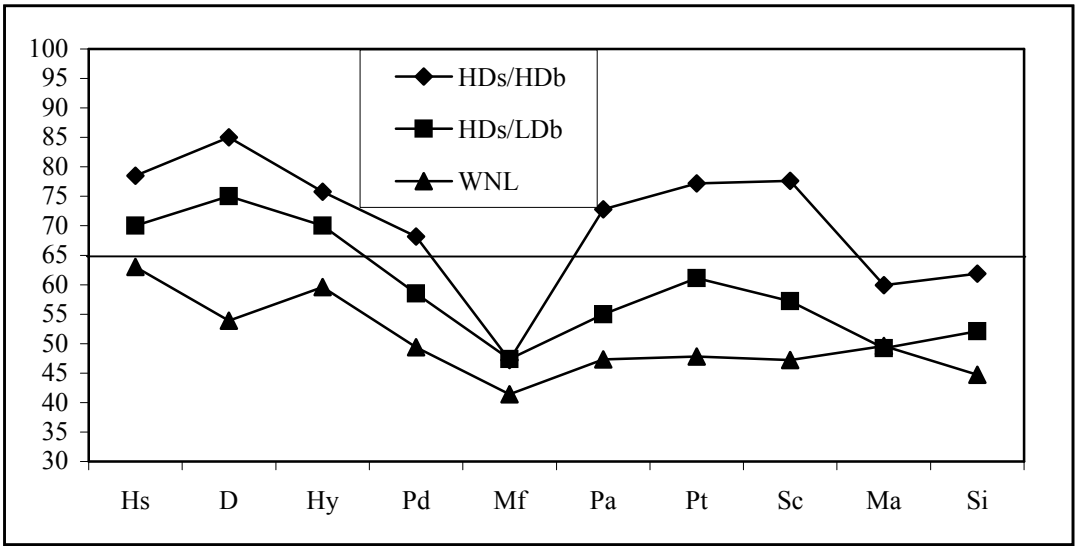

Figure 1.1 Examples of WNL, HDs/LDb, HDs/HDb profiles

Some of the most frequently encountered relationships occurring between the Basic Scales are found between three scales: Hypochondriasis (1), Depression (2), and Hysteria (3), collectively referred to as the Neurotic Triad (Greene, 2000).

Four configurations are most frequently encountered among the scales of the Neurotic Triad. One such configuration is that of a conversion V, where Scales 1 and 3 are elevated 10 points above scale 2. Another common neurotic triad configuration is the descending pattern, were all three scales are elevated above a T-score of 65, with Scale 1 being the highest, followed by Scales 2, and 3, in descending order. A third configuration is the elevation of Scale 2. Although all three Scales are elevated Scale 2 is higher than Scales 1 and 3. The fourth configuration is an ascending pattern, where all three scales are greater than a T-score of 65, with each succeeding scale higher than the previous one (Greene, 2000). Representations of the four most common Neurotic Triad profiles are presented in Figure 1.2.

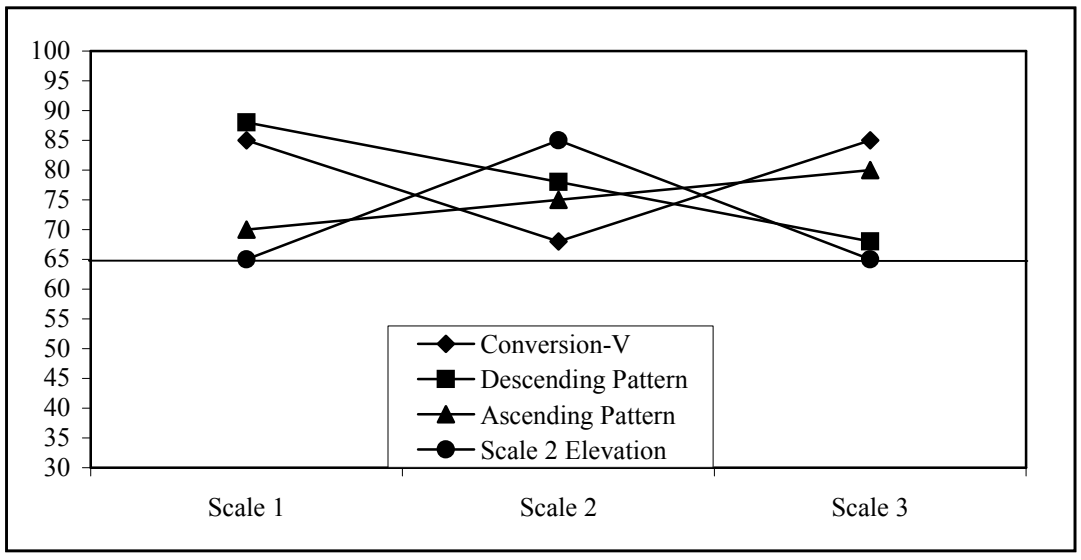

Figure 1.2 Examples of most frequently occurring Neurotic Triad configurations

Table 1.2

MMPI-2 Clinical Scales and Subscales

Scale		No. of Items	No. keyed true/false	Elevations represent
Hs	Hypochondriasis	32	11/21	Extreme concerns for health; sensitivity to bodily functions
D	Depression	57	20/37	Pessimism, sadness, self-deprecation, feelings of inadequacy, loss of energy and interest
D1	Subjective Depression	32	15/17	Depression, nervousness, lack of energy and interest, low self-interest, shyness
D2	Psychomotor Retardation	14	4/10	Immobilisation, lack of energy, denial of hostility
D3	Physical Malfunctioning	11	4/7	Preoccupation with physical functioning, somatic complaints, denial of good health
D4	Mental Dullness	15	8/7	Lack of energy, attention and concentration difficulties
D5	Brooding	10	8/2	Brooding and rumination, easily hurt by criticism
Hy	Conversion Hysteria	60	13/47	A neurotic condition in which physical symptoms are used to avoid or solve conflicts and to avoid responsibilities
Hy1	Denial of Social Anxiety	6	1/5	Extroversion, not easily influenced by social standards and customs
Hy2	Need for Affection	12	1/11	Need for attention and affection
Hy3	Lassitude-Malaise	15	5/10	Uncomfortable feelings, concentration problems
Hy4	Somatic Complaints	17	6/11	Somatic complaints, little hostility expressed
Hy5	Inhibition of Aggression	7	0/7	Denial of hostility
Pd	Psychopathic Deviate	50	24/26	A pattern characterised by an extreme disregard for social and moral norms
Pd1	Familial Discord	9	5/4	View home situation as unpleasant and unsupportive
Pd2	Authority Problems	8	2/6	Resentment of authority
Pd3	Social Imperturbability	6	0/6	Comfortable and confident in social situations
Pd4	Social Alienation	13	10/3	Feeling misunderstood, alienated, and estranged
Pd5	Self-Alienation	12	10/2	Uncomfortable, unhappy, find life uninteresting or unrewarding
Mf	Masculinity-Femininity	56	25/31	The extent to which the respondent accepts traditional sexual stereotyping
Pa	Paranoia	40	25/15	Delusions of reference, influence, grandeur, and persecution
Pa1	Persecutory ideas	17	16/1	View the world as threatening; suspicious; blames others
Pa2	Poignancy	9	7/2	Highly-strung, sensitive, feels misunderstood, takes risks
Pa3	Naïveté	9	1/8	Naive, trusting, high moral standards, denies hostility

table continues

Table 1.2 (Continued)

Scale		No. of Items	No. keyed true/false	Elevations represent
Pt	Psychasthenia	48	29/9	Obsessive-compulsive behaviour or thought patterns; overanxious, moralistic attitudes
Sc	Schizophrenia	78	59/19	A pattern characterised by bizarre sensory experiences and beliefs and social alienation
Sc1	Social Alienation	21	16/5	Feels misunderstood and mistreated, lonely; hostility towards family
Sc2	Emotional Alienation	11	8/3	Depression and despair
Sc3	Lack of Ego Mastery-Cognitive	10	9/1	Fear of losing their mind, strange thoughts, feelings of unreality
Sc4	Lack of Ego Mastery-Connative	14	11/3	Feel life is a strain; depression; may wish they were dead
Sc5	Lack of Ego Mastery-Defective Inhibition	11	11/0	Feels out of emotional control; impulsive, irritable
Sc6	Bizarre Sensory Experiences	20	14/6	Hallucinations or unusual thought patterns
Ma	Hypomania	46	35/11	A disorder characterised by over-activity, flight of ideas, emotional excitement
Ma1	Amorality	6	5/1	See others as selfish and dishonest and feel justified in being this way
Ma2	Psychomotor Acceleration	11	9/2	Accelerated speech, overactive thought processes, seek out excitement, easily bored
Ma3	Imperturbability	8	3/5	Denial of social anxiety
Ma4	Ego Inflation	9	9/0	Have unrealistic self-appraisal, resentful
Si	Social Introversion	69	34/35	A pattern characterised by shyness, modesty and avoidance of social contact
Si1	Shyness/Self-Consciousness	14	8/6	Shy, self-conscious
Si2	Social Avoidance	8	2/6	Avoids social situations, unfriendly; socially withdrawn
Si3	Alienation, Self & Others	17	17/0	Dislikes others; feelings of estrangement

References: Butcher (1996), Davison and Neale (1996), Gordon (2001), Murphy and Davidshofer (1994), Senior and Douglas (1999).

Subscales also exist for seven of the ten basic scales (Harris & Lingoes, 1955; Ben-Porath, Hostetler, Butcher, & Graham, 1989), and permit a more fine-tuned interpretation of their respective scale elevations. Subscales have also been developed for the Mf scale (Martin, 1993) but these have received little attention in the research literature, and have not been included in this study.

The MMPI-2 Content scales, and their component subscales (see Table 1.3), are a more recent development that rationally group items that have related content, such as Health Concerns, Work Interference, and Negative Treatment Indicators to name just a few (Ben-Porath & Sherwood, 1993). Whilst the Basic scales are more utilitarian in their association with particular diagnostic groups, the content scales are more readily interpretable due to their high face validity.

A third group of scales, the Supplementary scales, relate to specific clinical settings and clinical populations. This means that specific supplementary scales are examined when issues relevant to a matching clinical group are posed. These include scales associated with the assessment of Post Traumatic Stress Disorder (PK), marriage counselling (MDS), drug and alcohol counselling (MAC-R), and difficulties in engaging in University studies (Mt). No scales specific to the personal injury claimant setting are part of the official MMPI-2 structure.

More recently, Tellegen, Ben-Porath, McNulty, Arbisi, Graham, and Kaemmer (2003) developed the Restructured Clinical (RC) Scales to preserve the descriptive properties of the existing MMPI-2 clinical scales while enhancing their distinctiveness, and to address issues with high scale intercorrelations and item overlap. The authors first developed a measure of Demoralisation (an affectively coloured dimension represented to

Table 1.3

MMPI-2 Content Scales and Subscales

Scale		No. of Items	No. keyed true/false	Elevations represent
ANX	Anxiety	23	18/5	A pattern characterised by tension, worry, fear of losing one's mind, lack of confidence, and disturbed sleep
FRS	Fears	23	16/7	Encompasses both specific fears (e.g., agoraphobia, claustrophobia), and generalised fears
FRS1	Generalised Fearfulness	12	11/1	Generalised fearfulness
FRS2	Multiple Fears	10	4/6	Specific fears (high places, mice, spiders etc.)
OBS	Obsessiveness	16	16/0	A pattern characterised by rumination about decisions such as counting or saving unimportant things
DEP	Depression	33	28/5	Pattern characterised by dysphoria, self-deprecation, and suicidal ideation
DEP1	Lack of Drive	12	9/3	Lack of drive and motivation; lacking an interest in important aspects of life
DEP2	Dysphoria	6	4/2	Depressed mood
DEP3	Self-Deprecation	7	7/0	Negative self-concept, low level of self-confidence
DEP4	Suicidal Ideation	5	5/0	Potential for suicidal acts
HEA	Health Concerns	36	14/22	A pattern characterised by gastrointestinal and neurological upsets and general health concerns
HEA1	Gastrointestinal Symptoms	5	3/2	An inordinate number of gastro intestinal complaints
HEA2	Neurological Symptoms	12	5/7	Complaints associated with neurological functioning
HEA3	General Health Concerns	6	1/5	Preoccupied with general health concerns
BIZ	Bizarre Mentation	23	22/1	A pattern characterised by delusions, hallucinations, illusions, and ideals of reference
BIZ1	Psychotic Symptomatology	11	11/0	Delusions and hallucinations
BIZ2	Schizotypal Characteristics	9	9/0	Illusions and ideas of reference
ANG	Anger	16	15/1	A pattern characterised by explosive behaviour and irritability
ANG1	Explosive Behaviour	7	6/1	Violent, explosive, temper tantrums, loud arguments
ANG2	Irritability	7	7/0	Irritability and grouchiness, impatience, argumentative, petty
CYN	Cynicism	23	23/0	A pattern characterised by misanthropic beliefs, and interpersonal suspiciousness

table continues

Table 1.3 (Continued)

Scale		No. of Items	No. keyed true/false	Elevations represent
CYN1	Misanthropic Beliefs	15	15/0	Unlikely to be willing to turn to others for help, believing that other people are generally selfish
CYN2	Interpersonal Suspiciousness	8	8/0	Suspicions that others are out to get him or her and cause harm
ASP	Antisocial Practices	22	21/1	A pattern characterised by antisocial attitudes and practices
ASP1	Antisocial Attitudes	16	16/0	Little respect for law
ASP2	Antisocial Behaviours	5	4/1	Antisocial behaviour, may abuse drugs or engage in other reckless and illegal bahaviour
TPA	Type A	19	19/0	A pattern characterised by impatience and competitive drive
TPA1	Impatience	6	6/0	Impatience in a rude and inconsiderate manner
TPA2	Competitive Drive	9	9/0	Highly driven to succeed
LSE	Low Self-Esteem	24	21/3	These individuals are filled with self-doubt and submissiveness
LSE1	Self-Doubt	11	8/3	Lacking in self-confidence
LSE2	Submissiveness	6	6/0	Passive and obedient, prone to give up easily
SOD	Social Discomfort	23	13/11	A pattern characterised by introversion and shyness
SOD1	Introversion	16	8/8	Dislike the company of others, do not like social events
SOD2	Shyness	7	4/3	Difficulty in interacting with other people
FAM	Family Concerns	25	20/5	A pattern characterised by family discord and alienation
FAM1	Family Discord	12	11/1	Experienced or experiencing strife and discord with his or her family
FAM2	Familial Alienation	5	2/3	Family not a source of emotional support
WRK	Work Interference	33	28/5	Pattern of behaviour likely to contribute to poor work performance, difficulty concentrating, anxiety, tension, indecisiveness about career choice
TRT	Negative Treatment Indicators	23	23/3	A pattern characterised by negative attitudes towards health care providers and treatment
TRT1	Low Motivation	11	10/1	Unmotivated, apathetic, lacking in self-confidence
TRT2	Inability to Disclose	5	5/0	Unable to open up to others

References: Butcher (1996), Davison and Neale (1996), Gordon (2001), Murphy and Davidshofer (1994), Senior and Douglas (1999).

some degree in each of the clinical scales). A total of nine RC scales were developed to identify the core component of each clinical scale. Psychometric analyses indicate that the RC scales are at least as reliable as their Clinical scale counterparts, furthermore correlations between the RC scales are substantially lower than those between the Clinical scales. The revised scales also appear to predict extra-test criteria as well as or better than do the clinical scales, with comparable to substantially better convergent validity and markedly improved discriminant validity (Tellegen et al. 2003).

The nine RC Scales are presented in Table 1.4, where RC1 is the restructured version of Scale 1, RC2 is the restructured version of Scale 2 etc.

Table 1.4

The Restructured Clinical (RC) Scales

Scale		
RCd	(dem)	Demoralisation
RC1	(som)	Somatic Complaints
RC2	(lpe)	Low Positive Emotions
RC3	(cyn)	Cynicism
RC4	(asb)	Antisocial Behaviour
RC6	(per)	Ideas of Persecution
RC7	(dne)	Dysfunctional Negative Emotions
RC8	(abx)	Aberrant Experiences
RC9	(hpm)	Hypomanic Activation

That the MMPI-2 possesses such a large number of scales addressing a wide variety of potential complaints is perhaps its greatest strength. This benefit, however, is not always employed to greatest effect. MMPI-2 data, like most clinical data, are open to more than one interpretation. For example, a person with a psychological disorder (e.g., depression) may have a high score on the Depression (D) scale because of depression-related symptoms such as poor appetite and fatigue. A person with an organic

injury causing chronic pain, however, may obtain the same high score because they have endorsed the items as part of the sequelae of their particular injury, such as psychomotor retardation and reduced activity levels, rather than depression. This illustrates that the MMPI-2 generally has good sensitivity (i.e., those with depression characteristically elevate the D scale), but poor specificity (i.e., those without depression can frequently elevate the D scale). Thus, it is conceivable that inappropriate recommendations may be made with respect to treatment and rehabilitation. Furthermore, some clinicians, unsure of how to interpret particular scores of these individuals, may arbitrarily impose their own decision rules, or perhaps dispense with MMPI-2 profiles altogether. In view of these important implications more research is clearly needed.

The original MMPI was first introduced in the early 1940s (Hathaway & McKinley, 1940). From its early adoption by clinicians, emphasis has been placed on the interpretation of patterns, as they are reflected in two or three scale high points, the so-called codetypes. Green (1991), however, cautions that correlates of a specific codetype found in one population or setting may not be found in a new population or setting. Hence generalisation of a code type to a new setting or population needs to be made cautiously until the necessary research has been conducted. This codetype approach persists to this day on the MMPI-2 (Greene, 2000).

For a test like the MMPI-2 that has over 200 scales/subscales this method seems to reflect a gross oversimplification, particularly with regard to the ready availability of multivariate statistical procedures, and personal computers with more than adequate processing capacity. Such limited interpretations of profiles also highlight a variety of issues as far as classification of different diagnostic groups is concerned, and these will be

discussed below.

1.3 Issues in Group Classification

Research suggests that individuals seeking compensation for different problems produce somewhat different MMPI-2 patterns. For example, Bowler, Rauch, Becker, and Hawes (1989) reported that individuals manifesting somatoform disorder produce very different profiles from those for whom depression, or anxiety is the prominent complaint.

Other researchers, however, have identified highly similar patterns across quite distinct clinical conditions. Senior and Douglas (2001), when comparing the mean profiles of litigants with Chronic Pain (CP), Traumatic Brain Injury (TBI), or Post Traumatic Stress Disorder (PTSD), found high correlations between the mean profiles of these three separate diagnostic groups. Given the multifaceted nature of the problems faced by individuals who have suffered a physical, psychological, or neurological injury, it appears that grouping these individuals according to mean profiles or codetypes may lead to a failure to accurately capture the differences amongst these groups.

1.4 The Need for More Complex Strategies

An assumption that appears prevalent in the aforementioned research is that individuals with the same organic or psychological disorders will form relatively homogeneous groups. In essence this underlies the supposition that clinical group means accurately reflect the behaviour of the individuals that constitute those groups. The difficulties with this assumption, however, have been well-recognised. Butcher and Tellegen (1978) caution that interpretation of mean profiles is complicated by the content heterogeneity of the standard (Basic) scales. Keller and Butcher (1991) also suggest that mean profiles can obscure individual differences, and possible patient subgroups.

Research carried out with individuals who have suffered a Traumatic Brain Injury (Gass, 1991), and Chronic Pain (Keller & Butcher, 1991) suggests that scores on individual scales range from as low as 30 to as high as 120, in other words the full range of T-scores on the MMPI-2. Either such conditions generate difficulties that cover the entire spectrum of adjustment assessed by the MMPI-2, or there is a great need to explore possible subgroups among these and other populations. Certainly, it seems reasonable to assume that not all patients in a clinical group conform or correspond to descriptors based upon group means.

MMPI-2 researchers appear to have become more aware of the implications of heterogeneity in different diagnostic populations. In fact a great deal of the current MMPI-2 research on chronic pain (CP) is dominated by the identification of subtypes within this population. Several different approaches have been adopted. One approach focused on the establishment of subtypes on the basis of similar codetypes (e.g., the 13/31 codetype). For example, Slesinger, Archer, & Duane (2002) used the MMPI-2 to investigate the characteristics of CP patients participating in a hospital-based pain management program.

Costello, Hulsey, Schoenfeld, and Ramamurthy (1987) developed a second, empirically derived typology for chronic pain sufferers. These MMPI types have been labelled P-A-I-N. Type P individuals (all scales elevated) exhibited extremes in their claims of physical illness, psychological distress, and social maladaptation. Type A was intermediate to types P and N. Type I individuals showed elevations on all of the neurotic triad scales and appeared to be the most physically infirm. Type N individuals were normal in that no scale was often elevated, and were moderate in their claims of ill

health. An attempt by Costello et al., (1987) to sort their MMPI protocols into the four P-A-I-N sub groups, however, led to no more than half of their sample being correctly classified.

A third approach centres on the use of cluster analysis to empirically derive different subgroups. Rather than assuming the existence of homogeneous groups, and by implication a single diagnostically-related personality pattern, cluster analysis examines potential subgroups of individuals within a diagnostic grouping who share similar characteristics. Whilst, the use of cluster analysis has proven to be a popular method of deriving subgroups within diagnostic samples, it seems clear from the available literature that there is a general lack of consistency in the number of profiles found in similar groups. In the Chronic Pain literature, between three (Keller & Butcher,1991) and five (Bernstein & Garbin, 1983) different profiles have been identified. The findings from the various chronic pain cluster analytic studies, however, need to be viewed with some caution not only because different versions of the test (MMPI vs MMPI-2) were employed, but also because of the differences in clustering methods used.

Lange (2000), in what appears to be the first cluster analytic investigation of the presence of prototypical profiles in a clinical neuropsychological sample, found no evidence to support the notion of unique profiles in any of the clinical groups examined. Using the revised editions of the Wechsler Adult Intelligence Scale (WAIS-R) and Wechsler Memory Scale (WMS-R), the author found three patterns of performance within the seven diagnostic groups, with the same patterns occurring commonly across all groups. Again these profiles were not specific to any diagnostic category. This research indicated that there was an absence of prototypical cognitive patterns of performance

within the seven diagnostic groups examined on the revised editions of the Wechsler Intelligence and Memory batteries. Lange concluded, "that making reference to a particular pattern of scores as being consistent with a particular diagnosis appears to be without merit" (Lange, 2000, p.207).

1.5 Aim of the Current Investigation

The research carried out in the current study is designed to contribute to this growing body of knowledge regarding the relationship between patterns of psychological test performance and forensic clinical diagnosis, by examining whether unique MMPI-2 profiles exist within different forensic groups. The goal of the present study is to describe individual's responses to the MMPI-2 in terms of subgroups, which are distinguishable from each other, and clinically meaningful. Once the replicability of the cluster solutions has been established in one population (Chronic Pain), the MMPI-2's ability to differentiate between other populations (i.e., Traumatic Brain Injury, and Post Traumatic Stress Disorder) with different characteristics and psychopathology will be examined.

One aim of the current project is to examine whether the similar cluster profiles that have been found in clinical pain populations in the United States can be replicated in the Australian context. Even if the same subgroups do in fact exist it still cannot be concluded, however, that these profiles are typical of both clinical and forensic chronic pain populations. Additional diagnostic groups need to be investigated to determine whether these profiles are indeed specific to chronic pain samples. To address this issue it is proposed to cluster analyse samples of individuals suffering from Traumatic Brain Injury, and Post Traumatic Stress Disorder, to determine whether individuals from each diagnostic group exhibit unique patterns of psychosocial functioning. The specific aims

of the studies carried out in this dissertation will be addressed in greater detail at beginning of each chapter, and are only briefly reviewed below.

1. Study1: Determination of CP cluster patterns based on MMPI-2 test performance. The sample for this study consisted of individuals who were suffering Chronic Pain, and were in litigation at the time of assessment (n = 197).
2. Study 2: Determination of cluster patterns in a sample of individuals who had suffered a Traumatic Brain Injury, and were in litigation at the time of assessment (n = 200).
3. Study 3: Determination of cluster profiles in a forensic sample of individuals suffering Post Traumatic Stress Disorder, and were in litigation at the time of assessment (n = 132).
4. Study 4: This study will compare the results of studies 1 through 3 to determine if there is any communality in the cluster profiles found in the three diagnostically different samples.

Before beginning these investigations, however, it is necessary to understand the basic methodologies employed with cluster analysis, and their impact upon the detection of subgroups of MMPI-2 performance. These issues are examined in the next chapter.

CHAPTER 2

Cluster Analysis: A Method to Determine the Existence of Clinical Subgroups in Forensic Samples

2.1 Overview

Cluster analysis is becoming a widely accepted method for developing classification systems (Bernstein & Garbin, 1983; Everitt, 1972). The interest is due not only to decreasing satisfaction with conventional psychiatric and psychological classification schemes, but also due to its potential application to therapeutic intervention. The cluster analysis literature, however, is huge, and is scattered among many diverse disciplines. This chapter will only attempt to review those aspects from the literature that are most relevant to this study. The chapter discusses how cluster analysis can be used to determine the existence of subgroups within populations. It also provides a rationale for the methodology and statistical analyses used in subsequent chapters.

Whilst attempting to point out some of the basic issues relevant to cluster analysis, the following discussion is by no means a comprehensive overview. For a more complete review of cluster analysis the reader is directed to publications by Aldenderfer and Blashfield (1984); Blashfield and Aldenderfer (1988); Everitt (1993); and Hair, Anderson, Tatham, and Black (1995).

2.2 Background

The aim of cluster analysis in the behavioural sciences is to infer the nature of distinct underlying populations from analysis of the sample data. Cluster analysis has been utilised in such areas as sports psychology (Raedeke, 1997), educational psychology (Hale & Dougherty, 1988), counselling psychology (Borgen & Barnett, 1987), Clinical

psychology (Coste, Spira, Ducimetiere, & Paolagi, 1991), and neuropsychology (Crawford, Garthwaite, Jognson, Mychalkiw, & Moore, 1997).

Cluster analysis groups individuals, based solely on an analysis of similarities and differences in the multivariate data patterns, without making any prior assumptions as to group membership (Lorr, 1982). Cluster analysis also provides a method for identifying subgroups of individuals whose patterns of scores are similar to each other, and different from the patterns of individuals in other groups (Hair et al., 1995; Norusis, 1985). Currently, there are numerous cluster analytic techniques available to researchers. There is, however, a lack of agreement in the literature as to the most effective method of analysis. The use of cluster analysis is further confounded by a number of methodological issues that first must be resolved.

2.3 Essential Issues in Cluster Analysis

Both Aldenderfer and Blashfield (1984), and Milligan and Cooper (1986) delineate a number of basic issues that are essential considerations in any cluster analysis study:

(1) Selection of a sample to be clustered

(2) Selection of a set of variables on which to measure the entities in the sample

(3) Standardisation of data and detection of outliers

(4) Selection of a cluster analysis method to create groups of similar entities

(5) Computation of similarity/dissimilarity

(6) Determination of the number of clusters

The remainder of this chapter discusses these issues, as applied to the present study.

2.4 Sample Selection

This dissertation comprises a number of studies designed to delineate the personality characteristics of personal injury claimants assessed in the medicolegal setting. The protocols utilised in this research are drawn from assessments conducted over a three-year period in a forensic psychiatric and psychological practice, and represent the base rates of the specific clinical conditions in this setting. However, this also means that more rare conditions may constitute insufficient numbers for an adequate cluster analysis. Consequently, only those clinical groups with sufficient base rate frequency in the database could be considered for inclusion in the current studies. Whilst this is not a methodological flaw, it does mean that the implications of this research will, by necessity, be limited to those groups for which a sufficient sample size was available.

2.5 Definition of Variables with which to Measure Subjects in the Sample

For the present study the choice of subjects was predetermined by the research question as was the choice of variables. Aldenderfer and Blashfield (1984, p.19.) assert that, "the choice of variables to be used with cluster analysis is one of the most critical steps in the research process", with the basic problem being to find, "variables that best represent the concept of similarity under which the study operates". Inclusion of each of the four types of scales employed in analysing the MMPI-2 was considered. The validity scales consist of measures that relate to the consistency of the test data (Cannot Say, VRIN, TRIN), and those that relate to biased responding (L, F, K, Fb, Fp). Recent changes, however, in the interpretative guidelines, particularly regarding F and Fb leave substantial uncertainty regarding what criteria should be currently applied to the

determination of response bias (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 2001).

The consistency scales were not used as variables in the current studies, as they are used both here, and in the clinical setting, to exclude "invalid" profiles. The latter scales, those relating to response bias, were also not used in the current studies. Although these scales have been included in some previous studies, (e.g., de Beus, 1997; Keller & Butcher, 1991) they were not considered appropriate for the present study as their inclusion would confound two distinct phases of scale interpretation. Validity scales measure test-taking attitudes, not personality variables. Their evaluation is performed as the first step in examining a MMPI-2 protocol. The consequence of biased responding is usually the invalidation of the protocol, as a consequence of which, test interpretation stops. Clinicians proceed to interpretation of scale elevations only with protocols that have validity scales within accepted limits. Additionally, validity scales were not included in the current studies as the application of this research would only be expected to apply to valid MMPI-2 protocols.

The Basic scales were chosen as the basis for cluster analysis, and to determine cluster membership, because of their central role in MMPI-2 interpretation, and because of their high item overlap with content and supplementary scales. Examination of subscales was also utilised to help determine the underlying basis for a particular scale elevation.

Since this study focuses on the implications of cluster analysis for diagnostic purposes, utilisation of Basic scales designed specifically for that purpose was deemed more appropriate than including the rationally developed Content scales, as these scales

rationally group items with related content, in contrast to the diagnostically-driven Basic scale development. Once clusters have been defined, however, the Content scales and their Component subscales will be utilised to enhance the interpretability of the retained clusters.

Supplementary scales were not included in the current studies as their role relates to specific clinical settings and clinical populations. Consequently, they would not be expected to contribute meaningfully to the personal injury claimant setting examined here.

The selection of the Basic scales as the focus of the current studies aids in determining the role or placement of the findings of this research in terms of overall MMPI-2 interpretative strategy. Because of the exclusion of Validity and Content scales, information regarding MMPI-2 clusters is best examined following validity determination, and prior to consideration of individual Basic scales and codetypes. It must be acknowledged, however, that a further utilitarian rationale supported the use of only the Basic Scales. If all of the Validity, Basic scales and subscales, Content scales and component scales were used in the cluster analysis, more than 80 variables would have been used. This would have required far more cases than were available for analysis.

2.6 Standardisation of Data

Standardisation of scores has been the subject of much conjecture in the cluster analysis literature, and several arguments have been put forward as to why scores should be standardised. Often a variable's scale is arbitrarily assigned, and differences in scales can have a marked effect on the cluster results. Everitt (1993) suggested standardising

variables when they are measured in different units (e.g., ordinal, interval scales). Borgen and Barnett (1987) also suggest that data should be standardised within each variable to remove effects due to arbitrary differences in the standard deviations or means of the variables. Common practice has been to transform scores into z-scores. In research where profile shape is considered more important, Romesburg (1984) suggested that standardising a data matrix partially removes unwanted size displacements (i.e., magnitude differences) between data profiles.

Whilst partial magnitude effect may be removed, Moses and Pritchard (1966, p.63) asserted that when z-scores are used, the "transformation has the effect of removing all between subject differences in profile level and scatter". For example, when z-scores are used a dramatic change in profile shape may occur. Similarly, Lange and Senior (1996) suggest that the use of z-scores causes problems with distortion of profile shape, and loss of important information.

Conversely, Milligan, and Cooper (1986) suggest that routine application of standardisation in all analyses is not necessarily appropriate, especially when the variables have similar means and variance, as is the case with the MMPI-2 (i.e., all scales have a mean of 50 and a standard deviation of 10). Further, one of the aims of this study was to replicate previous research using a different (forensic) population, standardisation of variables was not considered appropriate in this study because all MMPI-2 scales are essentially already scored to the same standardised distribution, that of T-Scores (originally designed to eliminate the influence of gender). Additionally, most other researchers (deBeus 1997; Keller & Butcher 1991; Riley et al., 1993, 1998) did not standardise their data beyond that of the T-scores. To further standardise would represent

a change in methodology that would prevent direct comparison with prior published research. T-scores were also preferred for analysis as they are the scores that clinicians typically use when interpreting the MMPI-2, and will facilitate the generalisation of the study findings to clinical practice.

2.7 Detection of Outliers

Individual data points can affect the result of a cluster analysis in terms of the assignment of other data. Undue influence of a single data point occurs when different cluster partitions result from the removal of a single case from the data set (Cheng & Milligan, 1995). These cases can be represented by; (a) true cluster groups that are under-represented by the current sample or, (b) cases that are truly different from others (Hair et al, 1995). This is especially so in the case of hierarchical cluster analysis in which a poor early partitioning of the data can adversely affect the outcome of the cluster solution because of outliers left in the sample.

There are a number of methods to determine outliers, the most common of which involves screening methods in statistical packages such as SPSS. For the purposes of the present study, all cases were considered an important source of information. Test scores were regarded as being representative of each individual's current emotional and psychosocial state. In order to address this issue, however, a process suggested by Rapkin and Luke (1993) was adopted. Statistical outliers were identified before the cluster analysis was performed. Two cluster analyses were performed on the data set, one with outliers and the other without. Thus, any potential effect that they could have on the cluster solutions could be determined. If the presence of outliers altered the clustering solution, then the analyses without outliers were used in subsequent stages. If, however,

the clustering solution does not change, all data was retained in subsequent analyses. Data screening in this study was carried out using the data screening facilities of the Statistical Package for the Social Sciences (SPSS) Version-10.

2.8 Selection of a Method of Cluster Analysis

Blashfield and Aldenderfer (1978) pointed out that over 100 different clustering methods have been proposed, most of which represent different combinations of metrics and procedures. It is beyond the scope of this review, however, to consider the appropriateness of all. Rather, the following discussion will focus on the most commonly used techniques: (a) hierarchical agglomerative, (b) hierarchical divisive, (c) iterative partitioning, and (d) factor analysis, as each of these methods represents a different perspective on the creation of groups.

2.8.1 Hierarchical clustering procedures. Hierarchical procedures are stepwise clustering procedures that do not require apriori knowledge of the latent structure of the group. They involve a combination or division of objects, resulting in the construction of a hierarchy, or treelike structure (i.e., dendrogram) composed of separate clusters (Hair, et al., 1995). A defining feature of hierarchical clustering methods is that they form clusters in successive steps, with each individual or object seen as its own cluster at the beginning of the procedure. The similarity/dissimilarity matrix is recomputed and this cluster is compared to the remaining observations (or clusters). Each cluster is then merged one at a time based on similarity. At each successive stage, the two most similar clusters merge to form a new group until only one cluster remains (Hair et al., 1995).

Hierarchical clustering procedures, however, are not without their disadvantages, not the least of which is the fact that the researcher is required to infer how many clusters

exist. Unfortunately, little agreement exists in the literature as to which is the most appropriate method of determining the correct number of clusters.

A further disadvantage, pointed out by Blashfield and Aldenderfer (1988), centres on the fact that hierarchical procedures provide only one opportunity to assign cases to a particular cluster. Thus, if a case has been assigned to one cluster early in the procedure, and is considered more appropriately represented by a different cluster, it cannot be corrected later in this procedure.

Various hierarchical methods also define the distance between two clusters differently. A brief description of the way in which clusters are formed, together with a discussion of issues relating to the efficacy of each method, is presented below.

2.8.2 Hierarchical agglomerative. Hierarchical agglomerative methods begin with each case defined as a cluster. Clusters are then combined on the basis of their similarity until all cases are grouped into one cluster (Sneath & Sokal, 1973; Blashfield & Aldenderfer, 1988). These methods require the calculation of a similarity matrix that is subsequently searched to form clusters of cases. By definition, hierarchical agglomerative clustering methods produce non-overlapping clusters. That is, each case can be a member of only one cluster of the same rank or level (Aldenderfer & Blashfield, 1984). Hierarchical agglomerative methods are distinguished by their linkage rules for the formation of clusters. Whilst there are at least 12 different linkage rules (Everitt, 1993), four have become popular: single linkage (nearest neighbour), complete linkage (furthest neighbour), average linkage (between group/within group), and Ward's (1963) method.

2.8.2.1 Single linkage. For single linkage, a cluster is defined as a group of cases such that one member of the cluster is more similar to at least one member of the same cluster than it is to any member of another cluster (Blashfield & Aldenderfer, 1988). The procedure finds two clusters with the shortest distance and combines them in a cluster until all objects are in one cluster (Everitt, 1993; Hair et al., 1995; Sharma, 1996). Whilst one advantage of this method is its desirable mathematical properties, a major drawback is, that it is vulnerable to forming large, elongated clusters to which additional cases are added as the agglomerative process proceeds (Blashfield & Aldenderfer, 1988). Because of its tendency to "chain", Blashfield and Aldenderfer (1988) suggest that most applied uses of single linkage have been found to generate solutions that appear relatively meaningless.

2.8.2.2 Complete linkage. Complete linkage is an agglomerative algorithm in which the clustering criterion is based on the maximum distance between objects in two clusters (Sharma, 1996). This method is the opposite of single linkage, in that when two clusters merge, all members of both clusters must achieve a certain high level of similarity with each other (Blashfield & Aldenderfer, 1988). At each stage of the agglomeration, the clusters with the smallest maximum distance (or similarity) are combined (Hair et al., 1995; Sharma, 1996). Blashfield and Aldenderfer (1988) asserted that the main advantage of this method was the fact that it had a tendency to find relatively compact clusters composed of similar cases. Sneath and Sokal (1973), however, suggest that complete linkage methods are not without problems considering them too "conservative", as they require complete links among all members of the clusters to be merged. The complete linkage method has performed poorly in simulation

studies (see Borgen & Barnett, 1987) of known clusters. As such, it is not recommended as a useful technique.

2.8.2.3 Average linkage. Average linkage was developed as an alternative to the problems exhibited by single and complete linkage. This method uses the average distance from all objects in one cluster to all objects in another (i.e., average the similarities between all members of each cluster). At each stage, the two clusters with the smallest average distance are combined (Sharma, 1996). Implicitly, this method defines a cluster as a group of entities in which each member has a greater mean similarity with all members of the same cluster than it has with all members of any other cluster (Norusis, 1985). Hair et al (1995), however, suggested that these procedures tended to combine clusters with small variances, and were somewhat biased toward the production of clusters with approximately the same variance.

The average linkage algorithm has two alternative methods within this procedure, the between-group and the within-group methods. Both have performed adequately in simulation studies. For example, Edelbrock (1979) found that average linkage was more accurate than single linkage, complete linkage, and Ward's (1963) methods, which did not differ from each other.

2.8.2.4 Ward's method. Ward's (1963) method does not compute distances between clusters. Rather, this method forms clusters by maximising the within-cluster homogeneity (Sharma, 1996). The similarity method used to join clusters is calculated as the sum of squares between two clusters, summed over all variables. Clusters with the greatest similarity are combined at each stage (Hair et al., 1995). The method was designed to optimise the minimum variance within clusters. Also known as the within

group sum of squares, or the error sum of squares (ESS), Ward's method joins those clusters that result in the minimum increase in the ESS. Hence, a cluster according to this method is defined as a group in which the variance among members is relatively small (Aldenderfer & Blashfield, 1984). Ward's method also provides an index of within-group error at each stage of grouping. This index can be plotted to aid in selection of the best grouping level. When the error index shows a jump upward, it indicates that relatively disparate groups have been combined at that stage. A problem associated with Ward's method in social science research, however, is that it has been shown to generate solutions that are influenced by profile elevation (Aldenderfer & Blashfield, 1984).

2.8.3 Hierarchical Divisive. The opposite of the agglomerative method, hierarchical divisive clustering procedures commence with all objects in a single large cluster, and then proceed in a stepwise manner until all cases have been separated into groups based on the most dissimilar objects (Hair et al., 1995). Although this method of cluster analysis appears far less popular than other techniques, it has an advantage in that the computation required is considerably less than other methods. As with other divisive techniques, however, an inefficient early partition cannot be corrected at a later stage (Morris, Blashfield, & Satz, 1981).

2.8.4 Iterative Partitioning. Non-hierarchical methods are of particular use when there is prior knowledge of the likely number of clusters (Borgen & Barnett, 1987). One of the major non-hierarchical methods is the k-means iterative partitioning method. Iterative partitioning methods differ from the hierarchical techniques in that they are able to check cluster groups, and relocate any unassigned subjects to a more appropriate cluster. In contrast to hierarchical methods, non-hierarchical methods do not involve a

treelike construction process; they assign objects into clusters once the number of clusters to be formed is specified. Cluster seeds are used to group objects within a pre-specified distance of the seeds (Hair et al., 1995). These cluster seeds can be determined randomly, or specified. For example, most partitioning methods begin with an initial partition of the data set into some specified number of clusters, and then compute the centroids (i.e., the mean value for all the objects in the cluster) of these clusters. Each data point is then allocated to the cluster that has the nearest centroid. New centroids are then computed; clusters are not updated until there has been a complete pass through the data. These processes are alternated until no data points change clusters. The method then calculates centroids for a set of trial clusters, places each object in the cluster with the nearest centroid, and then recalculates the centroids and reallocates the objects. This process iterates until there are no changes in cluster membership (Borgen & Barnett, 1987).

Morris et al., (1981), however, suggest that one problem shared by all iterative methods, is that of sub-optimal solutions, since these methods can sample only a very small proportion of all possible partitions of a data set. Hence, there is some possibility that a sub-optimal partition may be chosen. Monte Carlo studies of the performance of iterative methods have also shown that the major cause of sub-optimal solutions is a poor starting partition of the data set (Aldenderfer & Blashfield 1984). Blashfield and Aldenderfer (1978) suggest that a rational selection of the starting position does little to improve this situation. Fisher et al. (1996) also assert that k-means clustering has been shown to be as effective as hierarchical methods in determining meaningful clusters.

2.8.5 Factor Analysis. Factor analytic methods (i.e., inverse factor analysis or Q-type factor analysis) start by forming a correlation matrix of similarities among cases.

Factor analysis is performed on the *N* x *N* correlation matrix, with factors being extracted from that matrix. Correlations are calculated between pairs of individuals (as opposed to variables) across a set of variables. Cases are then assigned to clusters based on their factor loadings (Aldenderfer & Blashfield, 1984). Fleiss, Lawlor, Platman, and Fieve (1971), however, criticise factor analytic methods because of the irrational use of a linear model across cases, the problem of multiple factor loading (i.e., when a case has high loadings on more than one factor), and double centring of the data.

2.9 Comparison of Cluster Analytic Studies

There are clearly many different problems associated with each method of cluster analysis, and although numerous cluster analytic procedures for grouping multivariate data have been proposed, methodological ambiguities persist. Whilst some adequate evaluations of cluster analysis methods have been reported (e.g., Blashfield, 1976; Kupier & Fisher, 1975; Milligan, 1980; Milligan, 1981; Milligan & Cooper, 1986; Overall, Gibson, & Novey, 1993), there still remains an imperfect basis for method selection. These include: (a) lack of adequate criteria for determining the number of clusters; (b) questionable agreement between cluster assignments and membership of true latent populations, given that the correct number of clusters have been identified; as well as (c) the effect of different shapes, sizes, and degrees of overlap, among the latent populations, on the validity of cluster results (Aldenderfer & Blashfield, 1984).

Differences among methods of cluster analysis are more than cosmetic. Indeed, different techniques often can generate quite different solutions from the same data set. A number of Monte Carlo studies have examined the effectiveness of these procedures using artificial data with known distributions (e.g., Milligan, 1981). Some studies

identified Ward's (1963) method as the algorithm of choice (Blashfield, 1976; Kupier & Fisher, 1975). Others, which compared more diverse clustering methods have not come to the same conclusion (Blashfield & Morey, 1980; Edelbrock, 1979; Hale & Dougherty, 1988; Milligan, 1980). Differing methodologies have also made it difficult to directly compare results from various Monte Carlo studies.

Morey, Blashfield, and Skinner (1983) examined psychosocial variables of alcohol abuse, and found that Ward's (1963) method performed better than eight other clustering techniques. Clusters appeared to be separated along a dimension related to profile elevation. Blashfield and Morey's (1980) Monte Carlo study also suggests that Ward's method is sensitive to profile elevation, particularly in the presence of increasing profile scatter.

In a more recent Monte Carlo study, Overall et al. (1993) evaluated all of the options offered by the hierarchical agglomerative cluster analysis program of the Statistical Package for the Social Sciences (SPSS: Norusis, 1986). Using 35 different methods of cluster analysis (i.e., all combinations of the five measures of proximity and seven agglomeration rules), the authors found that complete linkage, average linkage, and Ward's (1963) method performed best across all conditions. Ward's method was chosen as the preliminary method of cluster in the current research to minimise the within-cluster differences and to avoid the problem of chaining found in single and complete linkage methods. It was also chosen to permit comparison of cluster solutions found in earlier MMPI-2 studies that used Ward's method.

The method most likely to generate stable clusters has been proposed as a

two-step procedure outlined by Milligan (1980). The first involves the application of a hierarchical clustering method to determine the number of clusters to be retained. Of those techniques examined, Ward's method appears to be the most appropriate because of its sensitivity to profile magnitude, and its common usage in other research studies. Once the number of clusters has been determined, a second cluster analysis using the k-means procedure will be employed to generate the final cluster solutions. In this way the strengths of each procedure (hierarchical for determining number of clusters, and iterative partitioning for determining membership of those clusters) are employed to reduce the production of non-salient solutions.

2.10 Computation of Similarity/Dissimilarity

The majority of cluster analytic methods search for a proximity matrix in order to locate the most similar objects. There are, however, many potential measures of proximity that can tap aspects of similarity (or dissimilarity) in different ways.

2.10.1 Proximity measures

The concept of proximity and its measurement is important to understanding the performance of clustering procedures. Sneath and Sokal (1973) classified proximity measures into four types: (a) correlation, (b) distance measures, (c) association coefficients, and (d) probabilistic similarity coefficients. Only correlation and distance coefficients, however, have been widely used in psychological studies, therefore, only these measures will be reviewed. Further discussions of proximity measures can be found in Aldenderfer and Blashfield (1984), Clifford and Stephenson (1975), and Sneath and Sokal (1973).

An important practical issue is that different proximity measures can lead to different results when the same data and clustering methods are used. Skinner (1978)

suggests that all proximity measures involve a trade-off between profile pattern and elevation. For example, a distance measure is more appropriate when elevation across variables is an important consideration and pattern similarity is less crucial. Conversely, correlation has been shown to be more useful for data where the pattern of a subject's profile is important (Morris, et al.,1981).

2.10.1.1 Correlation coefficient. The Pearson product-moment correlation coefficient has been used in many studies. Its use in the context of cluster analysis, however, is more contentious than its role in assessing the linear relationship between pairs of variables. The correlation coefficient has frequently been described as being sensitive only to profile shape, implicitly standardising the data to remove level. In doing so, correlation coefficients provide no measure of elevation or scatter (Blashfield & Aldenderfer, 1988; Borgen & Barnett, 1987; Everitt, 1993; Morey et al., 1983). Being only sensitive to shape means that two profiles can have a correlation of +1.00 and yet not be equivalent, that is, the profiles of each case do not pass through the same data points (Blashfield & Aldenderfer, 1988). Edelbrock (1979), however, demonstrated that algorithms using correlation as a measure of similarity were more accurate than those using Euclidean and squared Euclidean distance, regardless of the amalgamation rule. Correlation may also be a useful similarity measure for discriminating sub-types, because it may be an advantage to consider only relative patterning of scores, rather than absolute elevation.

2.10.1.2 Euclidean distance. Euclidean distance is defined as square root of the sum of squared distances between the values for the items (Everitt, 1993). Morey et al. (1983), however, criticised the use of Euclidean distance as it confounds the profile

components of shape, elevation, and scatter. For example, Fleiss & Zubin (1969) suggest that two profiles having the same elevation may appear dissimilar due to differences in shape, while two profiles having the same shape may appear dissimilar due to differences in elevation.

2.10.1.3. Squared Euclidean distance. A commonly used distance (dissimilarity) measure, squared Euclidean distance is the sum of the squared differences between the values for the items (Norusis, 1985). Squared Euclidean distance reflects all three elements of elevation, shape, and scatter (Borgen & Barnett, 1987). Overall et al. (1993) provide evidence from Monte Carlo studies that suggests squared Euclidean distance provides a superior basis for population recovery across several different agglomeration procedures. As such, squared Euclidean distance was considered an adequate proximity measure for the current studies.

2.11. The Role of Shape, Elevation, and Scatter in MMPI-2 Profiles

Cronbach and Gleser (1953) assert that profiles (i.e., scores of a particular individual over a number of scales) can be defined in terms of shape (the pattern of highs and lows), elevation (the overall mean of the profile), and scatter (how dispersed scores are from the mean). Clustering of profiles can also be accomplished on the basis of shape alone (Burger & Kabacoff, 1982), or on the combination of elevation, scatter, and shape (Collins, Burger, & Taylor, 1976). Because of their different arithmetic features, the choice of proximity index directly determines the role that the components of shape, elevation, and scatter play (see Chronbach & Gleser, 1953; Skinner, 1978).

Burger (1991) investigated the contribution of shape, elevation, and scatter to differences in MMPI-2 profiles, in psychiatric and normal samples. Overall, the role of

shape and elevation appeared to play a role in accounting for profile differences. Scatter was of minimal importance. Both Skinner (1978), and Morey et al. (1983) suggest that the profile component of elevation represents the severity (i.e., the temporary factors influencing the degree of symptom severity) of an individual's condition, while profile shape represents more enduring predispositions. When choosing proximity coefficients, clearly, a desirable research strategy should be to choose the appropriate set of parameters for the specific research problem.

Current, MMPI-2 interpretive systems include both elevation and shape as major profile characteristics. For example, high point codetypes emphasise both shape (which scales are the highest) and elevation (how high are the elevations). In the present study it was felt that as elevation and shape were critical factors, squared Euclidean distance would be more useful in the preliminary cluster analysis for discriminating between clinical sub-types, and to compare clusters found in this study to past research (e.g., Keller & Butcher, 1991; deBeus, 1997).

To date no one has been able to definitively decide which clustering model will most accurately discover the correct number of populations underlying a data set. Most clustering procedures, including those reviewed, require the user to specify, or to determine the number of clusters in the final solution. Selecting the number of clusters following an analysis, however, differs depending on whether hierarchical or non-hierarchical methods are used.

2.12 Determination of the Number of Clusters

For non-hierarchical procedures, the numbers of clusters are assigned before the analysis. Hierarchical methods, however, require the researcher to infer the number of

clusters in the sample. Because there are no commonly accepted "stopping" rules, a major difficulty in cluster analysis involves the decision on the correct number of clusters to retain. Although there are no clear-cut rules, there are methods available which can be used, including subjective inspection of dendrograms, icicle plots, inverse scree plots, and statistical stopping rules. A brief discussion of these techniques follows.

2.12.1 Dendrograms. Dendrograms are treelike diagrams, which provide graphical representation of the sequence by which clusters are merged (see Figure 2.1). Decisions as to which is the correct cluster solution are based on subjective inspection of the different levels of the dendrogram. In Figure 2.1, a cut in the tree at the three cluster solution appears to be the most appropriate based on the number of lines cut by marker A. A major disadvantage of this method is that if you have a large sample of data, the graphic becomes rather large to handle and visual inspection becomes problematic

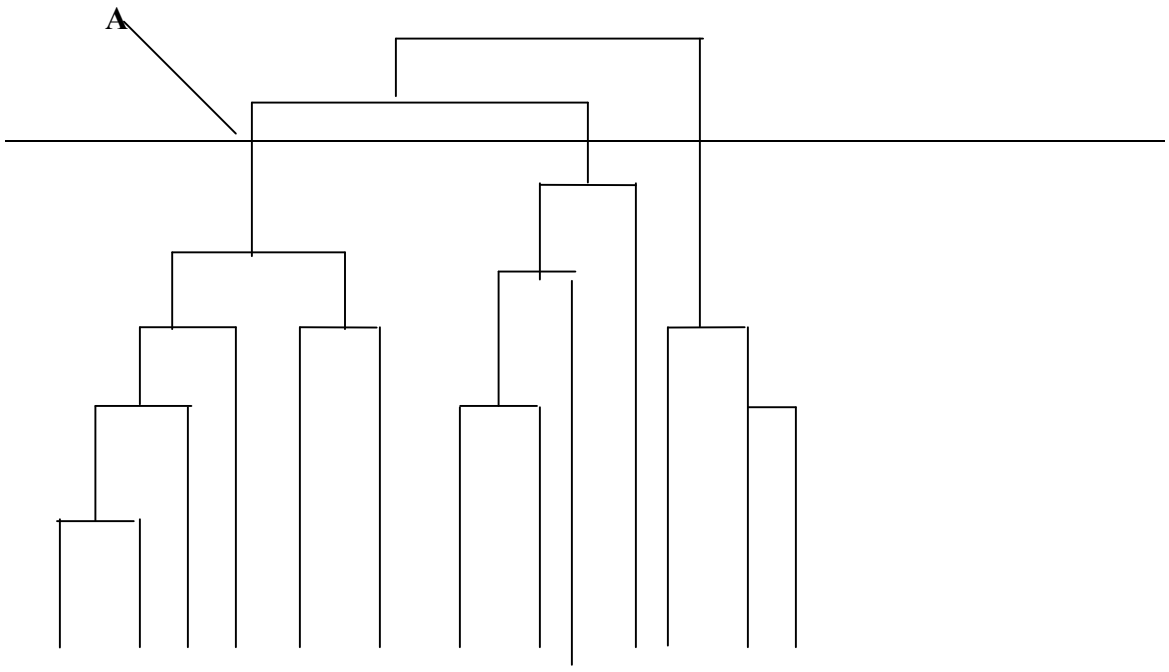

Figure 2.1 Example of a Dendrogram

2.12.2 Icicle plots. Icicle plots are similar in nature to the dendrograms but cluster mergers are represented by a series of bars (see Figure 2.2) radiating from the top of the graphic and project downward (i.e., read the black bars, not the white bars).

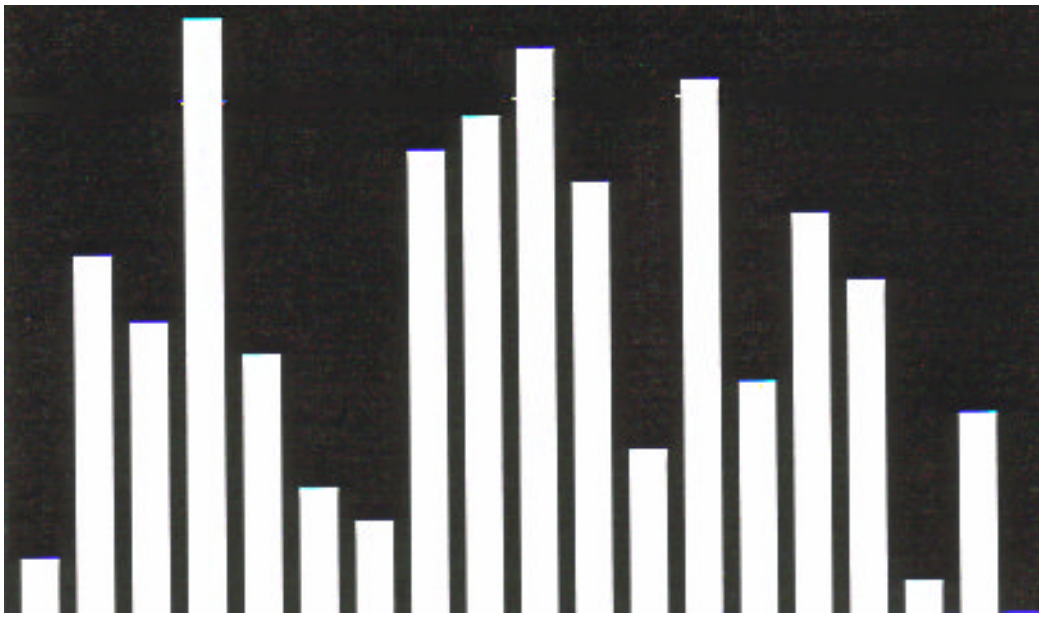

Figure 2.2 Example of an Icicle Plot

Both dendrograms and icicle plots, however, tend to provide little, if any, useful data in terms of objective heuristics for determining numbers of clusters and consequently have not been used in the current studies.

2.12.3 Inverse Scree plots. Inverse scree plots are graphical representations of amalgamation or agglomeration coefficients. The agglomeration coefficient is the numerical value of similarity assigned when two clusters merge. The inverse scree plot helps researchers to select the number of clusters by determining where a marked flattening in the line occurs. The flattening of the line suggests that mergers in the remaining clusters are no longer meaningful. For example, an examination of Figure 2.3, reveals a change in the direction of the line at a 4 cluster solution (Marker A). Whilst this

implies the likelihood of a 4 cluster solution additional methods should be employed to confirm the cluster solution.

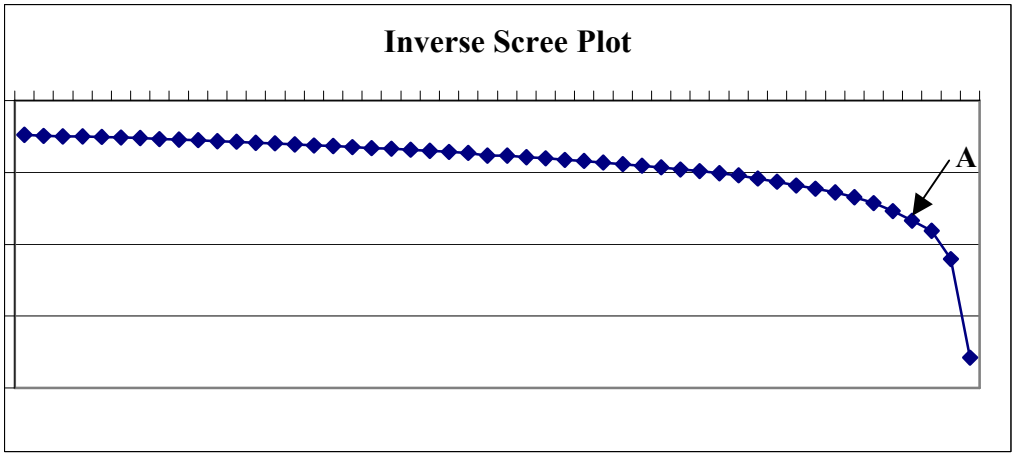

Figure 2.3 Example of an Inverse Scree Plot

Inverse scree plots in the current studies were created using Microsoft Excel 2000, and were inspected to assist in establishing the point where clusters are no longer meaningful.

2.12.4. Stopping rules. While many statistics, or "stopping rules" exist, none appear any more successful that others in determining the correct number of clusters. Milligan and Cooper (1985) examined the efficacy of 30 statistically based stopping rules to extract a predetermined cluster solution in a number of simulation studies. Whilst some stopping rules appeared to perform better than others, Milligan and Cooper concluded that success appeared to be dependent on the structure of the data.

Whilst unfortunately no standard, objective selection procedure exists, Hair et al. (1995) suggest that the distance between clusters (within-cluster sum of squares) at successive steps in the agglomeration procedure may serve as a useful guideline. Hence, one may choose to stop when the distance between clusters exceeds a specific value, or

when successive distances between steps make a sudden jump. Small coefficients indicate that fairly homogeneous clusters are being merged. The joining of two very different clusters results in a large coefficient.

The main advantage of the Hair et al. (1995) approach is that it is not only a stopping rule, but it also formalizes the use of the inverse scree plot. Stopping rules would seem to be preferred as they at least formally operationalise how the number of clusters to be retained is determined, as opposed to the more graphically intimidating icicle plots and dendrograms, which ultimately only support a subjective impression of where the greatest changes occur as an indication of the number of clusters to be retained. In the current studies inspection of the percentage change in the agglomeration coefficient (the distance between the clusters being combined) was carried out to determine the optimal clusters (see Hair et al., (1995) for a complete description).

Rapkin and Luke (1993) suggest that in clinical practice, however, the optimal cluster solution is generally thought to be determined by its ability to identify distinct groups within the sample (i.e., reliably classify the majority of cases), and by its ability to provide clusters that have clinical meaning. Both Everitt (1980) and Morris et al. (1981) assert that sub groups with membership of less than 5% of the data set do not represent a meaningful cluster. Accordingly, clusters with less than 5% membership were not included in the final cluster solutions in the current studies.

2.13 Summary

The previous review highlights the fact that there are many issues that need to be considered when choosing a method of cluster analysis. Whilst there are many methods available, no one method appears to be optimal. Until more efficient methods of

determining the number of clusters in a sample are developed, selection must rely on the convergence of the aforementioned techniques. With this caution in mind, all cluster analyses carried out in the following chapters are based on the steps proposed by Aldenderfer and Blashfield (1984) and Milligan and Cooper (1987) and the methodology outlined in the previous review. Given recent concerns regarding k-means clustering (Steinley, 2007) the conservative procedure adopted in the following studies is considered to be the most robust approach that still retains comparability with past research (i.e., Wards method).

Described below are the cluster analysis procedures used in all analyses carried out in the following chapters.

1. A hierarchical cluster analysis was applied to all data sets, using SPSS CLUSTER. Ward's (1963) method was used, with squared Euclidean distance as the proximity measure. This approach permitted both scale elevation, and profile shape to influence cluster solutions, and provided the greatest comparability to prior research.
2. An inverse scree plot was created using Microsoft Exel 2000. The plot included the final 50 agglomeration coefficients from the hierarchical cluster analysis agglomeration schedule. The scree plot was then examined to assist in establishing a point where the line started to flatten, and where cluster mergers were no longer meaningful. This information was then used as a guide for determining the number of clusters in the data set.
3. The agglomeration schedule was also examined, with small coefficients indicating the merging of comparatively homogenous clusters. The joining

of two clusters that are different results in a jump in the coefficient. To help identify relatively large increases in cluster homogeneity the percentage change in the agglomeration coefficient (see Hair et al., 1995) was calculated.

4. A preliminary cluster solution was then decided upon, based on the results of the inverse scree plot and the percentage increase in the agglomeration coefficient. Because of the arbitrary nature of the of the scree plot, this step was reviewed by an independent researcher for comparative purposes.
5. Once a solution was agreed upon, cluster membership was examined. Subgroups with membership of less than 5% of the data set were not considered meaningful, and were not included in the final cluster solution.
6. A k-means cluster analysis was then applied to the data. The number of clusters from the hierarchical analysis was used to specify the number of clusters to be generated. All clusters were generated using random seed points.

In the following chapters each of the above steps were followed. Whilst the information presented in the ensuing chapters must be repetitive, it is necessary to clearly demonstrate the process that occurred throughout the cluster analytic process. The following chapter reviews the MMPI literature pertinent to the establishment of subgroups in chronic pain patients.

CHAPTER 3

The MMPI-2 and Chronic Pain

3.1 Overview

Immediately after injury, physiological mechanisms are largely responsible for the mediation of the pain response. While acute pain is a normal sensation triggered in the nervous system to alert one to possible injury, and the need to take care of oneself, chronic pain is different. Chronic pain (CP) is pain that persists beyond the normal recovery time for the type of injury sustained (usually 3 to 6 months), or pain that is disproportionate to the nature of the injury. As chronic pain continues, environmental, social, cognitive, and behavioural factors increase in importance, and continue to do so as the pain persists (Gamsa, 1994; Payne & Horn, 1997).

Turk (1994) reports that the cost of CP exceeds $70 billion per annum in the USA alone. In Australia, it is estimated that sixteen percent of the adult population are partially or totally disabled by chronic pain each year, at an annual cost of some A$7.8 billion (Gross, 1986). A proportion of these individuals often pursue compensation for their injures through the court system. Hence, psychologists are increasingly becoming involved in personal injury litigation cases as expert witnesses. Their involvement in the courtroom, in part, comes from an increasing number of cases that incorporate a mental health, or pain and suffering component. One facet of the forensic evaluation involves the use of personality tests to assess personality and psychopathology factors post injury.

3.2 The Need for Classification

Keller & Butcher (1991) asserted that the major goals of strategies used to classify chronic pain patients should be to (a) describe the characteristics of the typical pain

patient personality, and (b) to describe the differences among pain patients. These goals have been most consistently addressed using the MMPI-2.

3.3 Classification Approaches

Several different approaches to classification have been utilised to group and better understand the chronic pain patient. Some of these approaches include, but are not limited to, psychogenic versus organic pain, and evidence of secondary gain as exemplified by studies of compensation status. As an alternative to the differentiation between organic and psychogenic pain, Hanvik (1951) developed the MMPI - Low Back Pain scale (Lb) to aid in the psychological diagnosis of chronic back pain patients. Although the aforementioned classification approaches defined groups of patients with shared characteristics, they appear to be based on preconceived ideas with little empirical validation that these characteristics actually formed meaningful patient groups (Vendrig, 2000).

Costello et al. (1987), using a metaclustering technique to combine the results of previous MMPI pain studies, classified sub groups of chronic pain patients with the acronym P-A-I-N. Within this coding, "P" equates to a depressed-pathological, generally elevated profile. "A" corresponds to a Conversion V profile with elevations for scales Hs (Hypochondriasis) and Hy (Hysteria) at least 10 points above scale D (Depression). "I" is a neurotic triad profile where the first three scales (Hs, D, Hy) are all elevated. "N" is a within normal limits profile.

More recently, two other approaches have been adapted to study MMPI subgroups. One approach has been to establish subgroups based on similar codetypes. For example, Slesinger et al. (2002) investigated the characteristics of CP patients

participating in a hospital-based pain management program, using the MMPI-2. An attempt to sort their MMPI-2 protocols into Costello et al's. (1987) four P-A-I-N subgroups, however, led to no more than half of their sample being correctly classified.

The second approach used cluster analysis as a tool to investigate chronic pain groups, and several studies have identified either three or four cluster profiles (e.g., deBeus, 1997; Keller & Butcher, 1991). As previously stated, the assumption underlying the initial examination of subgroups is that each group may be associated with a unique set of pain-related behaviours. Hence, replication of established subgroups may provide evidence for their validity. A review of previous MMPI-2 cluster analytic research is presented in the following section.

3.4 Review of Previous MMPI Cluster Analytic Research

Whilst numerous cluster analytic studies have been conducted on the MMPI profiles of Chronic Pain patients, far fewer have been carried out using the MMPI-2. Riley, Robinson, Geisser, and Wittmer (1993) investigated cluster solutions in 201 patients with chronic low-back pain. Utilising Ward's (1963) clustering method with squared Euclidean distance as the proximity measure, an analysis was performed on MMPI-2, K-corrected T-scores, using the three validity scales (L, F, K), and nine clinical scales (the Mf scale was omitted). Graphic representations of the resulting four cluster solution are presented in Figure 3.1.

Cluster 1 (Neurotic triad) reflected severe distress, and revealed clinical elevations scales 1 (Hs = 73.0), 2 (D = 68.4), and 3 (Hy = 74.6) with all other scales below the MMPI-2 cut-off of 65. This cluster consisted of 88 (44%) subjects. Cluster 2 (General elevation) revealed elevations above 65 on scales 8 (Sc = 85.6), 7 (Pt = 83.3), and 2 (D =

82.7) with significant elevations on scales 1 (Hs), 3 (Hy), 6 (Pa), and 10 (Si). This cluster consisted of 20 (10%) subjects. Cluster 3 (Within normal limits) had no elevations above the clinical cut-off level. This cluster comprised 49 (24%) patients. The fourth cluster (Conversion V) evidenced clinical elevations on scales 3 (Hy = 75.3), and 1 (Hs = 77.2), with these scales being elevated more than10 points above scale 2 (D = 63.1). There were 44 (22%) individuals within this cluster.

In a follow-up study of 569 chronic low back pain patients, Riley & Robinson (1998), using Ward's method with Euclidean distance, identified four MMPI-2 cluster profiles, which replicated those found in Riley et al,s earlier 1993 study. Graphic representations of the four cluster solution are presented in Figure 3.2.

Cluster 1 (Within normal limits) had one elevation on Scale 1 (Hs = 66), above the clinical cut-off level. This cluster consisted of 206 (36%) individuals. Cluster 2 (General elevation) had significant elevations on scales1 (Hs = 78.4), 2 (D = 83.2), 3 (Hy = 77.7), 4 (Pd = 71.7), 6 (Pa = 79.4), 7 (Pt = 82.4), 8 (Sc = 88.1), and 9 (Ma = 67.4). This cluster had 69 cases (12%). The third cluster (Conversion V) evidenced clinical elevations on scales 1 (Hs = 79.9), and 3 (Hy = 81.6), with these scales being elevated more than 10 points above scale (D = 78.6). All other scales were within normal limits. There were 161 (28%) patients within this cluster. Cluster 4 (Neurotic triad) revealed clinical elevations scales 1 (Hs = 79.9), 2 (D = 80.9), and 3 (Hy = 85.9). There were also significant elevations on scales 4 (Pd = 65.3), 7 (Pt = 70.4), 8 (Sc = 70.4). All other scales were below the MMPI-2 cut-off of 65. This cluster consisted of 133 (24%) subjects.

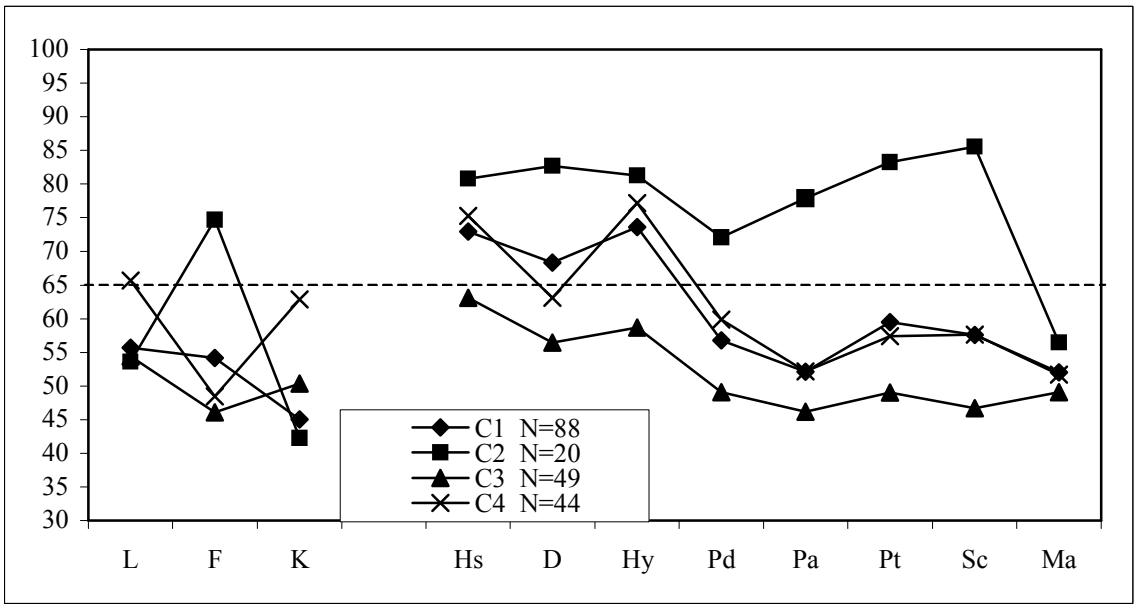

Figure 3.1 Mean Validity and Basic Scale T-scores by Hierarchical Cluster Group from Riley et al. (1993)

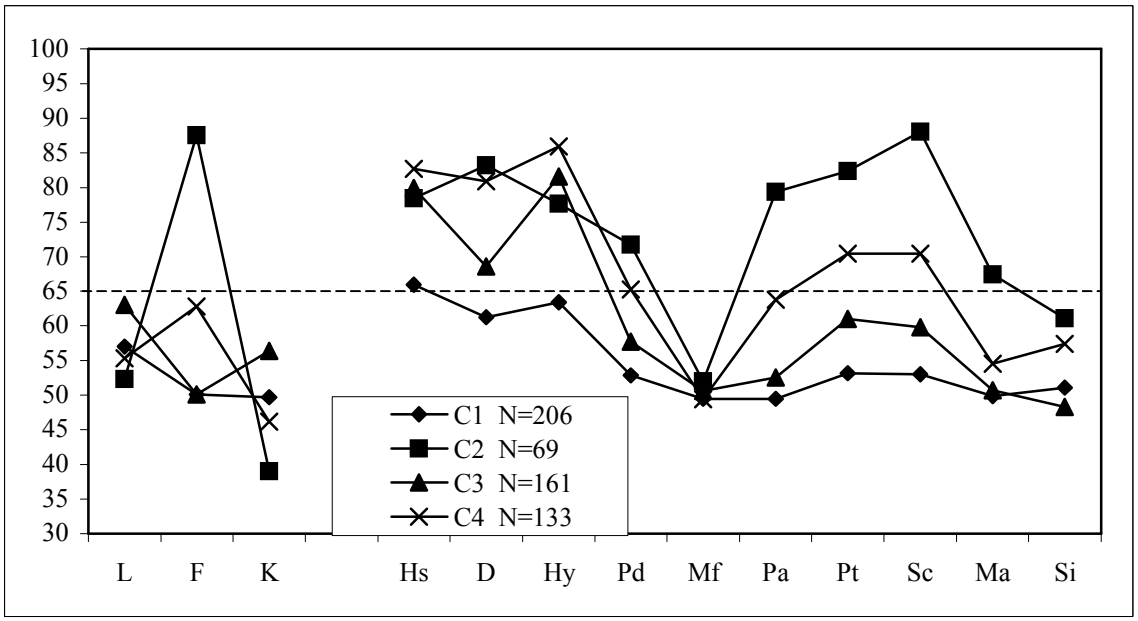

Figure 3.2 Mean Validity and Basic Scale T-scores by Hierarchical Cluster Group from Riley & Robinson (1998)

Using a slightly different methodology, Keller and Butcher (1991) examined 502 MMPI-2 profiles derived from the MMPI-AX form in a mixed pain sample. The AX form was the adult experimental form of the MMPI developed specifically for use in the re-standardisation research project to create the MMPI-2 (Butcher, 1989). A hierarchical cluster analysis was performed using Ward's (1963) method, and Euclidean distance as the proximity measure. Analyses were run separately for males and females, and within two sex cohorts for the purpose of replication. For both males and females only a three cluster solution replicated across cohorts. Graphic representations of the clusters generated by Keller and Butcher are presented in Figures 3.3 and 3.4.

In the male sample, Cluster 1 was described as a general elevation pattern, and consisted of 66 (25%) males. This cluster had significant elevations on scales 1 (Hs = 78.5), 2 (D = 77.3), 3 (Hy = 75.8), 4 (Pd = 68.2), 6 (Pa = 72.8), 7 (Pt = 77.2), and 8 (Sc = 77.6). All other scales were within normal limits. Cluster 2 was an elevated neurotic triad profile, and had 52 (57%) male patients. This cluster had clinical elevations on scales 1 (Hs = 76.4), 2 (D = 69.5), and 3 (Hy = 78.0). All other scales fell within normal limits. For the third male cluster (n = 50; 19%) all scales were within normal limits.

Cluster 1 for the female sample was a neurotic triad pattern (Hs = 81.6, D = 71.6, Hy = 76.5) with a sub-clinical elevation on scale 7 (Pt = 63) and consisted of 86 (37%) female patients. Female Cluster 2 was a general elevation profile (n = 71) and consisted of 37% of the sample. This cluster had clinical elevations on the following scales (Hs = 81.6, D = 81.6, Hy = 87.1, Pd = 68.3, Pa = 68.3, Pt = 73, Sc = 72.2). All other scales were within normal limits. The third female cluster was a low Conversion V profile

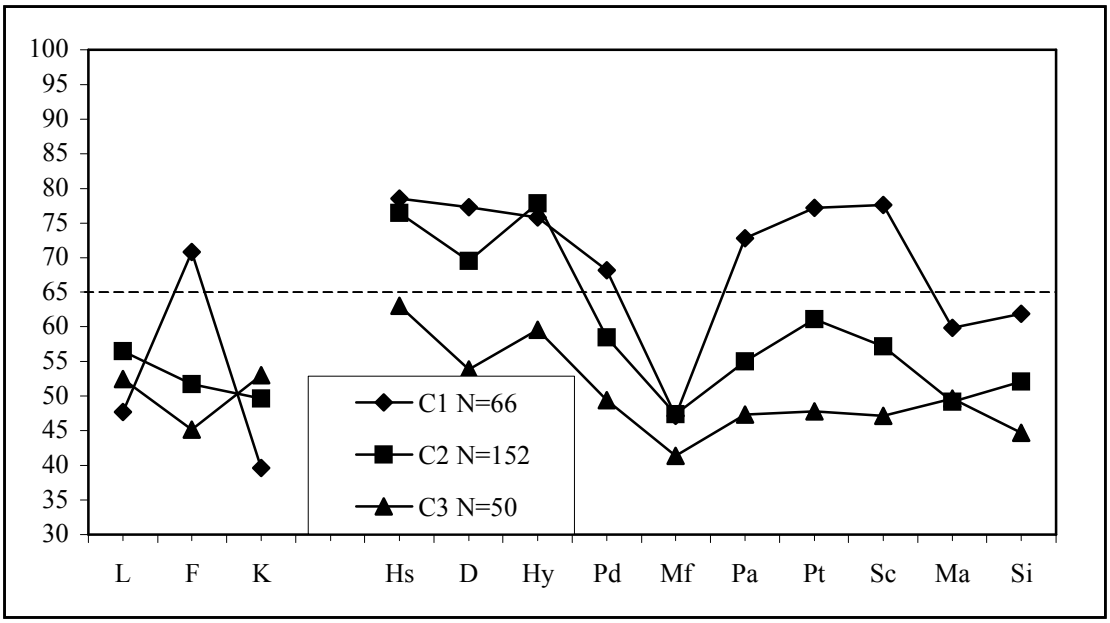

Figure 3.3 Mean Validity and Basic Scale T-scores by Hierarchical Cluster Group for Males (Keller & Butcher, 1991)

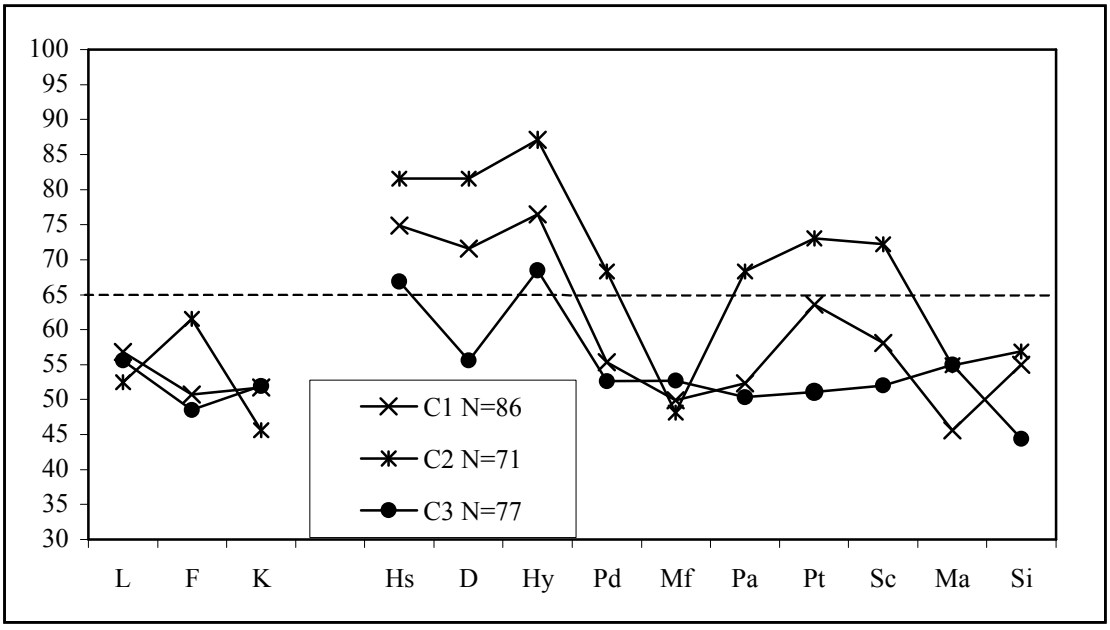

Figure 3.4 Mean Validity and Basic Scale T-scores by Hierarchical Cluster Group for Females (Keller & Butcher, 1991)

(n = 77), and comprised 33% of the sample. This cluster had elevations on the following scales (Hs = 66.9, Hy = 68.5). All other scales were within normal limits. Both male and female patterns appear to be similar to those found in other studies, being a within normal limits profile, a general elevation profile, and various elevations of the neurotic triad scales.

deBeus (1997) also investigated MMPI-2 cluster solutions in chronic low back pain patients. MMPI-2 profiles were collected from 2051 (1109 males, 942 females) chronic low back pain patients from an inpatient multidisciplinary pain clinic in the South Western United States of America. Using K-corrected T-scores of the three validity scales and ten clinical scales the author performed a hierarchical cluster analysis, with Ward's (1963) method and Squared Euclidean distance as a proximity measure.

In order to replicate cluster solutions each sex was randomly assigned to four cohorts. Similar to Keller and Butcher (1991), two to six clusters were examined to determine those that replicated across the cohorts within each sex. For the female sample, four relatively homogenous cluster profiles were found for all four cohorts. For females, Cluster 1 was a within normal limits profile (n = 232, 25% of females), with all scores remaining under the clinical cut-off of 65. Cluster 2 was a Conversion V profile (n =332, 35%). Cluster 3 produced Neurotic triad elevations (n = 247, 26%). The fourth cluster produced a general elevation profile (n = 131, 14%).

Four relatively homogenous profiles were found across all four cohorts in the male sample. Cluster 1 was a within normal limits profile with all elevations under the 65 cut-off point (n = 274, 25% of males). Cluster 2 was a general elevation profile

(n = 197, 18%), with elevation on scales Hs, D, Hy, Pd, Pa, and Pt. Cluster 3 produced Neurotic triad elevations (n = 225, 20%). The fourth cluster generally produced a Conversion V profile across cohorts (n = 259, 23%). The author considered this a "slight" elevations profile (n = 154, 14%), with the Hs scale between 65 and 70 for both cohorts. All other scale elevations were not clinically significant. It would appear that four different profiles were evident across both male and female groups. Although the author provided no data with which to graphically represent the aforementioned clusters here, they appear to replicate cluster solutions found by Riley et al. (1993, 1998), with only Keller and Butcher (1991) failing to find the Conversion V profile for males.

3.5 Summary

The use of cluster analysis has proven to be a popular method for identifying subgroups within chronic pain samples, with considerable consistency across the studies reviewed. The extent, however, to which personal injury claimants with chronic pain conditions demonstrate the same patterns has not yet been determined. Accordingly, the following chapter presents an MMPI-2 cluster analytic study of personal injury claimants suffering from chronic pain in order to ascertain the number of distinct patterns for this clinical group in the medicolegal setting.

CHAPTER 4

Cluster Analysis of a Forensic Chronic Pain Sample

4.1 Overview

In Chapter 2, the utilisation of cluster analysis as a means to determine the presence of subgroups within a data set was discussed. In Chapter 3, the MMPI-2 literature as it relates to chronic pain was reviewed. This chapter describes the use of the methods discussed in Chapter 2 to examine subgroups in a heterogenous medicolegal pain sample. The data examined were the MMPI-2 profiles of individuals who were suffering chronic pain (CP), and were litigants in personal injury compensation.

4.2 Method

4.2.1 Subjects. One hundred and ninety seven (107 males - 54%; 90 females - 46%) individual MMPI-2 profiles were collected from the archives of two medicolegal practices in Brisbane, Queensland, Australia. Each individual had sustained physical injuries sufficient to generate persistent (greater than 6 months) pain, and were reporting symptoms that had a clear organic basis.

Diagnoses and MMPI-2 raw score protocols were obtained for each subject. Cases were examined in chronological order, and all those meeting the criteria for a diagnosis of CP were included, without regard to the MMPI-2 validity scales (L, F, Fb, F(p), K). The failure of the validity scales to demonstrate independence from clinical scales has been a longstanding limitation of the scales. While elevated in those who seek to misrepresent themselves on the test, they also elevate in the presence of psychological difficulties. Accordingly, they have not been included in the cluster analyses, but will be examined with regard to their implication for cluster interpretation. All testing was conducted by experienced forensic psychiatrists and psychologists, the purpose of each

assessment being to determine the psychosocial difficulties associated with their condition.

Cases were required to meet the following criteria for inclusion:

- Subjects had undergone a comprehensive clinical assessment conducted by an experienced forensic psychiatrist or psychologist
- Subjects did not have multiple diagnoses, and could be appropriately placed into the CP diagnostic category.
- No more than 10 responses omitted from the test protocol (Greene, 2000)
- Respondents recorded T-scores of $\geq$ 80 on VRIN (inconsistent response set), and $\geq$ 80 TRIN (true/false response set) scales (Butcher et al., 1989)

No cases were excluded based on elevations of VRIN and TRIN responses. No cases recorded elevations > 10 on Cannot Say (no response). Characteristics of the sample are presented in Table 4.1.

Table 4.1

Characteristics of the Forensic Chronic Pain Group

Mixed Pain Sample			
Gender	Subjects	%	
Male	107	54	
Female	90	46	
Demographics	M	SD	Range
Age (years)	38.03	10.82	18 - 62
Education (years)	10.78	2.02	7 - 20

4.2.2 Measures. All cases were administered the softcover booklet version of the MMPI-2. The MMPI-2 was administered in the standardised manner outlined in the test

manual (Butcher et al., 1989). Scores used in the following analyses consisted of K-corrected T-Scores of the 10 Clinical Scales. Although some previous research retained gender separation when computing clusters, it was not considered appropriate for this study, since the use of gender-corrected T-scores has the effect of removing gender differences.

4.2.3 Data Screening. Due to the potential influence of statistical outliers to the validity of the cluster analysis, the CP sample was examined using the methods outlined in Chapter 2. All cases fell within 2.25 standard deviations of the mean for the 10 clinical scales. As all protocols were considered to be representative of their current emotional and psychopathological state, no cases were excluded from the data in the following procedures. Following data screening, cluster analyses were carried out using the CLUSTER, and QUICK CLUSTER components of the SPSS-V10 statistical program (SPSS Inc, 1999). Determination of the number of clusters was based on the steps outlined in Chapter 2. This provided a standard methodology for the analyses in this, and subsequent chapters.

Following the final cluster analysis, the means, standard deviations, range, and percentage of scale elevations were calculated for each of the MMPI-2 Clinical and Content scales and their subscales, for each k-means cluster. An elevated scale is one that falls one-and-a-half standard deviations above the mean of the U.S. standardisation sample (i.e., a T-score of 65). In the U.S. standardisation sample 6.5% of normal cases would be expected to have T-scores of 65 or above. These constitute the base rates of high scorers for the standardisation sample, and as such, represent a point of comparison when examining CP cluster base rates. Examination of scale elevations provides a direct

link between the multivariate statistical approach of cluster analysis, and the clinical interpretative method applied by clinicians.

Proportions of elevated scores were computed. A total of 88 comparisons for each cluster group were conducted to determine whether or not the CP base rates of abnormally high scores deviated significantly from the 6.5% expected in the normal population. A Bonferroni correction was applied to adjust for the number of comparisons, resulting in a critical alpha level of $p<.001$. Comparisons were conducted using a test of significance of the difference between two independent proportions (Ferguson & Takane, 1989). This was achieved by computing a score for the difference in proportion between the obtained base rate, and the hypothesised value of the population as a function of the standard error of proportion. The standard error of proportion was calculated using the value of the population proportion (6.5% or .065), and the sample size (n=197). Using this method it was determined that scales with a proportion of elevations of 13% or above indicated a significant difference in the CP sample.

4.3 Analysis and Results

A hierarchical cluster analysis was first applied to the 10 clinical MMPI-2 scales, using Ward's (1963) method and squared euclidean distance as the proximity measure. Following the cluster analysis, examination of the inverse scree plot (see Figure 4.1) indicated a flattening of the curve at a four cluster solution (marker A). The flattening of the curve became more pronounced at a three cluster solution (marker B). This suggested that either a three or four cluster solution would be likely.

To help identify increases in cluster homogeneity the percentage change in the agglomeration coefficient was calculated. The agglomeration coefficients, presented in

Table 4.2, show that the percentage change almost triples when moving from the four to the three cluster solution, after relatively small increases. The three cluster solution was identified as the more appropriate result.

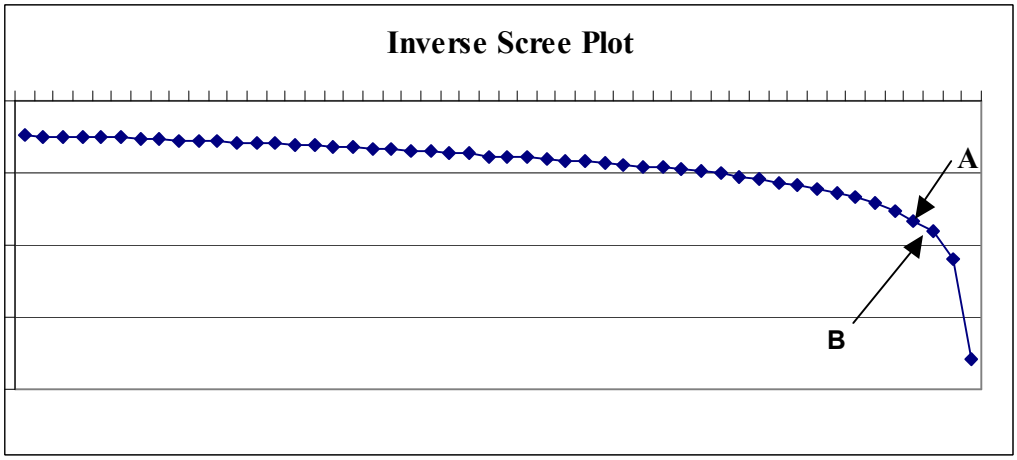

Figure 4.1 Inverse Scree Plot of the final 50 CP Agglomeration Coefficients

Examination of group membership at the three cluster solution indicated that all clusters included greater than 5% of the sample size (n>10), and were therefore considered appropriate on the basis of adequate group membership [Range: n = 53 (27%) to n = 73 (37%)]. Based on the interpretation of the scree plot, and the calculation of the percentage change in the agglomeration coefficient, a three cluster solution was considered to be most appropriate for the data set.

Table 4.2

Percentage Change in the Agglomeration Coefficient for the Hierarchical Analysis

Number of Clusters	Agglomeration Coefficient	Percentage Change
8	127796.37	4.97
7	134149.13	6.02
6	142226.77	8.20
5	153890.00	8.74
4	**167341.56**	**8.31**
3	**181239.30**	**21.72**
2	220597.42	62.21
1	357838.69	------

The outcome of the preliminary hierarchical cluster analysis will be presented here in some detail. Technically, this level of description would be contraindicated by the next phase of analysis, in which k-means cluster analysis is performed to derive the final cluster solutions. However, other cluster analysis studies [(deBeus (1997); Keller & Butcher (1991); Riley et al. (1993); Riley & Robinson (1998)] have not employed this methodology, and derived their clusters directly from the hierarchical analysis. The level of detail is presented here to permit direct comparisons between the current hierarchical analysis and the analyses carried out in other published research. It is not repeated for subsequent chapters where no comparable literature has been reported. A complete table of mean Basic and Content scale scores of the three profiles generated by Ward's (1963) method of hierarchical cluster analysis are presented in Appendix A.

4.4 Hierarchical Cluster Analysis Results Figure 4.2 shows a graphic representation of mean clinical scale K-corrected T-scores for each MMPI-2 cluster. Mean data for some of the validity scales is presented in subsequent figures and tables to facilitate comparison with other studies.

Skinner and Jackson (1978) provide empirical evidence for the distinction of MMPI profiles. Using a clustering procedure the authors identified three MMPI profiles: (i.e., Neurotic – scales Hs, D, Hy; Psychotic – scales Sc, Pt; and Sociopathic – scales Pd, Ma). Thus, the Basic scales used for the derivation of the hierarchical, and k-means clusters could be said to represent two psychological concepts, those of distress (scales 1-4, anxiety, depression etc.), and disturbance (scales 6 - 10., disturbed thinking, and perturbations in life-style).

Accordingly, cluster characteristics in this and following studies will be described with regard to distress (Ds), and psychopathological disturbance (Db). For example a cluster characterised by clinical elevations on Scales 1-4, and sub-clinical scores on Scales 6-9, would be best described as a High Distress / Low Disturbance (HDs/LDb) profile. Clusters characterised by clinical elevations on scales 1-4 and 6-10, would be best described as High Distress / High Disturbance (HDs/HDb) profiles. Clusters with no clinical elevations represent Within Normal Limits clusters (WNL).

4.4.1 Hierarchical Cluster 1. No mean clinical scale elevations (above the MMPI-2 cutoff of 65) were apparent for this subgroup. The highest scale was Hy (64.33), followed by Hs (64.08). This cluster was interpreted as a Within Normal Limits profile, and consisted of 73 individuals (37%).

4.4.2 Hierarchical Cluster 2. The second cluster reflects high levels of intrapersonal distress and relatively low levels of disturbance, evidenced by clinical elevations on the three scales of the neurotic triad. The highest scale was, Hy (79.47), followed by D (79.23), and Hs (75.57).

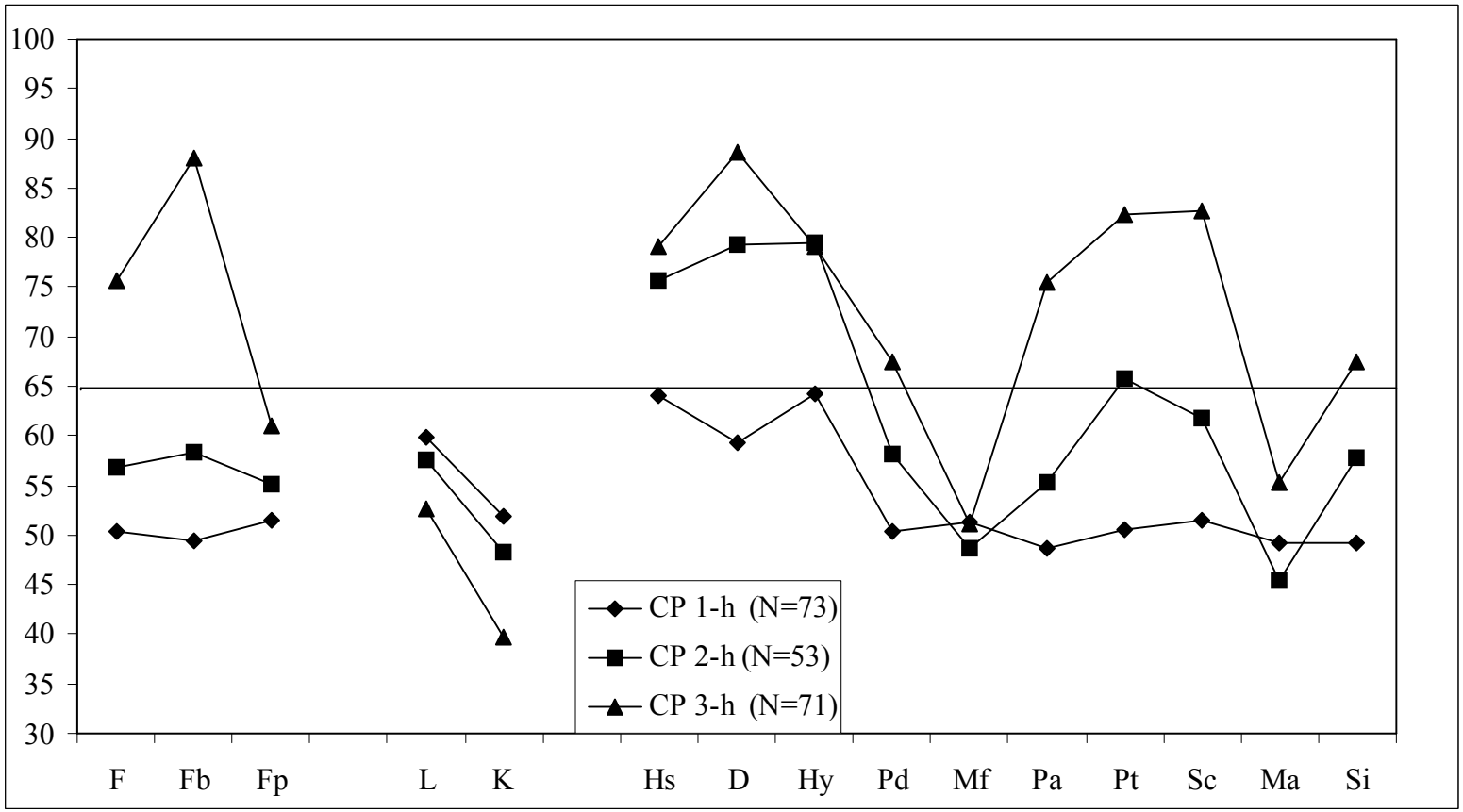

Figure 4.2 Mean Validity and Clinical Scale T-scores by Hierarchical Cluster Group

A slight clinical elevation of the Pt scale (65.70) was also evident. There were 53 individuals (27%) in this cluster. This profile was interpreted as a High Distress / Low Disturbance group. All other validity and clinical scale means were below the MMPI-2 cutoff of 65.

4.4.3 Hierarchical Cluster 3. Cluster 3 reflects high levels of intrapersonal distress and psychological disturbance, with elevations on eight of the ten clinical scales. This group consisted of 71 (36%) individuals and reflected a High Distress / High Disturbance profile. Highest scales were D (88.58), followed by Sc (82.66), Pt (82.28), Hy (79.11), Hs (78.99), Pa (75.41), Pd (67.42), and Si (67.49). All other clinical scale means were below the clinical cutoff.

4.5 Comparison of Hierarchical Clusters with Previous Pain Studies

The hierarchical clustering procedure used in this study classified three MMPI-2 subgroups. The three profiles were within normal limits, a neurotic triad group (high elevations of distress), and a general elevation profile (high levels of distress and disturbance). A conversion-V profile, however, was not found.

The findings in this mixed sample of forensic chronic pain patients appear to replicate the findings of Keller and Butcher's (1991) mixed pain group. Graphic representations of the mean scores of the aforementioned clusters, compared to Keller and Butcher's findings, are presented in Figures 4.4, 4.5, and 4.6, respectively. Correlations between cluster profiles are also presented.

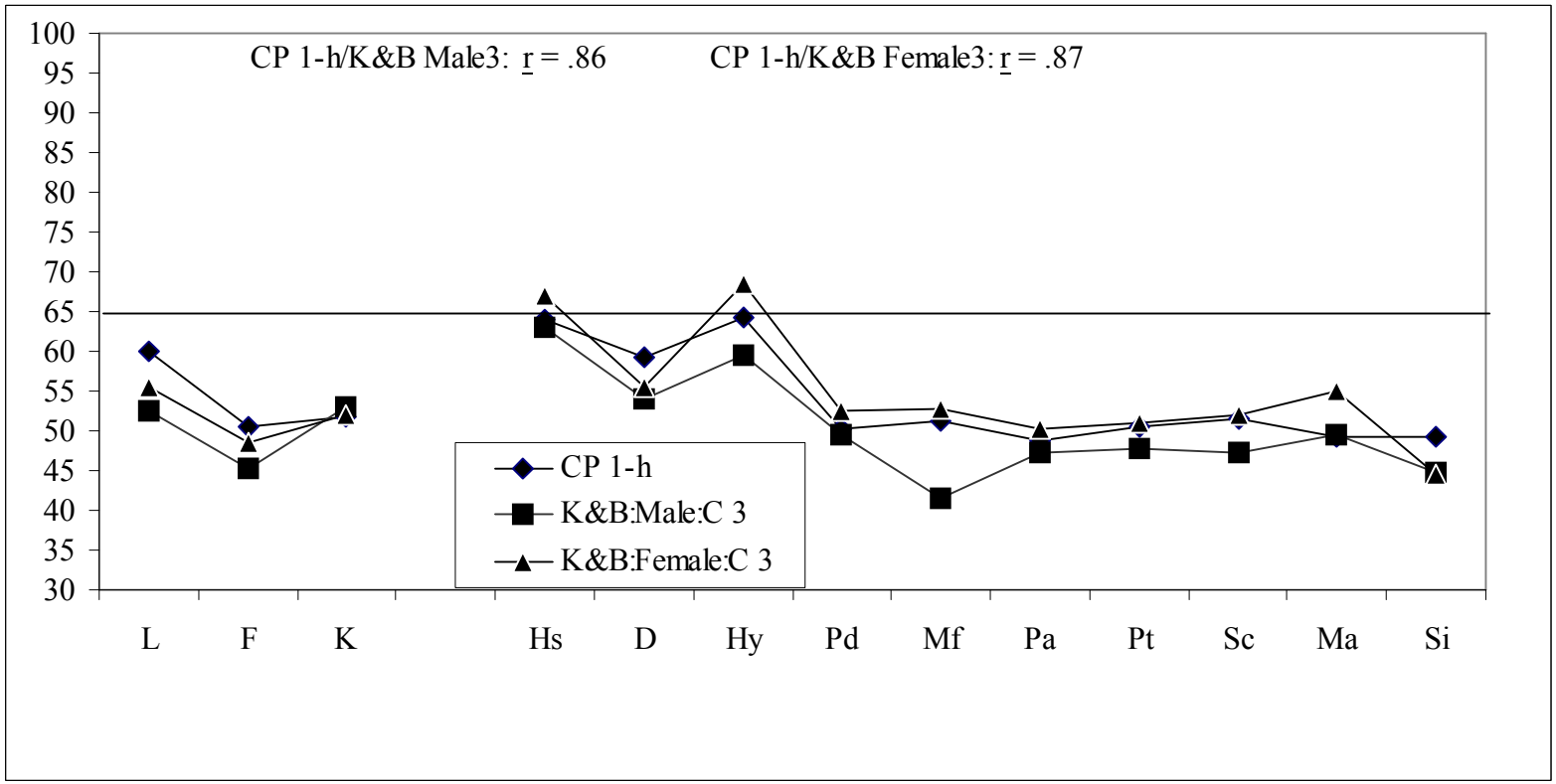

Figure 4.3 Mean Scores for the Within Normal Limits Profiles

Note: Whilst Keller & Butcher's Female Cluster 3 best matches CP cluster 1, it is actually a low conversion-V profile with slight clinical elevations of the Hypochondriasis (66.9), and Hysteria (68.5) scales

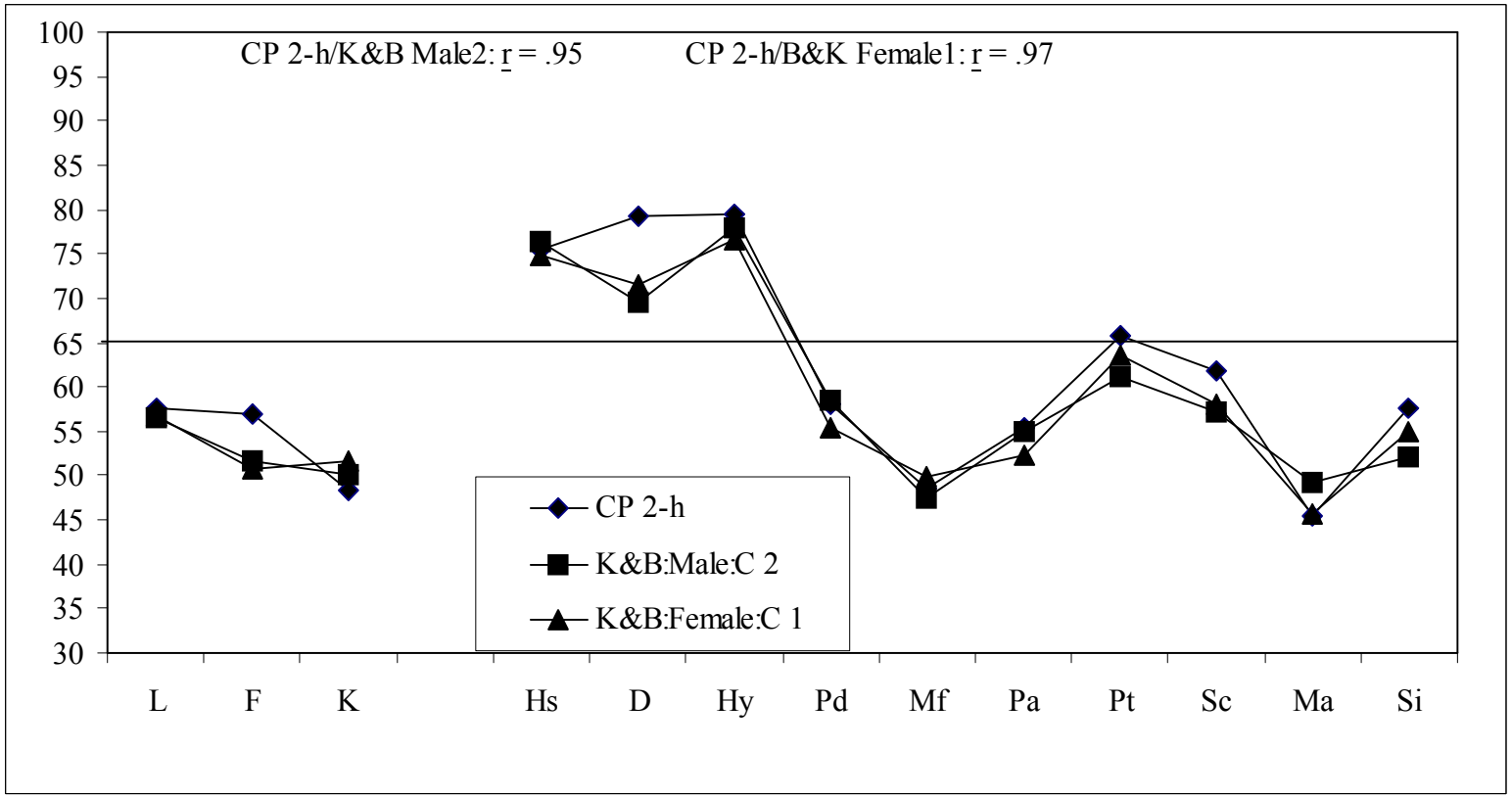

Figure 4.4 Mean Score for the High Distress / Low Disturbance Profiles

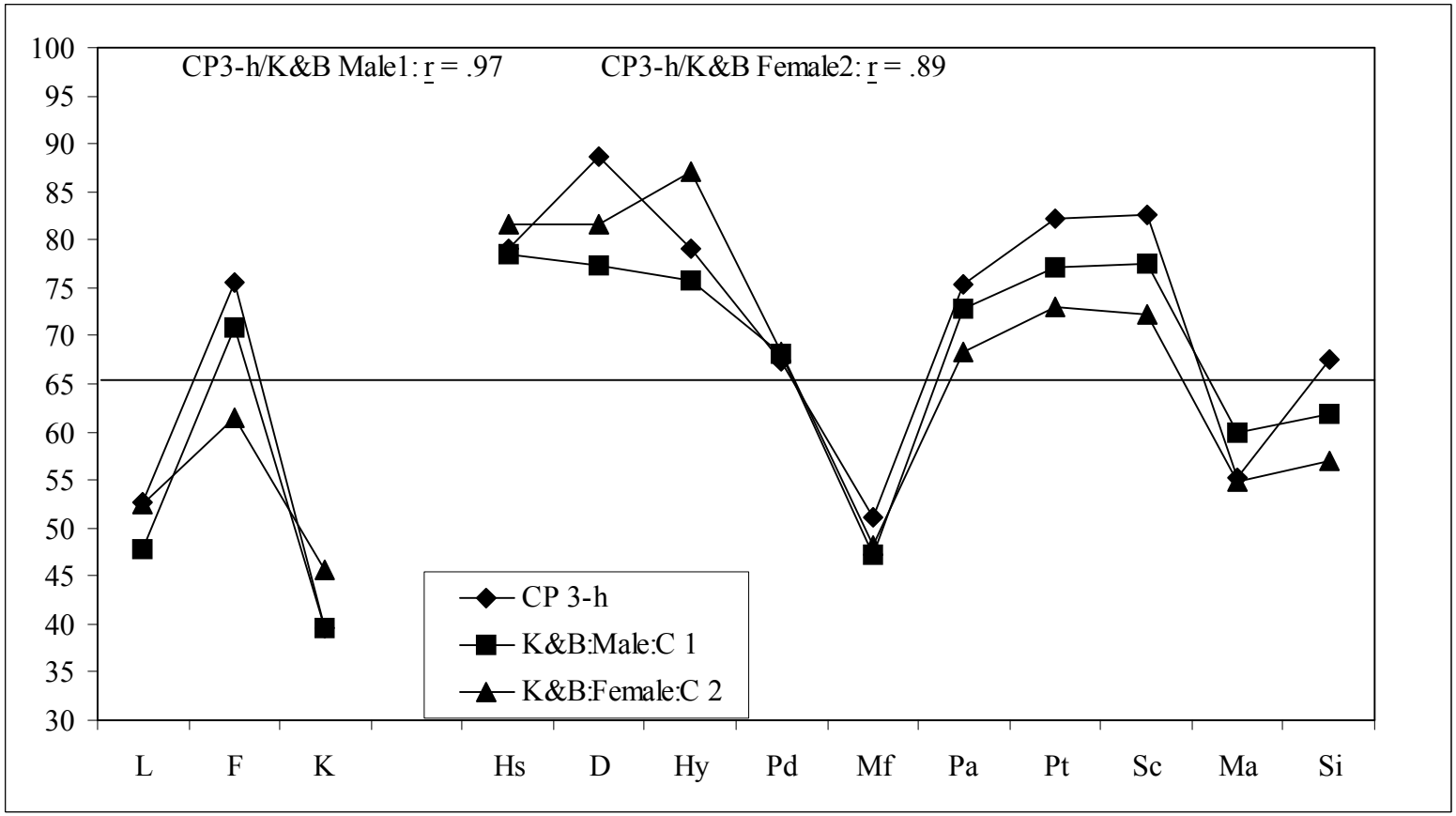

Figure 4.5 Mean Scores for the High Distress / High Disturbance Profiles

4.6 Comparison of Clusters with Previous Research on Low Back Pain Samples

Previous MMPI-2 cluster analytic research (de Beus, 1997; Riley et al., 1993; Riley & Robinson, 1998) conducted on samples of chronic low back pain patients (CLBP) consistently found four profiles (general elevation, neurotic triad, conversion-V, and within normal limits). In general, these findings appear to correspond to the MMPI four cluster P-A-I-N typology found by Costello et al. (1987). The three mixed pain group profiles found in this study appear to replicate clusters found in previous MMPI/MMPI-2 CLBP research. The conversion-V profile, however, was not found in this study. Graphic representations of the mean scores of the aforementioned clusters, compared to Riley et al. (1993), and Riley and Robinson's (1998) studies, are presented in Figures 4.7, 4.8, and 4.9, respectively. Correlations between cluster profiles reveal a high degree of similarity. Graphic comparison with deBeus's (1997) clusters was not possible, as this author presents no descriptive data. Visual inspection of the graphs presented in the aforementioned study, however, estimated clusters that appear to be very similar to the clusters found in this study.

4.7 k-means Cluster Analysis

As discussed in Chapter 2, while hierarchical analysis is useful for determining the number of clusters, k-means analysis is particularly well suited to determine cluster membership. In performing this analysis, the clustering algorithm was allowed to form clusters based on the inherent structure of the data through randomly selected initial seed points. Rather than being influenced by the centroids generated from the initial hierarchical analysis, this approach permits a modicum of independence between the two procedures. Descriptive statistics are presented for each k-means cluster in Table 4.3.

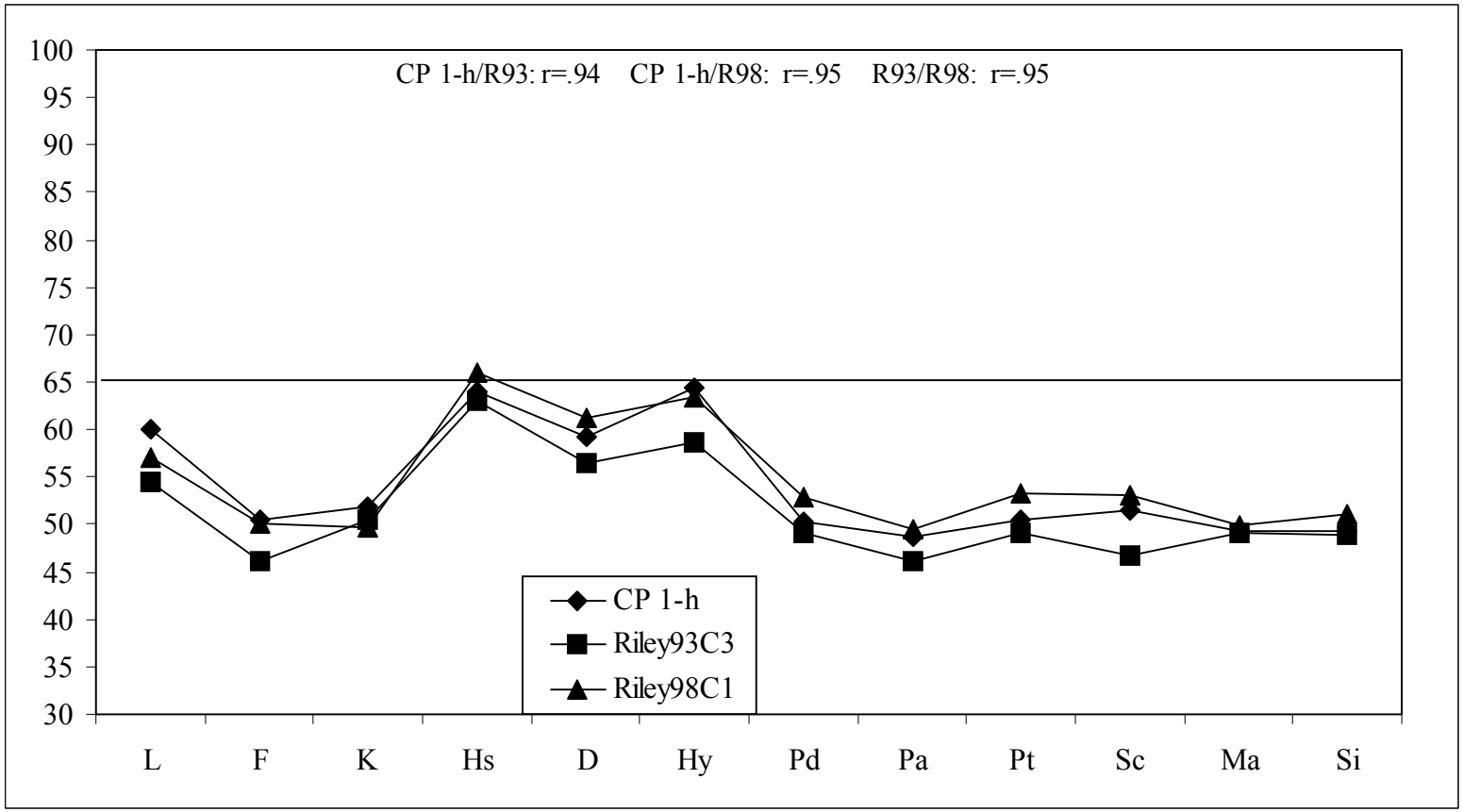

Figure 4.6 Mean Scores for the Within Normal Limits Profiles.

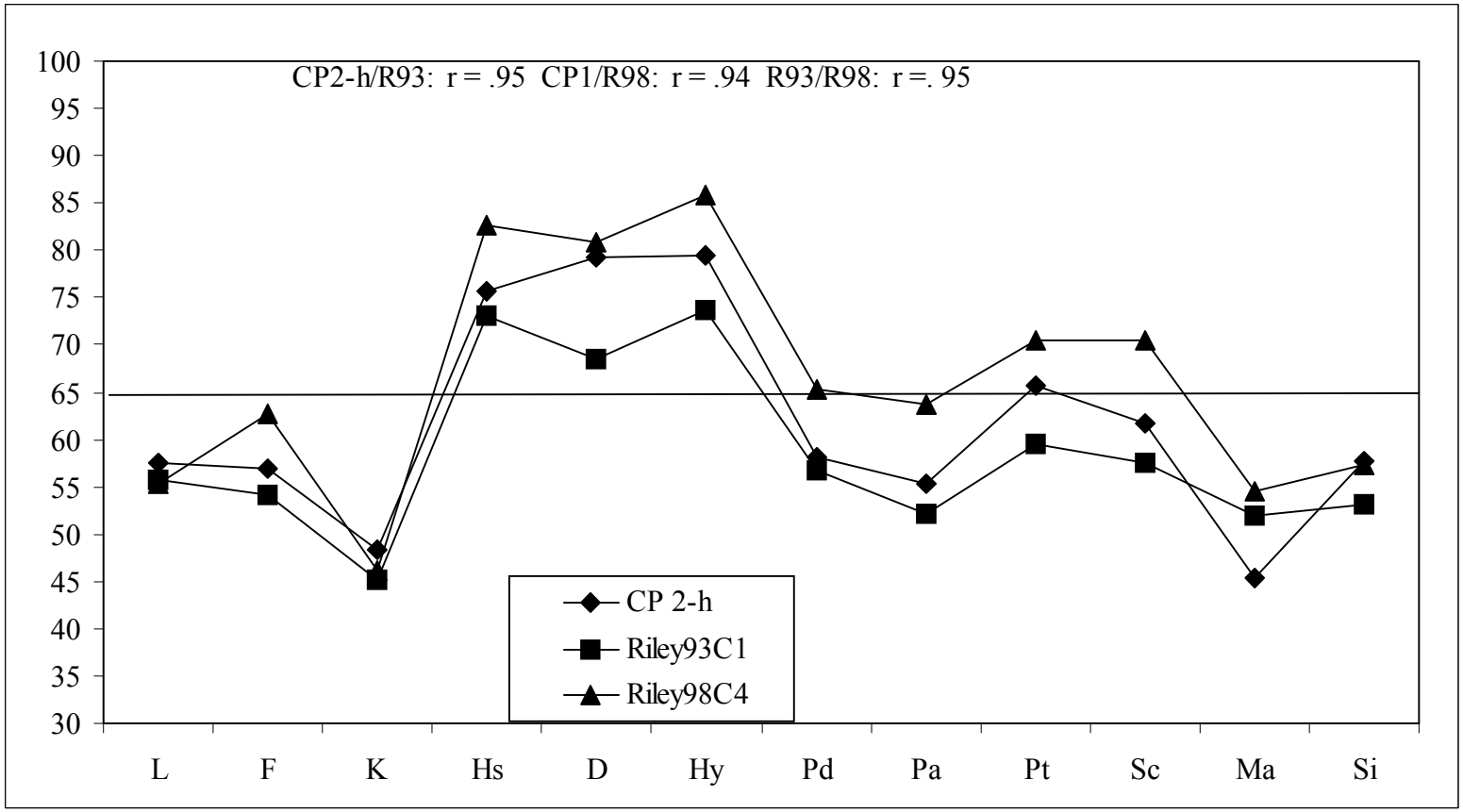

Figure 4.7 Mean Scores for the High Distress / Low Disturbance Profiles

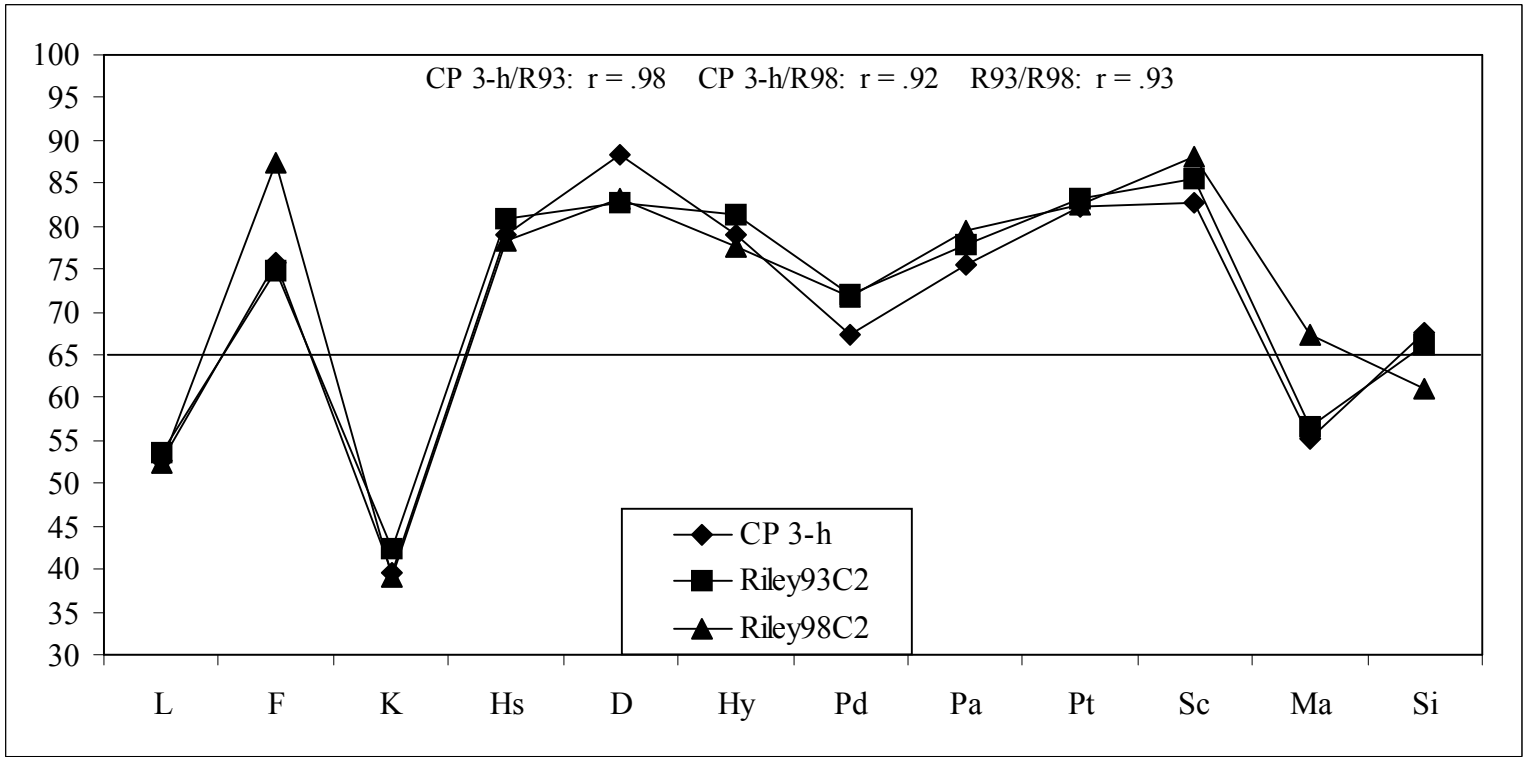

Figure 4.8 Mean Scores for the High Distress / High Disturbance Profiles

Whilst relatively stable cluster solutions appear to have been generated by different cluster analytic methodology, correlational analysis of the k-means clusters generated in this study indicates that they were formed along the dimensions of profile shape and profile magnitude. Correlations between the clusters are presented in Table 4 4. Cluster 1 appears to be separated from Cluster 2 ($r = .93$, $p<.01$) on the basis of profile magnitude, and Cluster 1 from Cluster 3 ($r = .54$, $p>.01$) on the basis of shape. Similarly, Clusters 2 and 3 ($r = .78$, $p<.01$) appear to be separated on the basis of profile magnitude.

Table 4.3

Mean Clinical Scale Scores for the k-means (k) Cluster Solutions

	CP k1		CP k2		CP k3	
N =	67		57		73	
	M	SD	M	SD	M	SD
Scales						
Hs	61.78	10.47	76.26	8.46	79.52	9.44
D	59.19	9.26	76.54	9.13	88.78	9.02
Hy	61.52	11.68	80.18	10.34	79.90	12.50
Pd	50.24	8.66	57.61	9.13	66.99	11.25
Mf	50.18	10.85	49.46	9.04	51.70	7.59
Pa	48.58	8.74	53.75	7.90	75.64	12.69
Pt	50.51	7.96	63.60	7.48	82.26	7.73
Sc	50.97	7.98	60.65	6.75	82.32	10.84
Ma	49.21	7.66	47.02	8.13	54.07	10.75
Si	49.99	7.66	55.28	8.89	67.79	10.29

Note: k = k-means cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance.

Table 4.4

Correlations between Chronic Pain k-means clusters

Cluster	CP k1	CP k2	CP k3
CP k1		.93*	.54
CP k2			.78*
CP k3			

Note: All tests two tailed. * = significant at .01.

Mean validity, clinical, and content scale scores of the three profiles, generated by k-means cluster analysis, are presented in Appendix B and C. Figures 4.9 and 4.10 graphically depict the three k-means clusters. The following section presents a discussion of the clinical and content scale characteristics of each k-means cluster.

4.7.1 k-means Cluster 1. None of the validity or clinical scale or clinical subscale means were elevated above the MMPI-2 cutoff of 65 in this cluster group. The highest scale was Hs (61.78), followed by, Hy (61.52).This cluster is described as a Within Normal Limits (WNL) profile, and consisted of 67 individuals (34%).

Examination of the percentage of cases that generated T-scores of 65 or greater produced significantly different base rates than those for the normative sample on one of the validity scales, three of the clinical scales, and eight of the clinical subscales. For example, 50% of the individuals in the cluster recorded clinical elevations on clinical scales Hs, and Hy, whilst 25% of the subgroup elevated scale D.

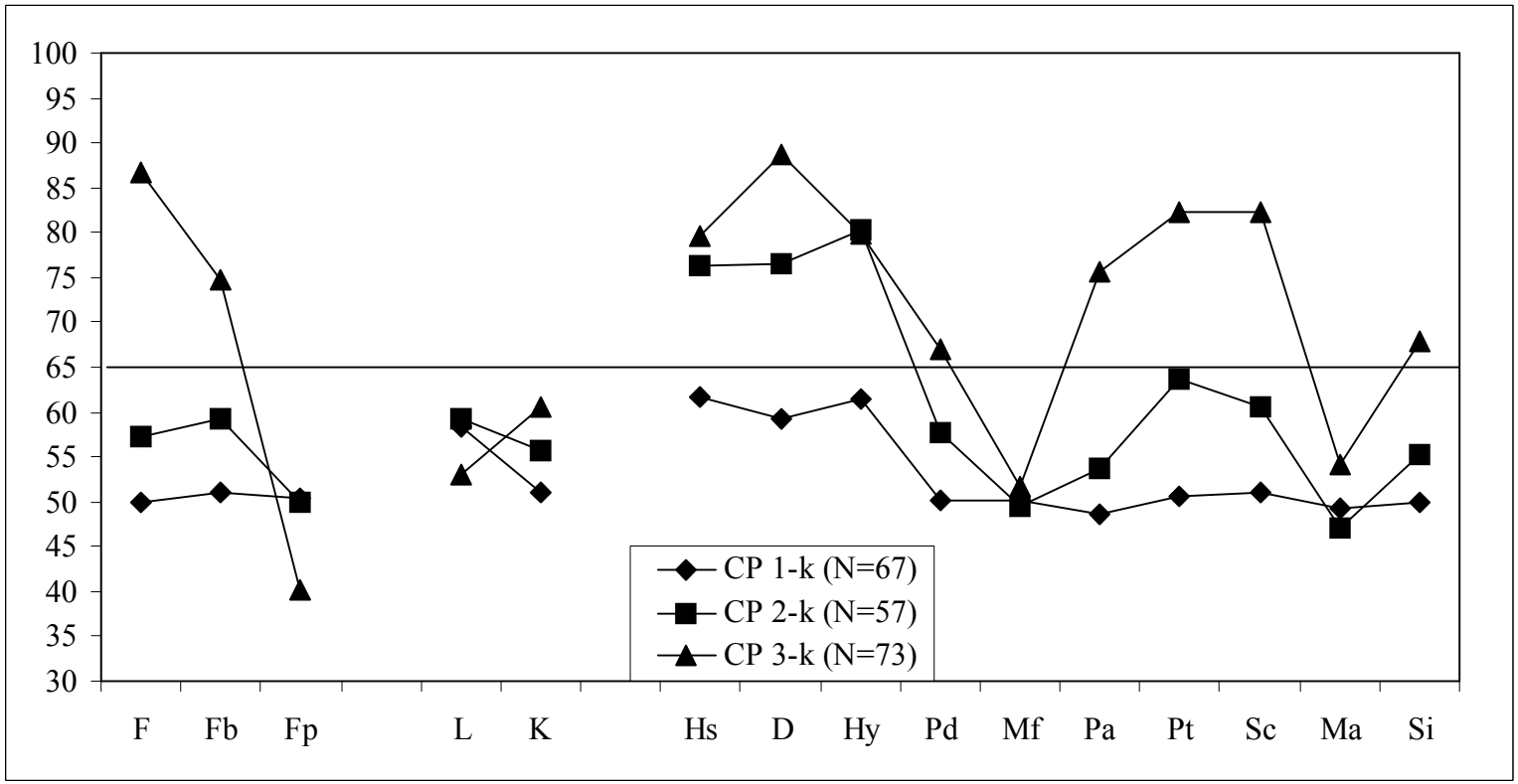

Figure 4.9 Mean Validity and Clinical Scale T-Scores by K-means Cluster Group

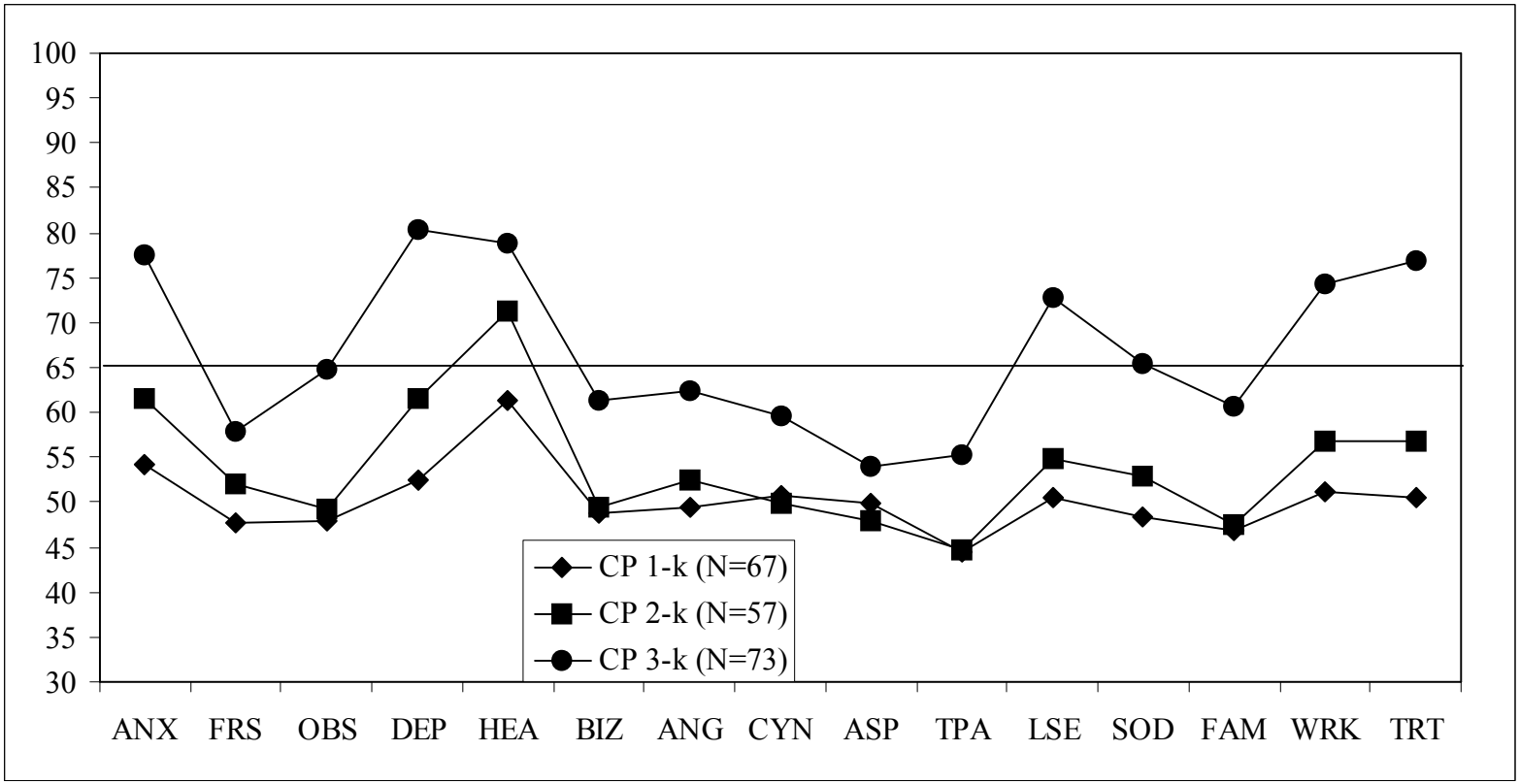

Figure 4.10 Mean Content Scale T-Scores by K-Means Cluster Group

This strongly highlights the limitations of describing individuals, based upon group mean data. Scales with significantly different base rates of elevated scores to the normative sample are highlighted in Table 4.5.

Examination of the Cluster 1 mean content scales revealed no mean clinical elevations, with the highest score being the HEA scale (61.33). Subsequent examination of the content subscales also revealed no mean clinical elevations, with the highest subscale being HEA3 (64.63). Closer scrutiny of the Cluster 1 content scales and their respective subscales, however, revealed that a number of cluster members did in fact elevate one of the content scales and six of the content subscales scales above the 65 cutoff point. Content scales and subscales with significantly different base rates of elevated scores are highlighted in Table 4.6.

Although this cluster was described as a WNL cluster, clearly there are a relatively high percentage of individuals that display clinical elevations on several scales. The significantly different base rates found in this cluster indicate that some individuals exhibit high degree of concern about their physical health. These individuals appear to be reporting a number of somatic, neurological, and general health complaints. It was further noted that 25% of participants also elevated scale D. The majority of these individuals elevated subscale D1, D3 & D4, indicating that they are generally apathetic, have difficulty attending and concentrating, and are concerned with their poor health. Whilst scale Sc was not elevated, a significant percentage of individuals elevated subscales Sc3, Sc4, and Sc6. As these subscales share an ego mastery component, these people appear to be experiencing problems with reasoning rather than with affect.

Table 4.5

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means CP Cluster 1 (n = 67)

Scale		n	Mean	SD	% of cases 65 or above
L		**24**	**58.37**	**11.00**	**36**
F		7	49.93	8.28	10
Fb		6	50.99	9.24	7
Fp			50.28	10.37	12
K		8	51.10	9.67	9
Hs		**34**	**61.78**	**10.47**	**50**
D		**17**	**59.19**	**9.26**	**25**
	D1	**12**	**55.82**	**9.20**	**18**
	D2	4	53.34	9.09	6
	D3	**23**	**59.31**	**11.70**	**34**
	D4	**17**	**57.00**	**11.55**	**25**
	D5	7	52.13	9.54	10
Hy		**34**	**61.52**	**11.68**	**50**
	Hy 1	0	53.18	8.61	0
	Hy2	5	49.16	10.40	7
	Hy3	**27**	**61.91**	**10.86**	**40**
	Hy4	**20**	**58.30**	**9.16**	**30**
	Hy5	5	50.69	10.84	7
Pd		5	50.24	8.66	7
	Pd1	6	49.18	8.61	8
	Pd2	6	51.55	8.76	8
	Pd3	5	53.27	8.77	7
	Pd4	7	50.28	9.69	10
	Pd5	4	49.31	9.86	6
Mf		8	50.18	10.85	11
Pa		2	48.58	8.74	3
	Pa1	5	51.22	9.82	7
	Pa2	2	47.75	9.26	3
	Pa3	5	48.76	9.49	7
Pt		4	50.51	7.96	6
Sc		5	50.97	7.98	7
	Sc1	5	48.06	10.21	7
	Sc2	5	49.27	8.93	7
	Sc3	**13**	**53.10**	**11.82**	**19**
	Sc4	**10**	**51.88**	**10.19**	**15**
	Sc5	8	50.54	9.45	12
	Sc6	**12**	**54.57**	**10.10**	**18**
Ma		3	49.21	9.11	4
	Ma1	4	49.94	9.00	6
	Ma2	3	47.73	9.84	4
	Ma3	**12**	**53.67**	**9.92**	**18**
	Ma4	4	48.67	10.52	6
Si		2	49.99	7.66	3
	Si1	4	47.76	8.75	6
	Si2	7	50.34	9.05	10
	Si3	6	49.87	10.59	9

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

Table 4.6

Percentage of elevations of Content Scale and Subscale Scores for k-means elevations of CP Cluster 1 (n = 67)

Scale		n	Mean	SD	% of cases 65 or above
ANX		6	54.28	8.21	9
FRS		5	47.64	9.71	7
	FRS1	4	48.79	8.37	6
	FRS2	3	44.73	10.72	4
OBS		6	47.85	10.55	9
DEP		8	52.48	9.09	12
	DEP1	**11**	**53.32**	**10.67**	**16**
	DEP2	**9**	**52.91**	**9.84**	**13**
	DEP3	6	51.04	10.45	9
	DEP4	1	49.25	7.93	1
HEA		**24**	**61.33**	**7.10**	**36**
	HEA1	4	50.24	9.10	6
	HEA2	**19**	**58.58**	**12.01**	**28**
	HEA3	**29**	**64.63**	**12.32**	**43**
BIZ		2	48.70	8.43	3
	BIZ1	7	49.58	9.13	10
	BIZ2	3	46.54	8.91	4
ANG		5	49.37	10.91	7
	ANG1	3	48.10	9.58	4
	ANG2	**9**	**50.69**	**10.36**	**13**
CYN		7	50.79	10.31	10
	CYN1	**9**	**51.06**	**10.50**	**13**
	CYN2	4	49.00	9.56	6
ASP		8	49.78	10.45	12
	ASP1	6	49.75	10.31	9
	ASP2	3	47.87	8.32	4
TPA		2	44.42	9.71	3
	TPA1	0	45.72	8.90	0
	TPA2	1	40.04	8.91	1
LSE		5	50.51	9.70	7
	LSE1	3	49.46	9.62	4
	LSE2	3	48.34	9.23	4
SOD		4	48.42	8.75	6
	SOD1	3	48.82	7.96	4
	SOD2	6	47.88	9.71	9
FAM		2	46.76	8.48	3
	FAM1	5	45.88	10.47	7
	FAM2	7	50.31	10.27	10
WRK		6	51.13	9.30	9
TRT		4	50.63	9.49	6
	TRT1	7	50.91	9.72	10
	TRT2	3	47.09	8.61	4

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

Thirty six percent of individuals elevated scale HEA and its subscales Hea2 (28%), and HEA3 (43%). As content scales ANX and DEP were not elevated, these individuals do not appear to be experiencing a great deal of negative affect as a result of their health concerns. Those scales and subscales which were elevated in 25% or more of the sample related predominantly to physical symptoms and health concerns: HEA (36%), HEA2 (28%), HEA3 (43%), Hs (50%), Hy (50), Hy4 (30%), Hy3 (40%), D3 (35%), and attention and concentration difficulties: D4 (25%), D (25%).

Whilst all of these individuals form part of the WNL group, their health concerns are something one could reasonably expect to find in a group of individuals with chronic pain. Treatment-wise, however, these people may still require conservative interventions (e.g., adjustment to injury counselling) to reassure them about their symptoms.

4.7.2 k-Means Cluster 2. The second cluster reflects high levels of intrapersonal distress, and relatively low levels of psychological disturbance, evidenced by clinical elevations on the three scales of the neurotic triad. There were 57 individuals (29%) in this cluster. This profile was interpreted as a High Distress / Low Disturbance group. The highest scale was Hy (80.18), followed by D (76.54), and Hs (76.26). All other validity and clinical scales were below the MMPI-2 cutoff of 65. An examination of the clinical subscales also revealed several elevations. The highest clinical subscale was Hy3 (81.98), followed by D1 (72.49), D4 (71.60), D3 (71.32), and Hy4 (71.26). All other subscales fell within normal limits.

Subsequent examination of the Cluster 2 content and content subscale scores revealed a clinical elevation on scale HEA (71.33), together with elevations on subscales HEA2 (70.12), and HEA3 (74.60). A slight clinical elevation was also

evident for content subscale DEP2 (65.19). All other content scales and subscales fell within normal limits.

While only eight of the forty-six clinical and validity scales and subscales exceeded a mean of 65, twenty nine scales (71%) produced significantly different base rates than their normative counterparts. Similarly, whilst four of the forty-two content scales and subscales had means that were clinically elevated, twenty-three (55%) of the scales displayed significantly different base rates of elevations (see Tables 4.7 and 4.8 for scales with significantly different base rates of elevations).

Examination of the percentage of individuals with clinical elevations (Hs - 89%; Hy - 92%) on each scale revealed the majority of individuals in this cluster appear to exhibit concern about their physical health. These people appear to report a variety of somatic complaints, something to be expected in a chronic pain condition. It was further noted that a similar percentage (91%) of participants also elevated the scale D. These individuals elevated subscales D1, D2, D3, D4, and D5, indicating that they are generally depressed and anxious, are apathetic, and are concerned with their poor health. They also appear to be reporting a number of somatic, neurological, and general health complaints, with the proportion of individuals who display these concerns being approximately twice that found in Cluster 1.

For almost half of the individuals in this cluster, their chronic pain condition appears to negatively impact on their ability to carry out their workplace responsibilities (WRK; 44% elevated). As a group, these individuals appear to be experiencing a high degree of negative affect as a result of their health problems. Treatment for approximately one third of the individuals (i.e., TRT1>65) may be somewhat problematic, because of their lack of self-confidence, and low motivation.

Table 4.7

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means CP Cluster 2 (n = 57)

Scale		n	Mean	SD	% of cases 65 or above
L		**16**	**59.18**	**10.60**	**28**
F		**9**	**57.19**	**13.05**	**16**
Fb		**14**	**59.18**	**10.02**	**25**
Fp		**8**	**50.04**	**11.61**	**14**
K		6	55.67	11.33	11
Hs		**51**	**76.26**	**8.46**	**89**
D		**52**	**76.54**	**9.13**	**91**
	D1	**46**	**72.49**	**10.66**	**81**
	D2	**20**	**60.19**	**9.90**	**35**
	D3	**43**	**71.32**	**9.16**	**75**
	D4	**43**	**71.60**	**11.26**	**75**
	D5	**23**	**62.17**	**11.33**	**40**
Hy		**53**	**80.18**	**10.34**	**92**
	Hy 1	0	51.84	8.36	0
	Hy2	6	52.97	11.05	11
	Hy3	**54**	**81.98**	**9.58**	**95**
	Hy4	**43**	**71.26**	**11.74**	**75**
	Hy5	3	49.44	9.63	5
Pd		**13**	**57.61**	**9.13**	**23**
	Pd1	**11**	**51.82**	**10.96**	**19**
	Pd2	**9**	**52.84**	**10.96**	**16**
	Pd3	2	50.91	9.80	3
	Pd4	6	52.60	9.29	11
	Pd5	**17**	**57.46**	**11.36**	**30**
Mf		5	49.46	9.04	9
Pa		2	53.75	7.90	3
	Pa1	3	51.18	8.13	5
	Pa2	5	51.09	10.19	9
	Pa3	**11**	**51.19**	**10.42**	**19**
Pt		**24**	**63.60**	**7.48**	**42**
Sc		**17**	**60.65**	**6.75**	**30**
	Sc1	3	49.33	9.13	5
	Sc2	**17**	**59.26**	**11.25**	**30**
	Sc3	**22**	**61.11**	**12.20**	**39**
	Sc4	**27**	**62.82**	**10.44**	**47**
	Sc5	4	52.07	9.22	7
	Sc6	**24**	**63.16**	**12.74**	**42**
Ma		1	47.02	8.13	2
	Ma1	5	48.39	9.69	9
	Ma2	2	45.89	9.57	3
	Ma3	6	50.84	11.31	11
	Ma4	2	46.30	10.35	3
Si		**9**	**55.28**	**8.89**	**16**
	Si1	**9**	**51.09**	**9.45**	**16**
	Si2	**8**	**54.12**	**8.71**	**14**
	Si3	**9**	**51.95**	**10.51**	**16**

Note. Cluster 2 = High Distress / Low Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

Table 4.8

Percentage of elevations of Content Scale and Sub-Scale Scores for k-means CP Cluster 2 (n = 57)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**27**	**61.44**	**10.80**	**47**
FRS		**8**	**52.14**	**10.49**	**14**
	FRS1	7	52.49	11.26	12
	FRS2	7	49.09	11.21	12
OBS		5	49.28	11.19	9
DEP		**24**	**61.49**	**10.05**	**42**
	DEP1	**22**	**63.12**	**12.39**	**39**
	DEP2	**28**	**65.19**	**14.53**	**49**
	DEP3	**11**	**57.30**	**8.58**	**19**
	DEP4	**13**	**56.88**	**18.90**	**23**
HEA		**42**	**71.33**	**9.21**	**74**
	HEA1	**15**	**58.32**	**13.70**	**26**
	HEA2	**37**	**70.12**	**17.15**	**65**
	HEA3	**47**	**74.60**	**9.64**	**82**
BIZ		4	49.42	9.82	7
	BIZ1	7	48.77	9.44	12
	BIZ2	6	48.30	9.32	11
ANG		**10**	**52.56**	**12.23**	**18**
	ANG1	**8**	**50.47**	**12.18**	**14**
	ANG2	**14**	**53.49**	**11.18**	**25**
CYN		**8**	**49.79**	**10.76**	**14**
	CYN1	7	49.60	11.29	12
	CYN2	3	48.58	9.76	5
ASP		1	47.93	10.33	2
	ASP1	2	46.54	9.91	4
	ASP2	**9**	**50.91**	**11.78**	**16**
TPA		1	44.68	9.57	2
	TPA1	0	48.42	9.66	0
	TPA2	0	39.74	8.89	0
LSE		**12**	**54.84**	**10.73**	**21**
	LSE1	**12**	**55.49**	**10.51**	**21**
	LSE2	4	47.89	8.57	7
SOD		7	53.00	9.46	12
	SOD1	**8**	**53.58**	**9.35**	**14**
	SOD2	**9**	**50.70**	**10.38**	**16**
FAM		2	47.58	9.82	4
	FAM1	2	46.63	10.15	4
	FAM2	7	48.30	9.86	12
WRK		**14**	**56.84**	**9.86**	**44**
TRT		**11**	**56.75**	**11.17**	**19**
	TRT1	**19**	**58.33**	**12.58**	**33**
	TRT2	5	49.61	10.13	9

Note. Cluster 2 = High Distress / Low Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

4.7.3 k-means Cluster 3. Cluster 3 reflects high levels of interpersonal distress and psychological disturbance, with elevations on eight of the ten clinical scales. This group consisted of 73 (37%) individuals. This profile was interpreted as a High Distress / High Disturbance subgroup. The highest mean clinical scale elevation was on scale D (88.78), followed by Sc (82.32), Pt (82.26), Hs (79.90), Hy (79.52), Pa (75.64), Pd (66.99), and Si (67.79). Scales Ma and Mf were not elevated. Many elevations were also evident on the clinical subscales [D1 (89.78), D2 (66.86), D3 (77.75), D4 (91.07), D5 (79.73), Hy3 (91.23), Hy4 (81.37), Pd4 (71.89), Pd5 (71.51), Pa1 (75.03), Pa2 (66.96), Sc1 (71.67), Sc2 (82.66), Sc3 (82.47), Sc4 (85.89), Sc5 (67.08), Sc6 (79.84), Si3 (67.08)].

The Cluster 3 content scales revealed clinical elevations for scales ANX (77.43), DEP (80.41), HEA (78.93), LSE (72.77), SOD (65.42), WRK (74.33), and TRT (76.90). Similarly, many elevations were also evident for the content subscales [DEP1 (85.74), DEP2 (80.55), DEP3 (70.32), DEP4 (83.62), HEA1 (67.18), HEA2 (81.49), HEA3 (77.42), LSE1 (72.88), and TRT1 (81.93)].

Thirty-two (78%) of the forty-one clinical and validity scales and subscales produced significantly higher base rates than the standardisation sample. Similarly, thirty-nine (93%) of the forty-two content scales and subscales displayed significantly different base rates of elevations (see Tables 4.9 and 4.10).

The numerous clinical elevations in this cluster suggest that these individuals are experiencing a great deal of distress and dysfunction in their lives. The pattern of scores on the scales of the neurotic triad is similar to that of Cluster 2, but of a higher magnitude. These individuals appear to be experiencing a high degree of negative affect.

Table 4.9

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means CP Cluster 3 (n = 73)

Scale		n	Mean	SD	% of cases 65 or above
L		**10**	**53.10**	**8.72**	**14**
F		**53**	**86.78**	**18.06**	**73**
Fb		**64**	**74.66**	**15.49**	**88**
Fp		**26**	**40.21**	**7.78**	**36**
K		0	60.60	12.49	0
Hs		**70**	**79.52**	**9.44**	**96**
D		**72**	**88.78**	**9.02**	**99**
	D1	**73**	**89.78**	**8.53**	**100**
	D2	**46**	**66.86**	**10.90**	**63**
	D3	**61**	**77.75**	**11.95**	**83**
	D4	**73**	**91.07**	**9.43**	**100**
	D5	**68**	**79.73**	**8.54**	**93**
Hy		**64**	**79.90**	**12.50**	**88**
	Hy 1	0	42.29	9.18	0
	Hy2	0	43.49	9.81	0
	Hy3	**72**	**91.23**	**9.32**	**99**
	Hy4	**66**	**81.37**	**13.01**	**90**
	Hy5	0	44.86	8.76	0
Pd		**38**	**66.99**	**11.25**	**52**
	Pd1	**30**	**60.34**	**13.88**	**41**
	Pd2	5	49.58	10.46	7
	Pd3	0	42.99	8.93	0
	Pd4	**51**	**71.89**	**11.44**	**70**
	Pd5	**58**	**71.51**	**7.85**	**79**
Mf		4	51.70	7.59	5
Pa		**61**	**75.64**	**12.69**	**84**
	Pa1	**48**	**75.03**	**20.17**	**66**
	Pa2	**44**	**66.96**	**9.72**	**60**
	Pa3	**10**	**47.26**	**11.66**	**14**
Pt		**73**	**82.26**	**7.73**	**100**
Sc		**72**	**83.32**	**10.84**	**99**
	Sc1	**51**	**71.67**	**12.13**	**70**
	Sc2	**61**	**82.66**	**16.03**	**84**
	Sc3	**68**	**82.47**	**12.48**	**93**
	Sc4	**71**	**85.89**	**10.46**	**97**
	Sc5	**45**	**67.08**	**11.93**	**62**
	Sc6	**55**	**79.84**	**16.78**	**75**
Ma		**15**	**54.07**	**10.75**	**21**
	Ma1	9	52.33	9.54	12
	Ma2	6	52.33	9.71	8
	Ma3	1	43.63	8.79	1
	Ma4	**13**	**53.64**	**12.04**	**18**
Si		**44**	**67.79**	**10.29**	**60**
	Si1	**32**	**60.81**	**9.35**	**44**
	Si2	**39**	**60.60**	**11.78**	**53**
	Si3	**48**	**67.08**	**8.53**	**66**

Note. Cluster 3 = High Distress / High Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

Table 4.10

Percentage of elevations of Content Scale and Sub-Scale Scores for k-means CP Cluster 3 (n = 73)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**69**	**77.43**	**7.40**	**95**
FRS		**24**	**57.88**	**14.59**	**33**
	FRS1	**29**	**64.41**	**19.83**	**40**
	FRS2	**10**	**49.66**	**11.42**	**14**
OBS		**41**	**64.82**	**10.30**	**56**
DEP		**71**	**80.41**	**8.34**	**98**
	DEP1	**72**	**85.74**	**10.35**	**99**
	DEP2	**69**	**80.55**	**8.81**	**94**
	DEP3	**53**	**70.32**	**8.73**	**73**
	DEP4	**44**	**83.62**	**27.60**	**60**
HEA		**69**	**78.93**	**9.00**	**95**
	HEA1	**34**	**67.18**	**16.66**	**47**
	HEA2	**63**	**81.49**	**15.42**	**86**
	HEA3	**65**	**77.42**	**9.26**	**89**
BIZ		**24**	**61.22**	**12.74**	**33**
	BIZ1	**28**	**62.18**	**20.49**	**38**
	BIZ2	**28**	**61.18**	**13.40**	**38**
ANG		**31**	**62.33**	**11.06**	**42**
	ANG1	**21**	**58.05**	**12.10**	**29**
	ANG2	**41**	**62.78**	**8.28**	**56**
CYN		**30**	**59.51**	**12.57**	**41**
	CYN1	**25**	**56.95**	**11.42**	**34**
	CYN2	**19**	**57.95**	**9.01**	**26**
ASP		**12**	**53.90**	**11.15**	**16**
	ASP1	6	53.36	10.58	8
	ASP2	8	50.85	9.79	11
TPA		**13**	**55.19**	**10.97**	**18**
	TPA1	**13**	**58.43**	**8.45**	**18**
	TPA2	7	47.38	10.89	10
LSE		**55**	**72.77**	**11.60**	**75**
	LSE1	**52**	**72.88**	**11.41**	**71**
	LSE2	**30**	**60.05**	**12.56**	**41**
SOD		**43**	**65.42**	**13.27**	**59**
	SOD1	**40**	**64.81**	**12.42**	**55**
	SOD2	**26**	**58.38**	**9.93**	**36**
FAM		**27**	**60.73**	**13.63**	**37**
	FAM1	**26**	**58.23**	**13.64**	**36**
	FAM2	**20**	**55.90**	**13.04**	**27**
WRK		**64**	**74.33**	**8.56**	**88**
TRT		**63**	**76.90**	**11.07**	**86**
	TRT1	**67**	**81.93**	**13.22**	**92**
	TRT2	**22**	**58.60**	**9.62**	**30**

Note. Cluster 3 = High Distress / High Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

The Depression clinical and content subscales were elevated by greater than 60% of the participants. This indicates that they are generally depressed, lack energy to cope with their problems, display apathy, and are concerned with their poor health. A similarly high proportion of these individuals also appear to be experiencing anxiety, and to a slightly lesser degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For almost 90% of the individuals in this cluster, their chronic pain condition appears to negatively impact on their ability to carry out their workplace responsibilities. Because of the high percentage of individuals (92%) that elevated the TRT1 subscale (low motivation), treatment may a problematic issue.

4.8 General Summary and Conclusion

The results of the cluster analyses indicate that there are three MMPI-2 profiles in this sample of forensic CP patients. A high degree of consistency was found between the clusters from the medicolegal sample and those found in the published pain literature.

Overall, the three clusters generated in this study appear to reflect two general dimensions of distress and disturbance, with two clusters reproducing these difficulties in increasing magnitude. While it is clear from the results that more than one profile exists in this forensic CP sample, it is also clear that these patterns occur in individuals with a similar diagnosis in other clinical settings. They are, therefore, not unique to the medicolegal setting. It has yet to be determined whether or not these profiles are unique to chronic pain, or more representative of the types of psychological maladjustment reported by those with other conditions. The following two chapters will examine forensic Traumatic Brain Injury (TBI), and Post Traumatic

Stress Disorder (PTSD) samples, to determine whether individuals from these particular diagnostic groups exhibit distinct MMPI-2 patterns. Chapter 5 begins with an investigation of MMPI-2 subgroups in a medicolegal TBI sample.

CHAPTER 5

Cluster Analysis of a Forensic Traumatic Brain Injury Sample

5.1 Overview

Traumatic Brain Injury (TBI) is in many respects the most significant neurological disorder in society. In frequency, only stroke surpasses TBI in the number of individuals affected (Morse & Montgomery, 1992). It is therefore critical that psychologists develop expertise in recognising TBI in their clients' histories, in assessing it, and in making recommendations for strategies to address the client's cognitive, emotional, and behavioural problems.

Mooney (1988) and Miller (1986) assert that personality changes after severe head injury are usually more predictive of community reintegration than cognitive deficits. Similarly, Lezak (1987) found that individuals who suffer TBI also suffer difficulty with social readjustment. These changes, however, have seldom been the subject of empirical research (DiCesare, Parente, & Anderson-Parente, 1990).

Most of the existing research describes diminished global social functioning (e.g., Livingston, Brooks, & Bond, 1985). Other researchers report problems with depression, mood changes, anxiety, and indifference (Lezak, 1987). As these personality changes may persist and even worsen over time, more research is clearly needed. The MMPI-2 serves an integral role in the psychological evaluation of people with a TBI, because it provides clinically relevant information regarding the presence of psychiatric illness, adaptation to the injury, and potential interpersonal strengths or liabilities that may impact on the rehabilitation process.

Underlying the following analysis is the belief that people who suffer a TBI are not a homogeneous population. The complexity of this population is evident in

research that demonstrates a wide variation of scores on individual MMPI-2 scales, with T-scores that range from as low as 30 to as high as 120 (Gass, 1991). To date there appear to be no MMPI-2 cluster analytic studies reported in the TBI literature.

In Chapter 4, three MMPI-2 personality profiles were identified in a medicolegal mixed chronic pain (CP) sample. Whether these profiles are unique to the CP population remains to be established. Thus, the objective of this chapter is to derive profiles characteristic of people who have suffered a TBI. The MMPI-2 test scores of individuals suffering from a TBI, and who were litigants in personal injury compensation, were examined. As was seen in Chapter 4, the method of determining commonly occurring profiles is a relatively protracted procedure. That method is applied in the analyses presented below, but less explanation is provided to reduce redundancy and to focus on the presentation of the results of each phase of the analysis leading to profile identification.

5.2 Method

5.2.1 Subjects

Two hundred (118 males - 59%; 82 females - 41%) individual MMPI-2 profiles were collected from the archives of two medicolegal practices in Brisbane, Queensland, Australia. Each patient had been medically assessed as having sustained a TBI. All participants were in litigation at the time of the assessment.

Diagnoses and MMPI-2 raw score protocols were obtained for each patient. Cases were examined in chronological order, and all those meeting the selection criteria were included, without regard to the MMPI-2 response bias validity scales. No cases were excluded based on elevations of VRIN and TRIN responses. No cases recorded elevations > 10 on Cannot Say (no response).

Subjects were required to meet the following criteria:

- Subjects had undergone a comprehensive clinical assessment conducted by an experienced forensic psychologist
- All subjects had sustained a TBI with a recorded loss of consciousness
- No more than 10 responses were omitted from the test protocol (Greene, 2000)
- Respondents recorded T-scores of $\geq$ 80 on VRIN (inconsistent response set), and $\geq$ 80 TRIN (true/false response set) scales (Butcher et al., 1989)

Characteristics of the sample are presented in Table 5.1

Table 5.1

Characteristics of the Forensic Traumatic Brain Injury Group

Gender	Subjects	%	
Male	118	59	
Female	82	41	
Demographics	**Mean**	**SD**	**Range**
Age (years)	33.32	13.93	18 – 78
Education (years)	11.25	1.87	7 - 18

5.2.2 Measures. The MMPI-2 was administered in the standardised manner outlined in the test manual (Butcher et al., 1989). As before, scores used in the following analyses consisted of K-corrected T-Scores of the 10 Basic Scales. Scree plots, and the percentage change in the agglomeration coefficient were used to determine the optimal number of clusters.

5.2.3 Data Screening. Protocols were included in the data set if they met the same criteria set down in the previous chapter. No protocols were excluded on the basis of clinical elevations of the validity scales. The potential influence of statistical outliers was also examined using the methods outlined in Chapter 2. All cases fell within 1.88 standard deviations of the mean for the 10 clinical scales. All protocols were considered to be representative of each patient's current emotional, and psychopathological state, and were included in the following analyses.

5.2.4 Scale Base Rates. Following the final cluster analysis, the means, standard deviations, range, and percentage of elevated scales were calculated for each of the MMPI-2 Basic and Content scales and their subscales, for each k-means cluster. The standard error of proportion was calculated using the value of the population proportion (6.5% or .065) and the sample size (n = 200). The critical alpha level for significance was adjusted, using a Bonferroni correction, to $p<.001$. Scales with a frequency of elevations of 13% or above indicated a significantly different proportion in the TBI sample.

In the following analyses, determination of the number of clusters was based on the steps outlined in Chapter Two, and below.

5.3 Analysis and Results

The inverse scree plot presented in Figure 5.1 indicates a flattening of the curve at a four cluster solution (marker A). This became more pronounced at a three cluster solution (marker B). This suggested that either a three or four cluster solution would be likely.

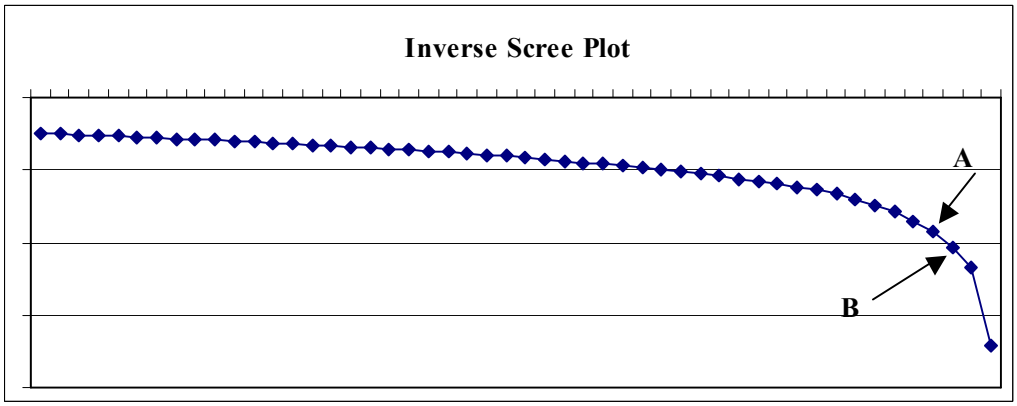

Figure 5.1 Inverse Scree Plot of the final 50 TBI Agglomeration Coefficients

The agglomeration coefficient (see Table 5.2) shows a jump in the percentage change when moving from the five to the four cluster solution, after relatively small increases. This identifies the four cluster solution as the most appropriate result.

Table 5.2

Percentage Change in the Agglomeration Coefficient for the Hierarchical Analysis

Number of Clusters	Agglomeration Coefficient	Percentage Change
8	139661.89	6.46
7	148678.36	6.64
6	158549.14	7.65
5	**170676.95**	**8.54**
4	**185247.28**	**11.14**
3	205878.59	14.04
2	234792.53	45.94
1	342646.81	-------

Group membership at the four cluster solution indicated that all clusters included greater than 5% of the sample size (n>10), and were therefore considered meaningful based on adequate group membership [Range: n = 29 (15%) to n = 68 (34%)]. Based on the scree plot and the percentage change in the agglomeration

coefficient, a four cluster solution was considered to be most appropriate for the data set. A complete table of descriptive data for the hierarchical analysis has been provided in Appendix D. Following the decision to apply a four cluster solution, a k-means cluster analysis specifying a four cluster solution was then carried out using random seeds.

5.4 k-means Cluster Analysis

Descriptive statistics for the four k-means clusters are presented in Table 5.3.

Table 5.3

Mean MMPI-2 Scores for the k-means (k) TBI Cluster Solutions

	TBI 1		TBI 2		TBI 3		TBI 4	
N =	62		54		55		29	
	M	SD	M	SD	M	SD	M	SD
Hs	59.35	9.83	61.59	8.84	80.85	6.76	77.21	11.96
D	58.95	7.87	72.93	9.37	79.24	9.85	82.41	10.80
Hy	56.32	10.07	59.07	8.83	81.15	9.47	72.69	12.17
Pd	47.18	8.62	59.13	9.13	58.53	8.46	72.14	11.57
Mf	53.18	11.57	49.76	9.12	49.53	8.11	53.69	9.82
Pa	46.18	8.54	58.17	9.32	60.60	11.08	81.45	13.58
Pt	51.92	7.29	65.19	8.53	72.38	7.42	86.31	7.42
Sc	52.55	8.02	65.72	10.46	68.96	9.21	93.86	8.75
Ma	49.48	8.97	50.26	11.12	54.49	10.57	60.38	10.21
Si	51.79	10.20	62.56	8.96	60.60	10.36	67.62	9.59

Note: k = k-means cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits. Cluster 2 = Depressed / Anxious. Cluster 3 = High Distress / High Disturbance Group 1. Cluster 4 = High Distress / High Disturbance Group 2.

Correlational analysis of the k-means clusters generated in this study indicates that they were formed along the dimension of profile shape and profile magnitude. Correlations between the cluster groups are presented in Table 5.4.

Table 5.4

Correlations between TBI k-means clusters

Cluster	TBI 1	TBI 2	TBI 3	TBI 4
TBI 1		.44	.74*	.13
TBI 2			.71*	.80*
TBI 3				.62
TBI 4				

Note: All tests two tailed. * = significant at .01.

Cluster 1 appears to be separated from Clusters 2 and 4 (r = ..44, p>.01; r = .13, p>.01) on the basis of profile shape, and from Cluster 3 (r = ..74, p>.01) on the basis of magnitude. Cluster 2 appears to be separated from Clusters 3 and 4 (r = .71, p<.01; r = .80, p<.01) on the basis of profile magnitude. Cluster 3 appears to be separated from Cluster 4 (r = .62, p>.01) on the basis of both shape and magnitude.

Figures 5.2 and 5.3 show graphic representations of the mean T-scores for MMPI-2 k-means cluster clinical and content scales. For a more complete table of descriptive statistics by k-means cluster, see Appendices E and F. The following section presents a discussion of the clinical and content scale characteristics of each k-means cluster.

5.5 k-means Cluster Solutions

5.5.1 k-means Cluster 1.

The highest mean Cluster 1 scale was Hs (59.35), followed by Hy (56.32). This cluster is described as a Within Normal Limits (WNL) profile, and consisted of 62 individuals (31%). Examination of the Cluster 1 content

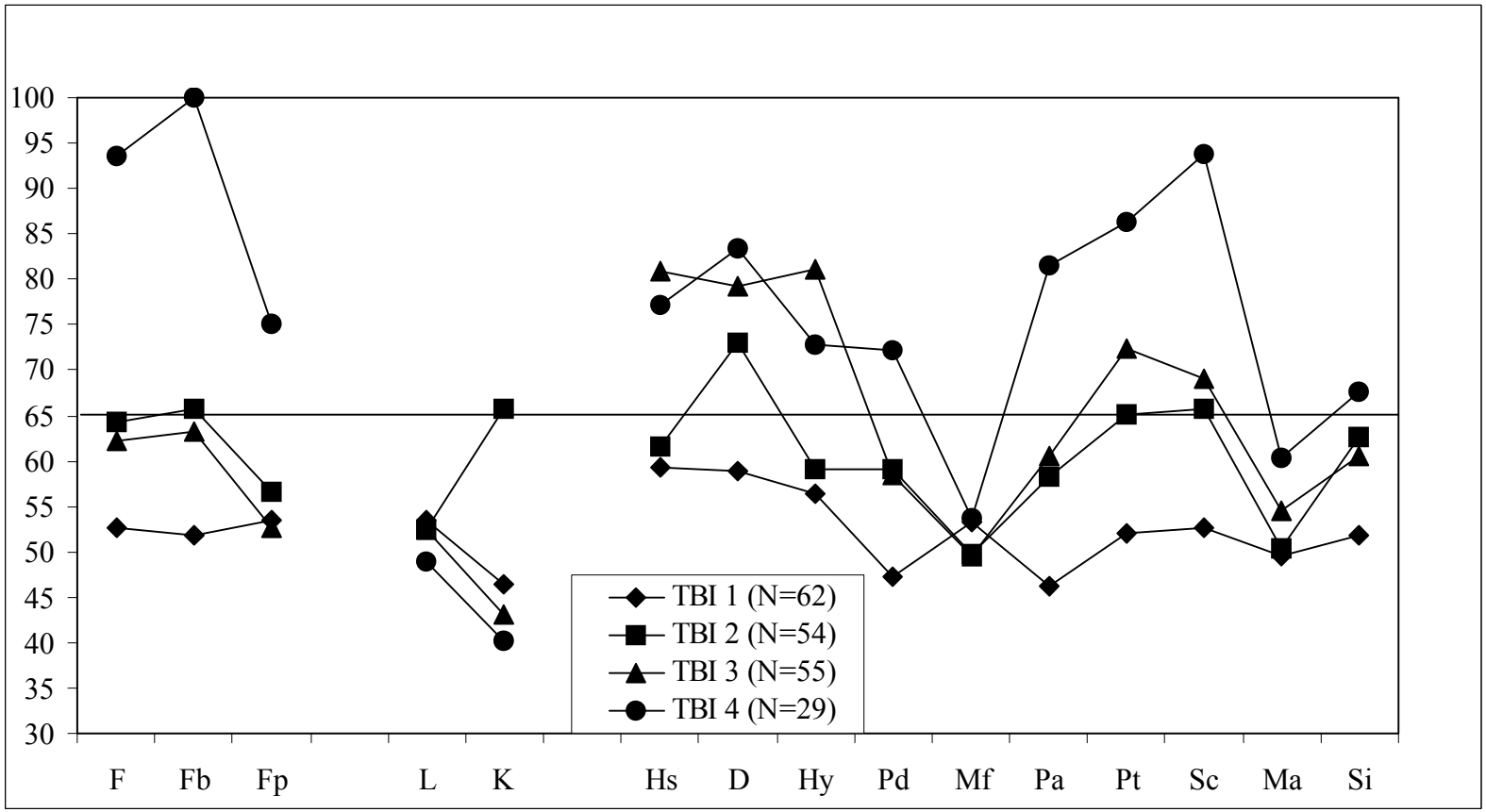

Figure 5.2 Mean Validity and Clinical Scale T-scores by K-means Cluster Group

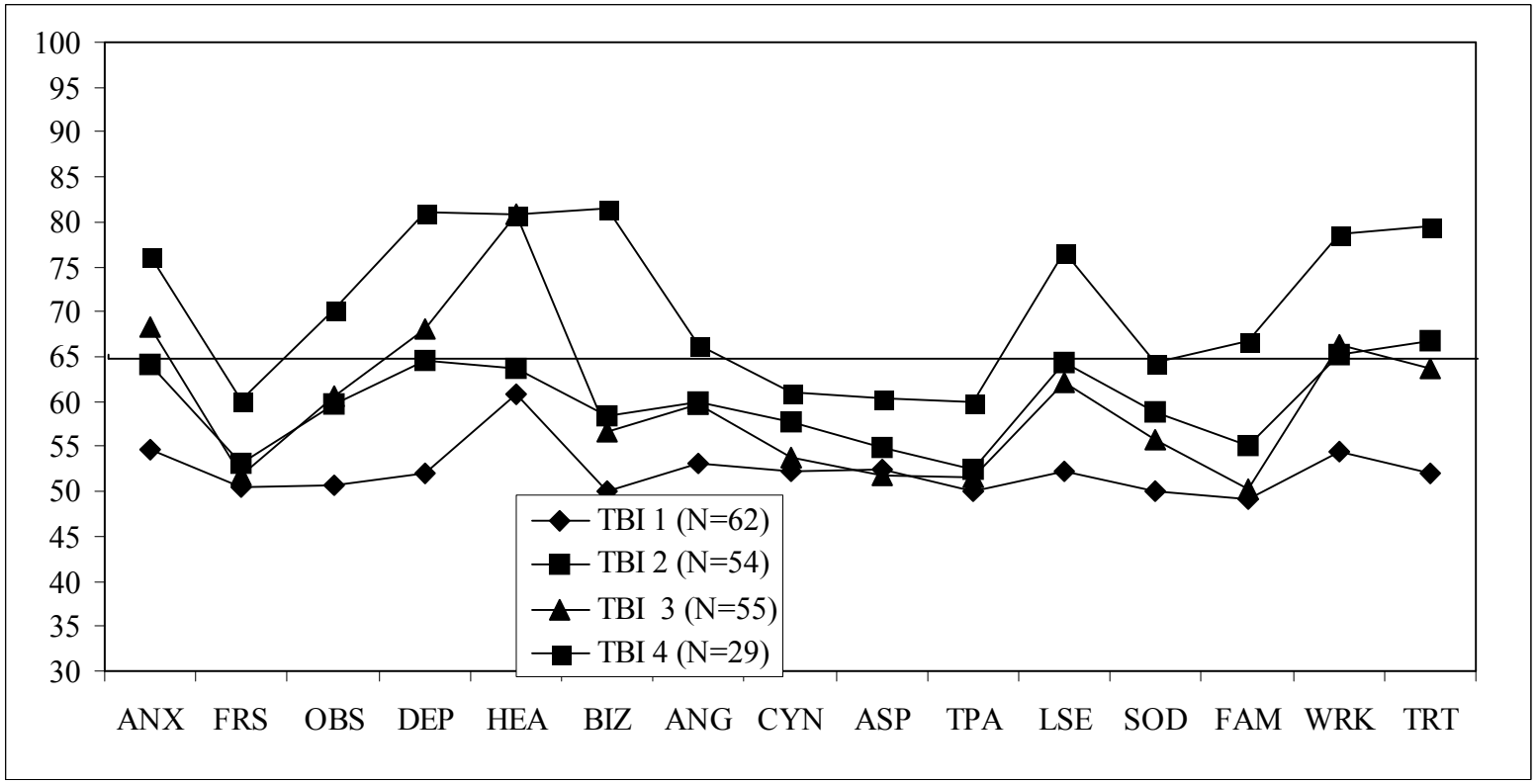

Figure 5.3 Mean Content Scale T-scores by K-means Cluster Group

scales and subscales also revealed no clinical elevations, with the highest score being the HEA scale (60.82), followed by HEA2 (59.94). When taken as an average these individuals do not appear to be experiencing any negative affect as a result of their TBI condition. Closer scrutiny, however, revealed that three validity and eighteen clinical scales and subscales had significantly different base rates of scale elevation from the normal population.

Thirty-two percent of individuals in this cluster appear to display extreme concerns for their health, together with increased sensitivity to bodily functions. It was noted that 26% of participants also elevated the Depression scale. These individuals elevated subscales D1, D3, and D4, indicating that they are generally apathetic, lack energy, have difficulty attending and concentrating, and are concerned with their poor health. They may, however, be elevating these scales as a result of their TBI condition and not because they are depressed. Whilst scale Sc was not elevated, a significant percentage (see Table 5.5) of individuals elevated subscales Sc3, Sc4, Sc5, and Sc6.

Eighteen of the forty-two content scales and subscales displayed increased base rates of elevation. These individuals reported anxiety, lack of drive, depressed mood, irritability, difficulty interacting with others, family discord, and alienation, low motivation, and self-confidence. Thirty-two percent also displayed general health concerns. Those scales and subscales that were elevated in 25% or more of the sample related predominantly to physical symptoms and health concerns: HEA (32%), HEA2 (39%), HEA3 (27%), Hs (32%), Hy4 (34%), Sc4 (31%), Hy3 (35%), and attention and concentration difficulties: D4 (42%), D (26%), Sc3 (44%), Sc6 (27%). Significantly different base rates of elevated scores are presented in Tables 5.5 and 5.6.

Table 5.5

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means TBI Cluster 1 (n = 62)

Scale		n	Mean	SD	% of cases 65 or above
L		**11**	**53.42**	**11.02**	**18**
F		**8**	**52.56**	**8.99**	**13**
Fb		10	51.89	9.17	6
Fp		**12**	**53.53**	**11.91**	**19**
K		5	46.40	11.40	8
Hs		**20**	**59.35**	**9.83**	**32**
D		**16**	**58.95**	**7.87**	**26**
	D1	**11**	**58.39**	**8.03**	**18**
	D2	6	51.42	8.44	10
	D3	**11**	**55.63**	**9.51**	**18**
	D4	**26**	**61.62**	**10.21**	**2**
	D5	6	52.48	8.94	10
Hy		**12**	**56.32**	**10.07**	**19**
	Hy 1	0	49.35	9.61	0
	Hy2	1	47.06	9.83	1
	Hy3	**22**	**60.77**	**10.14**	**35**
	Hy4	**21**	**59.69**	**13.37**	**34**
	Hy5	2	43.45	9.67	3
Pd		3	47.18	8.62	5
	Pd1	5	50.72	8.92	8
	Pd2	4	51.45	9.96	6
	Pd3	3	49.35	9.53	5
	Pd4	2	48.87	8.44	3
	Pd5	3	48.61	9.46	5
Mf		**11**	**53.18**	**11.57**	**18**
Pa		0	46.18	8.54	0
	Pa1	1	50.44	7.10	1
	Pa2	0	47.71	8.12	0
	Pa3	2	46.79	9.95	3
Pt		3	51.92	7.29	5
Sc		4	52.55	8.02	6
	Sc1	5	49.24	8.89	8
	Sc2	**9**	**51.55**	**9.79**	**15**
	Sc3	**27**	**60.10**	**12.73**	**44**
	Sc4	**19**	**55.84**	**9.81**	**31**
	Sc5	**8**	**51.31**	**9.68**	**13**
	Sc6	**17**	**56.42**	**10.90**	**27**
Ma		4	49.48	8.97	6
	Ma1	**12**	**53.55**	**9.92**	**19**
	Ma2	2	49.03	9.80	3
	Ma3	2	49.32	9.47	3
	Ma4	4	50.82	9.30	6
Si		7	51.79	10.20	11
	Si1	**10**	**50.94**	**10.02**	**16**
	Si2	7	48.61	10.05	11
	Si3	**10**	**53.13**	**11.32**	**16**

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

Table 5.6

Percentage of elevations of Content Scale and Subscale Scores for k-means TBI Cluster 1 (n = 62)

Scale		n			% of cases 65 or above
ANX		**13**	**54.68**	**10.18**	**21**
FRS		3	50.39	9.40	5
	FRS1	**8**	**50.87**	**9.85**	**13**
	FRS2	5	47.45	11.00	8
OBS		6	50.79	10.04	10
DEP		4	52.08	8.74	4
	DEP1	**10**	**53.69**	**10.10**	**16**
	DEP2	**9**	**52.34**	**9.79**	**15**
	DEP3	5	51.84	9.28	8
	DEP4	1	48.37	7.11	2
HEA		**20**	**60.82**	**8.77**	**32**
	HEA1	6	50.55	8.47	10
	HEA2	**24**	**59.94**	**13.59**	**39**
	HEA3	**17**	**59.63**	**10.13**	**27**
BIZ		4	49.98	7.60	6
	BIZ1	**14**	**52.79**	**10.45**	**23**
	BIZ2	5	48.29	8.85	8
ANG		6	53.21	10.02	10
	ANG1	4	49.79	9.43	6
	ANG2	**14**	**54.89**	**10.61**	**23**
CYN		7	52.13	9.55	11
	CYN1	**11**	**52.47**	**10.24**	**18**
	CYN2	2	50.48	8.38	3
ASP		**8**	**52.52**	**10.78**	**13**
	ASP1	**8**	**52.48**	**10.52**	**13**
	ASP2	6	50.19	11.23	10
TPA		5	50.08	10.02	8
	TPA1	6	49.90	11.08	10
	TPA2	2	44.79	8.95	3
LSE		5	52.34	10.37	8
	LSE1	6	52.29	10.45	10
	LSE2	**8**	**50.35**	**10.98**	**13**
SOD		5	50.08	10.30	8
	SOD1	7	49.02	9.99	11
	SOD2	**9**	**51.26**	**10.39**	**15**
FAM		6	49.11	10.04	10
	FAM1	7	49.16	11.27	11
	FAM2	**9**	**51.32**	**9.56**	**15**
WRK		**11**	**54.37**	**9.99**	**18**
TRT		6	52.11	8.59	10
	TRT1	**10**	**52.35**	**9.64**	**16**
	TRT2	4	48.71	8.80	6

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are indicated in bold typeface.

5.5.2 k-means Cluster 2. The second cluster reflects high levels of intrapersonal distress (depression) and anxiety, evidenced by clinical elevations on scales D and Pt. There were 54 individuals (27%) in this cluster. This profile was interpreted as a Depressed / Anxious group. The highest scale was, scale D (72.93), followed by Sc (65.72), and Pt (65.19). All other validity and clinical scale means were below the cut-off of 65. An examination of the clinical subscales also revealed elevations on D4 (77.53), followed by Sc3 (74.80), D1 (74.00), Hy3 (71.11), Sc4 (69.98), Sc6 (66.78), and D5 (65.30). All other subscales fell within normal limits.

Although all other mean Clinical scale and subscale scores were not elevated, an examination of cases that elevated each scale revealed a significant number of participants had elevated thirty-three of the forty-one clinical scales and subscales. Scales with significantly different numbers of elevations when compared to the normal population are presented in Table 5.7

A subsequent examination of the Cluster 2 mean Content and subscale scores revealed clinical elevations on scales TRT (66.78) and WRK (65.15), along with subscales TRT1 (66.98), and DEP1 (66.00). All other content scales and subscales fell within normal limits. Despite their within normal limits profile moderate numbers of individuals in this cluster elevated 38 of the 42 content scales and subscales. A complete table of the percentage of individuals that elevated these scales is presented in Table 5.8. Scales with significantly increased base rates to the normative sample are highlighted.

Table 5.7

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means TBI Cluster 2 (n = 54)

Scale		n	Mean	SD	% of cases 65 or above
L		**8**	**52.41**	**10.95**	**15**
F		**26**	**64.33**	**14.36**	**48**
Fb		**27**	**65.63**	**15.56**	**50**
Fp		**12**	**56.65**	**11.60**	**22**
K		1	41.30	8.39	2
Hs		**22**	**61.59**	**8.84**	**41**
D		**46**	**72.93**	**9.37**	**85**
	D1	**49**	**74.00**	**9.06**	**91**
	D2	**19**	**57.93**	**11.20**	**35**
	D3	**23**	**62.96**	**10.69**	**43**
	D4	**49**	**77.54**	**10.95**	**91**
	D5	**24**	**65.30**	**10.48**	**44**
Hy		**15**	**59.07**	**8.83**	**28**
	Hy 1	0	44.07	8.84	0
	Hy2	1	42.13	9.03	2
	Hy3	**43**	**71.11**	**8.57**	**80**
	Hy4	**23**	**63.44**	**10.40**	**43**
	Hy5	3	46.04	11.14	6
Pd		**17**	**59.13**	**9.13**	**31**
	Pd1	**16**	**59.65**	**10.37**	**30**
	Pd2	**7**	**52.98**	**10.76**	**13**
	Pd3	0	44.46	8.31	0
	Pd4	**22**	**62.00**	**10.05**	**44**
	Pd5	**20**	**62.15**	**9.55**	**37**
Mf		3	49.76	9.12	6
Pa		**15**	**58.17**	**9.32**	**28**
	Pa1	**19**	**61.02**	**11.39**	**35**
	Pa2	**17**	**59.17**	**10.73**	**31**
	Pa3	3	44.96	10.06	6
Pt		**30**	**65.19**	**8.53**	**56**
Sc		**32**	**65.72**	**10.46**	**59**
	Sc1	**21**	**60.74**	**12.63**	**39**
	Sc2	**26**	**62.00**	**13.57**	**48**
	Sc3	**41**	**74.80**	**12.94**	**76**
	Sc4	**41**	**69.98**	**11.25**	**76**
	Sc5	**23**	**60.83**	**12.99**	**43**
	Sc6	**31**	**66.78**	**13.67**	**57**
Ma		**7**	**50.26**	**11.12**	**13**
	Ma1	**8**	**51.04**	**11.25**	**15**
	Ma2	5	50.74	8.836	9
	Ma3	0	42.72	8.18	0
	Ma4	**10**	**54.00**	**13.01**	**19**
Si		**22**	**65.56**	**8.96**	**41**
	Si1	**14**	**58.07**	**8.40**	**26**
	Si2	**13**	**55.26**	**10.75**	**24**
	Si3	**22**	**61.39**	**10.96**	**41**

Note. Cluster 2 = Depression/Anxiety. Scales with significantly different base rates are highlighted in bold typeface.

Table 5.8

Percentage of elevations of Content Scale and Subscale Scores for k-means TBI Cluster 2 (n = 54)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**26**	**64.20**	**10.07**	**48**
FRS		4	53.15	9.27	7
	FRS1	**9**	**55.67**	**12.28**	**17**
	FRS2	2	49.02	9.50	4
OBS		**16**	**59.63**	**10.21**	**30**
DEP		**29**	**64.59**	**10.45**	**54**
	DEP1	**29**	**66.00**	**12.49**	**54**
	DEP2	**29**	**64.93**	**13.42**	**54**
	DEP3	**21**	**62.39**	**9.64**	**39**
	DEP4	**10**	**56.98**	**16.55**	**19**
HEA		**26**	**63.72**	**8.18**	**48**
	HEA1	**8**	**53.30**	**11.30**	**15**
	HEA2	**25**	**62.69**	**11.08**	**46**
	HEA3	**24**	**64.57**	**10.64**	**44**
BIZ		**17**	**59.37**	**11.79**	**31**
	BIZ1	**18**	**56.70**	**14.95**	**33**
	BIZ2	**17**	**58.24**	**12.85**	**31**
ANG		**20**	**59.85**	**11.26**	**37**
	ANG1	**15**	**57.44**	**12.38**	**37**
	ANG2	**24**	**59.85**	**9.84**	**44**
CYN		**13**	**57.74**	**11.33**	**24**
	CYN1	**14**	**57.30**	**9.82**	**26**
	CYN2	**10**	**55.13**	**10.23**	**19**
ASP		**9**	**54.89**	**10.40**	**17**
	ASP1	6	54.15	10.35	11
	ASP2	**10**	**53.02**	**11.30**	**19**
TPA		**8**	**52.54**	**11.23**	**15**
	TPA1	**14**	**54.37**	**10.62**	**26**
	TPA2	2	46.37	10.19	4
LSE		**23**	**64.39**	**11.04**	**43**
	LSE1	**27**	**64.91**	**11.58**	**50**
	LSE2	**12**	**56.30**	**10.41**	**22**
SOD		**14**	**58.81**	**9.93**	**26**
	SOD1	**20**	**58.13**	**10.88**	**37**
	SOD2	**10**	**56.70**	**9.16**	**19**
FAM		**9**	**55.07**	**10.16**	**17**
	FAM1	**14**	**55.13**	**11.04**	**26**
	FAM2	**7**	**54.00**	**10.04**	**13**
WRK		**25**	**65.15**	**10.76**	**46**
TRT		**33**	**66.78**	**12.95**	**61**
	TRT1	**29**	**66.98**	**15.01**	**54**
	TRT2	**17**	**56.37**	**11.15**	**31**

Note. Cluster 2 = Depression / Anxiety. Scales with significantly different base rates are highlighted in bold typeface.

These individuals report elevations on scales D, D1, D4 & D5, and DEP1, indicating that they are generally depressed, and lack energy to cope with their problems. Elevations on scales Sc, Sc3, Sc4 and Sc6 indicate that these individuals are experiencing unusual thought patterns and sensory experiences, and feelings of unreality, and were of a considerably higher magnitude than for Cluster 1. A slightly lower proportion of these individuals also appear to be experiencing anxiety, anger, self doubt ,and poor motivation. For the individuals in this cluster, their TBI condition appears to negatively impact on their ability to carry out their workplace responsibilities. These individuals also appear to be experiencing a high degree of negative affect as a result of their injury.

5.5.3 k-means Cluster 3. Cluster 3 reflects high levels of distress and disturbance, with mean elevations on five of the ten clinical scales. This group consisted of 55 (28%) individuals. This profile was interpreted as a High Distress / High Disturbance subgroup. The highest clinical scale mean was Hy (81.15), followed by Hs (80.85), D (79.24), Pt (72.38), and Sc (68.96). All other clinical scale means fell within normal limits. Numerous elevations were also evident on clinical subscales [D1 (77.84), D3 (69.60), D4 (80.73), D5 (67.33), Hy3 (84.18), Hy4 (83.07), Sc3 (75.76), Sc4 (72.45), Sc6 (75.89)]. The percentage of individuals that elevated clinical scales and subscales are presented in Table 5.9.

Cluster 3 content scales revealed mean clinical elevations for scales ANX (68.29), DEP (68.04), HEA (80.84), and WRK (66.22). Several elevations were also evident for the content subscales, with scales DEP1 (69.24), DEP2 (72.64), HEA2 (83.00), HEA3 (76.91), TRT1 (67.22) all recording clinical elevations. The percentage of individuals that elevated content scales and content subscales are presented in Table 5.10.

Table 5.9

Percentage of elevations of Clinical Scale and Sub-Scale Scores k-means TBI Cluster 3 (n = 55)

Scale		n	Mean	SD	% of cases 65 or above
L		6	52.42	10.85	11
F		**21**	**62.13**	**10.57**	**38**
Fb		**25**	**63.31**	**12.88**	**45**
Fp		**8**	**52.55**	**10.70**	**15**
K		0	43.07	7.60	0
Hs		**55**	**80.85**	**6.76**	**100**
D		**52**	**79.24**	**9.85**	**95**
	D1	**50**	**77.84**	**10.39**	**91**
	D2	**21**	**58.40**	**10.33**	**38**
	D3	**36**	**69.60**	**12.33**	**65**
	D4	**55**	**80.73**	**9.12**	**100**
	D5	**35**	**67.33**	**9.78**	**64**
Hy		**55**	**81.15**	**9.47**	**100**
	Hy 1	0	48.22	9.54	0
	Hy2	1	46.78	8.99	2
	Hy3	**54**	**84.18**	**8.84**	**98**
	Hy4	**51**	**83.07**	**12.25**	**93**
	Hy5	1	47.73	9.15	2
Pd		**11**	**58.53**	**8.46**	**20**
	Pd1	**10**	**52.55**	**10.18**	**18**
	Pd2	5	51.80	9.62	9
	Pd3	4	47.95	10.79	7
	Pd4	**20**	**61.20**	**10.45**	**36**
	Pd5	**25**	**64.18**	**10.11**	**45**
Mf		3	49.53	8.11	5
Pa		**18**	**60.60**	**11.08**	**33**
	Pa1	**12**	**59.22**	**9.57**	**22**
	Pa2	**20**	**58.98**	**10.71**	**36**
	Pa3	5	48.18	9.91	9
Pt		**47**	**72.38**	**7.42**	**85**
Sc		**41**	**68.96**	**9.21**	**75**
	Sc1	**14**	**57.07**	**10.15**	**25**
	Sc2	**25**	**64.13**	**12.10**	**45**
	Sc3	**45**	**75.76**	**11.75**	**82**
	Sc4	**46**	**72.45**	**10.22**	**84**
	Sc5	**21**	**59.98**	**11.69**	**38**
	Sc6	**43**	**75.89**	**14.49**	**78**
Ma		**11**	**54.49**	**10.57**	**20**
	Ma1	**7**	**51.53**	**8.72**	**13**
	Ma2	6	52.33	9.99	11
	Ma3	1	47.84	8.81	2
	Ma4	**7**	**52.98**	**10.55**	**13**
Si		**21**	**60.60**	**10.36**	**38**
	Si1	**11**	**54.60**	**9.97**	**20**
	Si2	**21**	**55.24**	**12.90**	**38**
	Si3	**19**	**61.69**	**9.50**	**35**

Note. Cluster 3 = High Distress/High Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

Table 5.10

Percentage of elevations of Content Scale and Subscale Scores for k-means TBI Cluster 3 (n = 55)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**36**	**68.29**	**9.03**	**65**
FRS		5	51.84	8.10	9
	FRS1	**11**	**56.71**	**12.30**	**20**
	FRS2	2	46.62	9.83	4
OBS		**19**	**60.67**	**10.47**	**35**
DEP		**38**	**68.04**	**8.92**	**69**
	DEP1	**36**	**69.24**	**10.51**	**65**
	DEP2	**40**	**72.64**	**14.67**	**73**
	DEP3	**15**	**61.42**	**7.06**	**27**
	DEP4	**12**	**59.38**	**17.93**	**22**
HEA		**52**	**80.84**	**9.43**	**95**
	HEA1	**23**	**63.78**	**13.12**	**42**
	HEA2	**48**	**83.00**	**14.28**	**87**
	HEA3	**50**	**76.91**	**8.14**	**91**
BIZ		**15**	**56.71**	**12.93**	**27**
	BIZ1	**19**	**60.56**	**16.73**	**35**
	BIZ2	**10**	**53.96**	**12.34**	**18**
ANG		**17**	**59.75**	**10.43**	**31**
	ANG1	**12**	**56.56**	**11.37**	**22**
	ANG2	**24**	**60.75**	**9.70**	**44**
CYN		**9**	**53.75**	**10.34**	**16**
	CYN1	**7**	**53.51**	**9.36**	**13**
	CYN2	**7**	**51.95**	**10.93**	**13**
ASP		6	51.84	9.89	11
	ASP1	6	51.42	9.99	11
	ASP2	6	50.76	9.29	11
TPA		**7**	**51.56**	**10.11**	**13**
	TPA1	5	54.49	9.47	9
	TPA2	1	44.96	8.82	2
LSE		**23**	**62.13**	**9.54**	**42**
	LSE1	**22**	**62.71**	**10.22**	**40**
	LSE2	**7**	**53.02**	**10.28**	**13**
SOD		**15**	**55.73**	**11.88**	**27**
	SOD1	**16**	**55.80**	**12.03**	**29**
	SOD2	**8**	**53.18**	**10.37**	**15**
FAM		4	50.36	9.27	7
	FAM1	6	50.96	10.49	11
	FAM2	5	48.24	9.59	9
WRK		**33**	**66.22**	**9.60**	**60**
TRT		**21**	**63.76**	**10.64**	**38**
	TRT1	**28**	**67.22**	**14.13**	**66**
	TRT2	**7**	**51.78**	**10.59**	**13**

Note. Cluster 3 = High Distress / High Disturbance. Scales with significantly different base rates are highlighted in bold type.

5.5.4 k-means Cluster 4. Cluster 4 reflects even higher levels of distress and disturbance, with elevations on eight of the ten clinical scales. This group consisted of 29 individuals (15%). This profile was interpreted as another High Distress /High Disturbance subgroup, but with scores of a higher magnitude. The numerous clinical elevations in this cluster suggest that these individuals are experiencing a great deal of distress and dysfunction in their lives. Scales with significantly higher base rates of clinical elevations than the normal population are highlighted in Tables 5.11 and 5.12.

The pattern of scores on the scales of the neurotic triad is similar to that of individuals in Cluster 3, but of a higher magnitude. As well as reporting physical symptoms and somatic complaints, these individuals also appear to be experiencing a high degree of negative affect. Ninety seven percent of participants elevated the Depression clinical scale and content subscales, indicating that they are generally depressed and are concerned with their poor health. All of the individuals elevated the D4 subscale, indicating that they lack of energy, and are experiencing attention/concentration difficulties.

A similarly high proportion of these individuals also appear to be experiencing anxiety, and to a slightly lower degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For over ninety percent of the individuals in this cluster, their TBI condition appears to negatively impact on their ability to carry out their workplace responsibilities. Treatment may also be a problematic issue due to low motivation.

Table 5.11

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means TBI Cluster 4 (n = 29)

Scale		n	Mean	SD	% of cases 65 or above
L		3	48.90	8.81	10
F		**29**	**93.62**	**18.89**	**100**
Fb		**28**	**99.97**	**20.92**	**97**
Fp		**17**	**75.07**	**20.58**	**59**
K		0	40.10	6.84	0
Hs		**25**	**77.21**	**11.96**	**86**
D		**28**	**83.41**	**10.80**	**97**
	D1	**28**	**87.17**	**9.82**	**97**
	D2	**10**	**63.52**	**9.72**	**34**
	D3	**22**	**74.10**	**12.85**	**76**
	D4	**29**	**90.03**	**10.07**	**100**
	D5	**26**	**79.14**	**9.88**	**90**
Hy		**19**	**72.69**	**12.17**	**66**
	Hy 1	0	41.03	8.70	0
	Hy2	0	39.66	6.86	0
	Hy3	**28**	**85.72**	**10.79**	**97**
	Hy4	**24**	**80.24**	**13.14**	**83**
	Hy5	3	48.03	11.29	10
Pd		**20**	**72.14**	**11.57**	**69**
	Pd1	**18**	**68.00**	**13.69**	**62**
	Pd2	2	53.34	9.15	7
	Pd3	1	40.59	9.29	3
	Pd4	**21**	**74.55**	**12.39**	**72**
	Pd5	**25**	**75.31**	**10.10**	**86**
Mf		3	53.69	9.82	10
Pa		**24**	**81.45**	**13.58**	**83**
	Pa1	**23**	**86.24**	**18.47**	**79**
	Pa2	**24**	**71.03**	**10.38**	**83**
	Pa3	1	43.45	10.54	3
Pt		**29**	**86.31**	**7.42**	**100**
Sc		**20**	**93.86**	**8.75**	**100**
	Sc1	**26**	**78.52**	**11.32**	**90**
	Sc2	**27**	**87.17**	**16.24**	**93**
	Sc3	**28**	**91.48**	**11.35**	**97**
	Sc4	**28**	**86.62**	**10.73**	**97**
	Sc5	**24**	**77.62**	**12.41**	**83**
	Sc6	**29**	**94.03**	**12.71**	**100**
Ma		**10**	**60.38**	**10.21**	**34**
	Ma1	**6**	**55.90**	**11.04**	**21**
	Ma2	**5**	**55.90**	**8.69**	**17**
	Ma3	0	44.17	8.94	0
	Ma4	**6**	**59.10**	**10.90**	**21**
Si		**18**	**67.62**	**9.59**	**62**
	Si1	**10**	**60.52**	**8.89**	**34**
	Si2	**9**	**58.14**	**10.21**	**31**
	Si3	**23**	**71.24**	**8.23**	**79**

Note. Cluster 3 = High Distress / High Disturbance. Scales with significantly different base rates are highlighted in bold typeface.

Table 5.12

Percentage of elevations of Content Scale and Subscale Scores for k-means TBI Cluster 4 (n = 29)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**28**	**76.21**	**8.43**	**97**
FRS		**10**	**60.10**	**13.07**	**34**
	FRS1	**19**	**74.59**	**20.23**	**66**
	FRS2	**4**	**47.90**	**11.15**	**14**
OBS		**21**	**70.31**	**9.06**	**72**
DEP		**28**	**81.10**	**10.38**	**97**
	DEP1	**26**	**80.72**	**12.50**	**90**
	DEP2	**24**	**77.17**	**12.36**	**83**
	DEP3	**25**	**74.93**	**7.88**	**86**
	DEP4	**16**	**80.21**	**27.70**	**55**
HEA		**26**	**80.79**	**13.07**	**90**
	HEA1	**16**	**68.28**	**16.95**	**55**
	HEA2	**24**	**83.59**	**16.73**	**83**
	HEA3	**24**	**73.97**	**8.92**	**83**
BIZ		**24**	**81.59**	**17.29**	**83**
	BIZ1	**22**	**86.83**	**29.26**	**76**
	BIZ2	**24**	**77.17**	**13.76**	**83**
ANG		**16**	**66.24**	**10.46**	**55**
	ANG1	**13**	**64.48**	**13.56**	**45**
	ANG2	**20**	**64.62**	**8.10**	**69**
CYN		**10**	**61.03**	**9.03**	**34**
	CYN1	**10**	**59.31**	**8.66**	**34**
	CYN2	**6**	**60.21**	**7.59**	**21**
ASP		**8**	**60.41**	**13.06**	**28**
	ASP1	**9**	**58.83**	**11.66**	**31**
	ASP2	**8**	**57.10**	**11.25**	**28**
TPA		**6**	**59.83**	**9.13**	**21**
	TPA1	**11**	**60.48**	**8.98**	**38**
	TPA2	**4**	**53.79**	**9.01**	**14**
LSE		**25**	**76.69**	**9.69**	**86**
	LSE1	**26**	**76.79**	**10.71**	**90**
	LSE2	**11**	**61.45**	**10.67**	**38**
SOD		**15**	**64.38**	**11.33**	**52**
	SOD1	**15**	**64.10**	**10.89**	**52**
	SOD2	**7**	**57.76**	**9.31**	**24**
FAM		**16**	**66.83**	**12.66**	**55**
	FAM1	**15**	**63.59**	**12.89**	**52**
	FAM2	**13**	**60.38**	**12.18**	**45**
WRK		**28**	**78.58**	**8.55**	**97**
TRT		**26**	**79.48**	**10.20**	**90**
	TRT1	**25**	**82.38**	**13.67**	**86**
	TRT2	**13**	**61.59**	**8.90**	**45**

Note. Cluster 4 = High Distress / High disturbance. Scales with significantly different base rates are highlighted in bold typeface.

5.6 General Summary and Conclusion

The results indicate that there are four MMPI-2 profiles in this forensic TBI sample. Unfortunately the clusters found in this study were unable to be compared to previous research, as there appears to be no other MMPI-2 cluster analytic studies of TBI profiles at the time of this writing.

One interesting point in this analysis was the percentage of clinical elevations found in the WNL subgroup, with participants elevating the Hs (32%) and D (26%) scales. These individuals appear to exhibit concern about their physical symptoms and somatic complaints. The majority of these individuals elevated scales D3 and D4, indicating general apathy, apprehension with regard to their poor health, and attention/concentration difficulties. Whilst all of these individuals form part of the WNL group, their concerns are something one would reasonably expect to find in individuals that have suffered a TBI.

The four TBI clusters generated in this study appear to reflect two general dimensions of psychological distress and interpersonal dysfunction, with each cluster reproducing these difficulties, but with increasing magnitude. It is clear from the results that there is more than one profile that exists in this forensic TBI sample. In the following chapter a forensic sample of individuals suffering from Post Traumatic Stress Disorder (PTSD) will be analysed to determine whether individuals from that particular diagnostic group exhibit distinct MMPI-2 patterns.

CHAPTER 6

Cluster Analysis of a Forensic Post Traumatic Stress Disorder Sample

6.1 Overview

A great deal of MMPI and MMPI-2 research relating to Post Traumatic Stress Disorder (PTSD) has been carried out on samples of war veterans, as was the case in the development of existing MMPI-2 trauma scales, PK, and PS. Civilian trauma, however, also accounts for a large percentage of PTSD sufferers, and trauma related conditions. With greater frequency these individuals are finding their way into the forensic arena.

Elhai, Frueh, Davis, Jacobs, and Hamner (2003) investigated subtypes of symptom patterns among male combat veterans diagnosed with PTSD through cluster analysis of their MMPI-2 clinical and validity scales. Overall, Elhai et als. Study revealed four distinct clinical presentations of PTSD, and came to the conclusion that PTSD diagnosed combat veterans represent heterogenous patterns of symptom endorsement rather than being categorised by a single MMPI-2 code type. Four PTSD clusters were found. Cluster 1 was a within normal limits cluster. Clusters 2, 3, and 4 were generally elevated clusters which were similar in shape but differed in elevation.

Similarly, Forbes, Creamer, Allen, Elliott, McHugh, Debenham, & Hopwood cluster analysed (Ward's method) a sample of Australian Vietnam war veterans. The authors identified three distinct subgroups on the basis of their MMPI-2 profile. These subgroups consisted of a subclinical, within normal limits cluster and two severe PTSD groups that differed only in levels of distress and disturbance (i.e., profile elevation).

Munley, Bains, Bloem, and Busby (1995) compared the MMPI-2 profiles of 27 war veterans with PTSD with veterans with other mental disorders. Although the mean

profiles found in this study appeared to be consistent with previous research, the PTSD group's mean scores on the MMPI-2 clinical scales did not differ significantly from the mean scores of the psychiatric comparison group. The method of comparison used by the authors, however, assumed homogeneity of the group being studied. Underlying the current analysis is the belief that various PTSD groups are not homogeneous populations. Rather than identifying groups based on univariate characteristics the intention of this study is to let multidimensional representation of the data guide the construction of specific groups.

This study uses cluster analysis to examine the existence of subgroups in a medicolegal PTSD sample. The profiles of individuals who were suffering from PTSD, and were litigants in personal injury litigation, were examined. As in the previous chapters, data was obtained from the administration of the MMPI-2.

6.2 Method

6.2.1 Subjects

One hundred and thirty-two (68 males - 52%; 64 females - 48%) individual MMPI-2 profiles were collected from the archives of two medicolegal practices in Brisbane, Queensland, Australia. All individuals had suffered civilian trauma, were in litigation, and were seeking financial compensation as a result of their injuries. Participants were diagnosed according to the Diagnostic and Statistical Manual of Mental disorders, fourth ed. (DSM-1V criteria (American Psychiatric Association, 1994). MMPI-2 raw score protocols were obtained for each participant.

Cases were examined and all those meeting the criteria for classification were included, without regard to the MMPI-2 validity scales. Experienced forensic

psychiatrists and psychologists carried out all assessments, which were conducted to determine psychosocial difficulties associated with the condition.

Readers may be surprised at the use of individuals in this study that did not have co-morbid conditions. In the light of the common co-morbidities associated with PTSD, it is important to understand that if the sample had been derived from individuals that had co-morbid conditions, then identified patterns of performance would show patterns of similarity. Accordingly it is only through the use of "pure" diagnostic samples, in which cases with co-morbid conditions have been excluded, can the hypothesis of unique underlying patterns of performance be evaluated.

Subjects were required to meet the following criteria:

- Subjects had undergone a comprehensive clinical assessment conducted by an experienced forensic psychiatrist or psychologist
- Subjects did not have multiple diagnoses, and were diagnosed as suffering PTSD according to DSM-IV criteria
- No more than 10 responses were omitted from the MMPI-2 protocol (Greene, 2000)
- Respondents recorded T-scores of $\geq$ 80 on VRIN (inconsistent response set), and $\geq$ 80 TRIN (true/false response set) scales (Butcher et al., 1989)

No cases were excluded based on elevations of VRIN and TRIN responses. No cases recorded elevations > 10 on Cannot Say (no response). Characteristics of the sample are presented in Table 6.1.

Table 6.1

Characteristics of the Forensic PTSD Group

Forensic PTSD Sample			
Gender	Subjects	%	
Male	68	52	
Female	64	48	
Demographics	Mean	SD	Range
Age (years)	39.15	11.78	18 - 74
Education (years)	11.45	3.04	4 – 21

6.2.2 Measures. The MMPI-2 was administered in the standardised manner as outlined in the test manual. As in the previous studies, scores consisted of K-corrected T-Scores of the 10 Clinical Scales. Inverse scree plots, and the percentage change in the agglomeration coefficient (Hair et al., 1995) were used to determine the optimal number of clusters.

6.2.3 Data Screening. All cases fell within 2.00 standard deviations of the mean for the 10 clinical scales. As all protocols were considered to be representative of each individual's current emotional and psychosocial state, no cases were excluded from the data in the following procedures. In the following analyses, determination of the number of clusters was based on the steps outlined in Chapter 2.

6.2.4 Scale Base Rates. The percentage of elevated scores were calculated for each of the MMPI-2 Clinical and Content scales and their subscales, for each k-means cluster. The standard error of proportion was calculated using the value of the population proportion (6.5% or .065) and the sample size (n=132). Using this method it was determined that a scale with scale elevations of 14% or above indicated a significantly different proportion compared to the normative sample.

6.3 Analysis and Results

Following the hierarchical cluster analysis examination of the inverse scree plot presented in Figure 6.1 indicated a flattening of the curve at a four cluster solution (marker A). This became more pronounced at a three cluster solution (marker B). This suggested that either a three or four cluster solution would be likely.

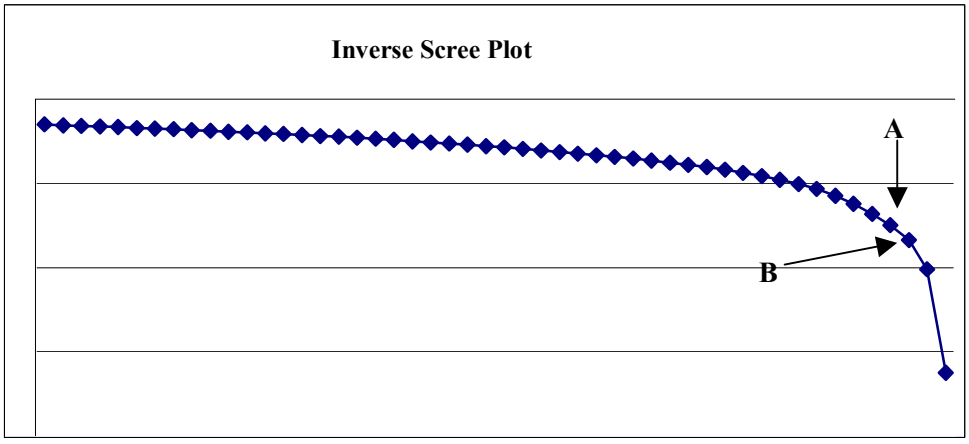

Figure 6.1 Inverse Scree Plot of the final 50 PTSD Agglomeration Coefficients

The agglomeration coefficient (see Table 6.2) shows that the percentage change almost doubles when moving from the four to the three cluster solution, after relatively small increases. This identifies the three cluster solution as the more appropriate result.

Table 6.2

Agglomeration Coefficients for Cluster Analysis

Number of Clusters	Agglomeration Coefficient	Percentage Change
8	98 086.95	5.20
7	104530.13	6.56
6	112699.63	7.81
5	121764.56	8.04
4	**134134.23**	**9.27**
3	**146574.25**	**22.99**
2	180277.11	59.23
1	287047.06	------

Examination of the four cluster solution revealed that the fourth cluster contained only one individual and was below the five percent cutoff for cluster membership. Examination of group membership at the three cluster solution, however, indicated that all clusters included greater than 5% of the sample size ($\underline{n} > 7$), and were therefore considered meaningful based on adequate group membership alone [(Range: $\underline{n} = 22$ (17%) to $\underline{n} = 64$ (48%)]. Based on the interpretation of the scree plot, and the percentage change in the agglomeration coefficient, a three cluster solution was considered to be most appropriate for the data set. Cluster means for the hierarchical analysis are presented in Appendix G. A k-means cluster analysis was then carried out specifying a three-cluster solution. In performing this analysis the clustering algorithm was allowed to randomly select the initial seed points, rather than be influenced by the centroids

generated from the initial hierarchical analysis. Descriptive statistics for the k-means clusters are presented in Table 6.3.

Table 6.3

Mean MMPI-2 Clinical Scale Scores for the k-means (k) Cluster Solutions

	PTSD 1		PTSD 2		PTSD 3	
N =	43		58		31	
	M	SD	M	SD	M	SD
Hs	62.65	10.80	70.80	10.46	90.87	7.11
D	62.63	10.49	83.97	11.26	96.13	7.36
Hy	62.77	12.51	72.57	12.92	93.87	12.21
Pd	53.16	8.76	64.00	10.77	73.26	9.64
Mf	50.30	10.04	49.98	7.11	53.45	9.94
Pa	54.19	9.74	71.97	11.64	86.87	14.14
Pt	57.77	9.87	79.90	8.34	92.71	7.09
Sc	57.16	11.20	78.21	9.96	97.06	9.76
Ma	50.91	11.66	54.64	11.69	53.61	9.71
Si	50.23	9.10	67.34	10.47	75.58	8.45

Note: k = k-means cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / High Disturbance Group 1; Cluster 3 = High Distress / High Disturbance Group 2

6.4 k-means Cluster Analysis Results

Whilst relatively stable cluster solutions appear to have been generated by different cluster analytic methodology, the correlational analysis of the k-means clusters generated in this study indicates that, as with the previous CP and TBI studies, they were formed along the dimensions of profile magnitude and shape. Cluster 1 appears to be separated from Cluster 2 (r=.73, $p<.05$) on the basis of magnitude and shape, and from Cluster 3 (r=.81, $p<.01$) on the basis of magnitude. Cluster 2 appears to be separated from Cluster 3 (r=.95, $p<.01$) on the basis of magnitude alone. Correlations between the cluster groups are presented in Table 6.4.

Table 6.4

Correlations between PTSD k-means clusters

Cluster	PTSD 1	PTSD 2	PTSD 3
PTSD 1		.73*	.81**
PTSD 2			.95**
PTSD 3			

Note: All tests two tailed. * = significant at .05; ** = significant at .01.

Figures 6.2 and 6.3 show graphic representations of the mean T-scores for each k-means cluster on the clinical and content scales, respectively. For a complete Table of descriptive statistics by k-means clusters, see Appendices H and I. The following section presents a discussion of the clinical and content scale characteristics.

6.4.1 k-means Cluster 1. The highest mean Cluster 1 scale was Hy (62.77), followed by Hs (62.65). This cluster is described as a Within Normal Limits (WNL) profile, and consisted of 43 individuals (33%). Cluster 1 mean content scales and subscales also revealed no clinical elevations, with the highest scale being HEA (61.35) followed by subscale HEA3 (60.81). Closer scrutiny of the clinical and content scales (and their respective subscales), however, revealed that significant proportions of cluster members elevated 24 of the 41 clinical scales and subscales, and 16 of the 42 content scales and subscales. Scales with a significant proportion of elevations are presented in Tables 6.5 and 6.6. Although this subgroup was described as WNL, a significant percentage of individuals in this cluster appear to exhibit some concern about their health.

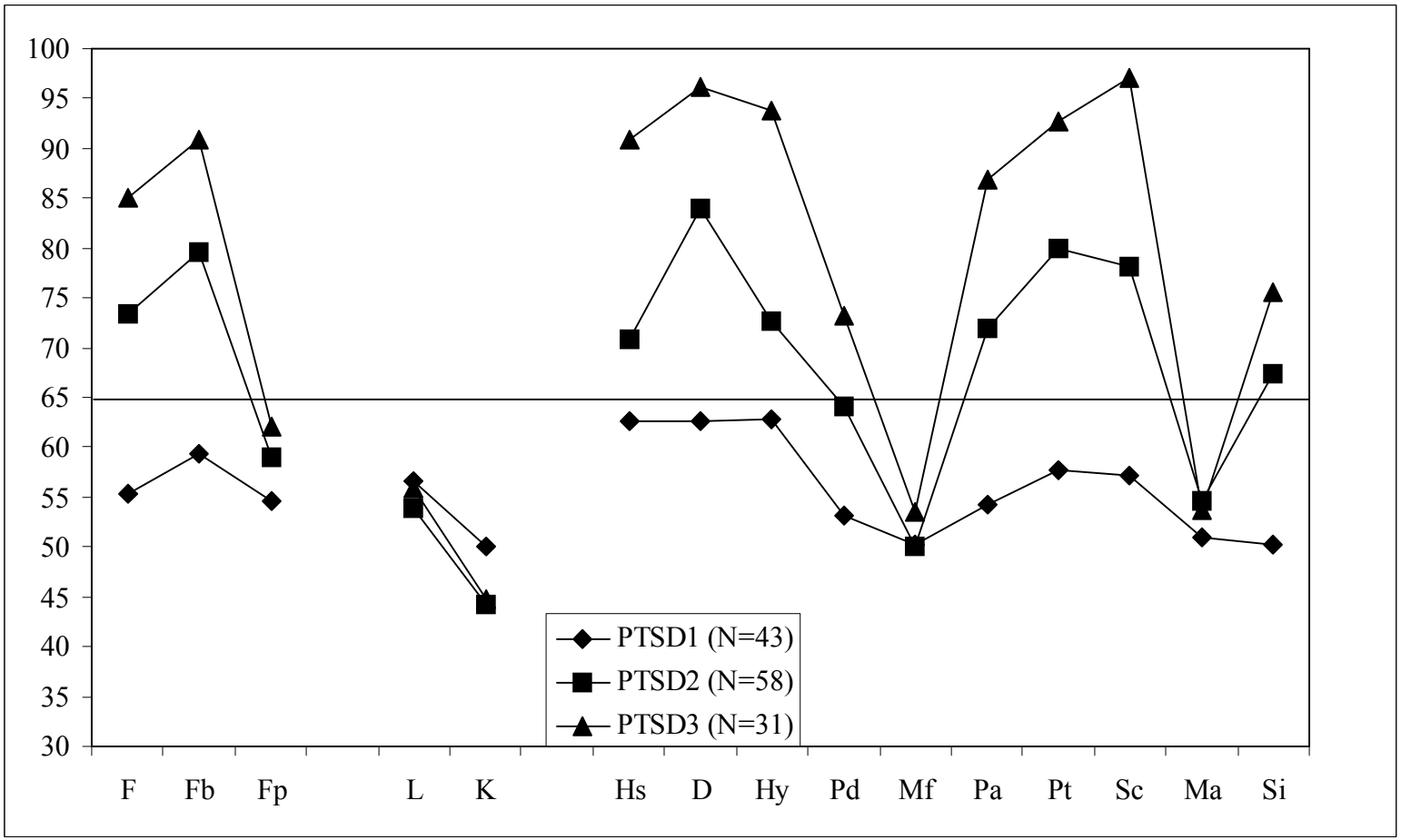

Figure 6.2 Mean Validity and Clinical Scale T-scores by K- means Cluster Group

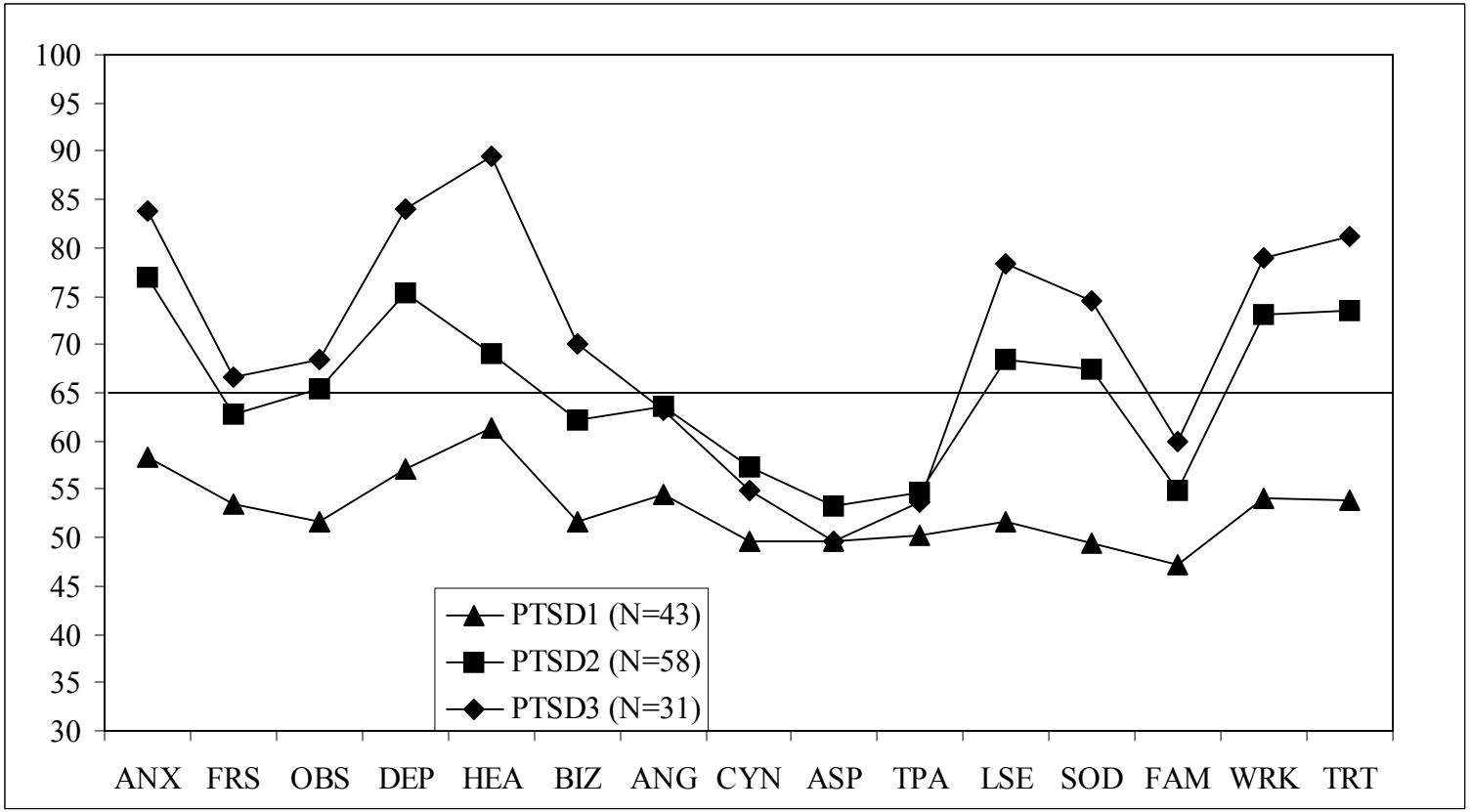

Figure 6.3 Mean Content Scale T-scores by K- means Cluster Group

Table 6.5

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means PTSD Cluster 1 (n = 43)

Scale		n	Mean	SD	% of cases 65 or above
L		**14**	**56.60**	**10.71**	**33**
F		4	55.33	11.98	9
Fb		**12**	**59.44**	**15.79**	**28**
Fp		**8**	**54.65**	**16.25**	**19**
K		3	50.14	9.72	7
Hs		**19**	**62.65**	**10.80**	**44**
D		**15**	**62.63**	**10.49**	**35**
	D1	**15**	**61.51**	**11.43**	**35**
	D2	**6**	**53.26**	**9.70**	**14**
	D3	**10**	**59.84**	**12.06**	**23**
	D4	**12**	**59.67**	**12.22**	**28**
	D5	**9**	**55.63**	**10.13**	**21**
Hy		**18**	**62.77**	**12.51**	**42**
	Hy 1	0	54.05	7.97	0
	Hy2	2	48.30	9.16	5
	Hy3	**24**	**64.35**	**10.85**	**56**
	Hy4	**17**	**60.26**	**12.11**	**40**
	Hy5	2	49.23	10.13	5
Pd		4	53.16	8.76	9
	Pd1	4	49.16	9.30	9
	Pd2	5	52.30	9.83	12
	Pd3	4	53.95	7.80	9
	Pd4	5	51.16	9.52	12
	Pd5	5	53.42	10.63	12
Mf		4	50.30	10.04	9
Pa		**7**	**54.19**	**9.74**	**16**
	Pa1	**6**	**52.98**	**10.02**	**14**
	Pa2	4	50.93	9.57	9
	Pa3	**6**	**51.28**	**10.05**	**14**
Pt		**10**	**57.77**	**9.87**	**23**
Sc		**13**	**57.16**	**11.20**	**30**
	Sc1	**7**	**50.74**	**11.58**	**16**
	Sc2	**10**	**54.72**	**13.37**	**23**
	Sc3	**19**	**61.12**	**14.12**	**44**
	Sc4	**12**	**57.00**	**11.02**	**28**
	Sc5	**6**	**54.16**	**10.01**	**14**
	Sc6	**14**	**59.58**	**11.87**	**33**
Ma		**6**	**50.91**	**11.66**	**14**
	Ma1	3	49.53	8.41	7
	Ma2	2	46.84	10.47	5
	Ma3	**6**	**52.53**	**10.62**	**14**
	Ma4	3	48.84	10.21	7
Si		4	50.23	9.10	9
	Si1	2	47.35	8.60	5
	Si2	**7**	**51.63**	**10.00**	**16**
	Si3	3	52.77	8.41	7

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

Table 6.6

Percentage of elevations of Content Scale and Subscale Scores for k-means PTSD Cluster 1 (n = 43)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**12**	**58.23**	**10.83**	**28**
FRS		**9**	**53.47**	**11.05**	**21**
	FRS1	**10**	**56.60**	**13.03**	**23**
	FRS2	5	48.44	11.89	12
OBS		5	51.56	10.10	12
DEP		**10**	**57.21**	**9.95**	**23**
	DEP1	**12**	**57.88**	**12.87**	**28**
	DEP2	**13**	**59.30**	**11.28**	**30**
	DEP3	5	52.16	9.98	12
	DEP4	**6**	**54.49**	**15.15**	**14**
HEA		**14**	**61.35**	**10.26**	**33**
	HEA1	**7**	**54.33**	**11.41**	**16**
	HEA2	**12**	**58.88**	**11.56**	**28**
	HEA3	**12**	**60.81**	**13.18**	**28**
BIZ		4	51.70	9.03	9
	BIZ1	2	49.60	8.10	5
	BIZ2	4	50.77	10.45	9
ANG		**9**	**54.58**	**12.57**	**21**
	ANG1	4	53.19	10.85	9
	ANG2	**13**	**54.74**	**11.56**	**30**
CYN		4	49.53	9.45	9
	CYN1	1	48.79	9.32	2
	CYN2	3	49.86	10.34	7
ASP		4	49.70	10.26	9
	ASP1	2	48.93	9.46	5
	ASP2	4	50.16	10.29	9
TPA		5	50.14	10.98	12
	TPA1	2	49.91	10.72	5
	TPA2	3	45.05	10.76	7
LSE		5	51.65	8.99	12
	LSE1	5	50.56	10.73	12
	LSE2	2	48.84	8.90	5
SOD		4	49.51	9.29	9
	SOD1	5	50.65	9.85	12
	SOD2	1	46.79	9.22	2
FAM		4	47.21	9.23	9
	FAM1	5	47.02	10.47	12
	FAM2	4	50.64	9.32	9
WRK		**8**	**54.02**	**10.72**	**19**
TRT		**7**	**53.84**	**11.85**	**16**
	TRT1	**12**	**55.28**	**13.26**	**28**
	TRT2	4	48.74	9.98	9

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

It was further noted that 35% of participants also elevated the Depression scale. The majority of these individuals elevated scales D1, D3, D4, and D5, indicating that they are generally depressed, apathetic, and concerned with their poor health. Similarly, 30% of individuals elevated scale Sc, with the majority elevating subscales Sc2, Sc3, Sc4, and Sc6.

Scales ANX and DEP were elevated by 28%, and 23% of the group, respectively. These individuals are experiencing negative affect as a result of their health concerns. Slightly fewer individuals elevated scales WRK (19%) and TRT (16%). Their PTSD condition appears to negatively impact on their ability to carry out their workplace responsibilities. Treatment may also be somewhat problematic, due to their lack of motivation and self-confidence. Those scales and subscales which were elevated in 25% or more of the sample related predominantly to physical symptoms and health concerns: HEA (33%), HEA 1 (28%), HEA2 (28%), HEA3 (28%), Hs (44%), Hy (50), Hy4 (40%), Hy3 (56%), D3 (35%), and attention and concentration difficulties: D4 (25%), D (25%), Sc6 (33%), ANX (28%).

6.4.2 k-means Cluster 2. The second cluster reflects high levels of distress and disturbance, evidenced by clinical elevations on seven of the ten clinical scales. There were 58 individuals (44%) in this cluster. This profile was interpreted as a High Distress / High Disturbance group. The highest scale was D (83.97), followed by Pt (79.90) and Sc (78.21). An examination of the clinical subscales also revealed elevations on eighteen of the thirty-one scales. The highest subscale was D4 (86.67), followed by Hy3 (84.80) and D1 (84.29). All other subscales fell within normal limits.

A subsequent examination of the Cluster 2 content and content subscale scores revealed elevations on eight major scales and ten of the subscales. The highest scale was ANX (76.86), followed by DEP (75.40), and TRT (73.55). The highest subscale elevation was DEP1 (79.88), followed by DEP 2 (77.47), and HEA3 (69.69). For a complete table of scale elevations for this cluster see Appendix I. Scales with significantly higher base rates of clinical elevations when compared to the normal population are presented in Tables 6.7 and 6.8.

The numerous clinical elevations in this cluster suggest that these individuals are experiencing a great deal of distress and dysfunction in their lives. The pattern of scores on the scales of the neurotic triad indicates that these individuals are reporting a number of physical symptoms and somatic complaints. These individuals also appear to be experiencing a high degree of negative affect as a result of their health concerns. Ninety-three percent of participants elevated scale D. Equally high percentages elevated all of the Depression subscales, indicating that they are generally depressed, lack energy to cope with their problems, display apathy, and are concerned with their poor health.

A similarly high proportion of these individuals also appear to be experiencing anxiety, and to a slightly lesser degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For 86 percent of the individuals in this cluster, their PTSD condition appears to negatively impact on their ability to carry out their workplace responsibilities. Because of the high percentage of individuals that elevated the TRT1 subscale (low motivation), treatment may also be a problematic issue.

Table 6.7

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means PTSD Cluster 2 (n = 58)

Scale		n	Mean	SD	% of cases 65 or above
L		7	52.93	10.50	12
F		**35**	**73.40**	**16.80**	**60**
Fb		**45**	**79.59**	**21.02**	**78**
Fp		**20**	**59.02**	**17.83**	**34**
K		3	44.26	12.55	5
Hs		**43**	**70.80**	**10.46**	**74**
D		**54**	**83.97**	**11.26**	**93**
	D1	**57**	**84.29**	**10.45**	**98**
	D2	**31**	**65.05**	**12.91**	**53**
	D3	**35**	**69.81**	**10.89**	**60**
	D4	**56**	**85.67**	**11.26**	**97**
	D5	**50**	**75.93**	**10.01**	**86**
Hy		**43**	**72.57**	**12.92**	**74**
	Hy 1	0	43.64	8.51	0
	Hy2	0	43.52	10.08	0
	Hy3	**57**	**84.80**	**9.33**	**98**
	Hy4	**43**	**72.50**	**15.58**	**74**
	Hy5	2	46.79	9.02	3
Pd		**27**	**64.00**	**10.77**	**47**
	Pd1	**16**	**55.50**	**11.73**	**28**
	Pd2	**5**	**50.74**	**10.74**	**9**
	Pd3	0	43.62	8.36	0
	Pd4	**36**	**67.79**	**14.13**	**62**
	Pd5	**44**	**71.33**	**10.30**	**76**
Mf		3	49.98	7.11	5
Pa		**43**	**71.97**	**11.64**	**74**
	Pa1	**31**	**70.10**	**17.89**	**53**
	Pa2	**37**	**66.56**	**10.81**	**64**
	Pa3	5	48.02	10.37	9
Pt		**56**	**79.90**	**8.34**	**97**
Sc		**55**	**78.21**	**9.96**	**95**
	Sc1	**39**	**69.24**	**12.90**	**67**
	Sc2	**47**	**76.74**	**16.31**	**81**
	Sc3	**51**	**82.55**	**13.59**	**88**
	Sc4	**57**	**82.71**	**9.88**	**98**
	Sc5	**42**	**70.88**	**12.01**	**72**
	Sc6	**42**	**75.07**	**16.85**	**72**
Ma		**15**	**54.64**	**11.69**	**26**
	Ma1	5	51.12	7.92	9
	Ma2	7	53.62	8.67	12
	Ma3	1	42.86	9.34	2
	Ma4	**12**	**54.50**	**11.61**	**21**
Si		**37**	**67.34**	**10.47**	**64**
	Si1	**19**	**60.77**	**9.04**	**33**
	Si2	**34**	**63.07**	**11.95**	**59**
	Si3	**27**	**65.05**	**10.24**	**47**

Note. Cluster 2 = High Distress / High Disturbance Group 1. Scales with significantly different base rates are indicated in bold typeface.

Table 6.8

Percentage of elevations of Content Scale and Subscale Scores for k-means PTSD Cluster 2 (n = 58)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**53**	**76.86**	**8.35**	**91**
FRS		**27**	**62.84**	**12.02**	**47**
	FRS1	**45**	**73.50**	**14.65**	**78**
	FRS2	**9**	**52.00**	**11.44**	**16**
OBS		**31**	**65.40**	**10.96**	**53**
DEP		**53**	**75.40**	**9.61**	**91**
	DEP1	**52**	**79.88**	**13.12**	**90**
	DEP2	**49**	**77.47**	**11.45**	**84**
	DEP3	**28**	**66.69**	**10.30**	**48**
	DEP4	**23**	**72.10**	**25.95**	**40**
HEA		**36**	**70.24**	**11.50**	**62**
	HEA1	**24**	**64.50**	**16.39**	**41**
	HEA2	**33**	**67.17**	**17.11**	**57**
	HEA3	**34**	**69.69**	**10.99**	**59**
BIZ		**20**	**62.07**	**14.99**	**34**
	BIZ1	**19**	**59.79**	**19.47**	**32**
	BIZ2	**26**	**63.26**	**15.84**	**45**
ANG		**25**	**63.60**	**13.20**	**43**
	ANG1	**22**	**60.24**	**14.91**	**38**
	ANG2	**33**	**62.21**	**8.29**	**57**
CYN		**15**	**57.37**	**11.89**	**26**
	CYN1	**12**	**55.33**	**10.30**	**21**
	CYN2	**14**	**56.74**	**10.19**	**24**
ASP		**14**	**53.28**	**12.71**	**24**
	ASP1	7	52.22	10.93	12
	ASP2	**8**	**51.03**	**10.64**	**14**
TPA		**11**	**54.69**	**11.70**	**19**
	TPA1	**10**	**58.62**	**8.22**	**17**
	TPA2	4	45.67	11.44	7
LSE		**37**	**68.48**	**10.93**	**64**
	LSE1	**38**	**68.22**	**10.18**	**66**
	LSE2	**17**	**58.57**	**11.68**	**29**
SOD		**37**	**67.43**	**13.64**	**64**
	SOD1	**36**	**66.97**	**14.14**	**62**
	SOD2	**19**	**58.79**	**8.64**	**33**
FAM		**17**	**54.91**	**12.13**	**33**
	FAM1	**18**	**54.19**	**12.23**	**31**
	FAM2	**10**	**50.74**	**12.13**	**17**
WRK		**50**	**73.16**	**8.59**	**86**
TRT		**46**	**73.55**	**10.87**	**79**
	TRT1	**51**	**76.41**	**13.35**	**88**
	TRT2	**16**	**57.96**	**10.34**	**28**

Note. Cluster 2 = High Distress / High Disturbance Group 1. Scales with significantly different base rates are highlighted in bold typeface.

6.4.3 k-means Cluster 3. Cluster 3 reflects even higher levels of distress and disturbance, than was found in Cluster 2. High elevations were evident on two validity scales, as well as eight of the ten clinical scales. This group consisted of 31 (24%) patients. This profile was interpreted as an elevated High Distress /High Disturbance subgroup.

The highest clinical scale was Sc (97.06), followed by D (96.13) and Hy (93.87). Many elevations were also evident on the clinical subscales, with the highest subscale being Hy4 (98.48), followed by D4 (97.61) and D1 (96.97). Examination of the Cluster 3 content scales revealed clinical elevations for ten of the fifteen scales. Similarly, elevations were also evident for the thirteen of the fifteen content scales, and twenty-four of the twenty-seven content subscales. A complete table of the elevated Cluster 3 scales and subscales are presented in Tables 6.9 and 6.10.

The numerous elevations in this cluster suggest that these individuals are experiencing very high distress and dysfunction in their lives. The pattern of scores on the clinical and content scales is similar to that of individuals in Cluster 2, but of a much higher magnitude. Similar to Cluster 2, these individuals appear to report a number of somatic complaints. They also appear to be experiencing an even higher high degree of negative affect. All participants elevated scales Hs, D, and Hy, indicating that they are generally depressed, lack energy to cope with their problems, display apathy, and are concerned with their poor health. Scale Sc was also elevated by all of the people in this cluster. Equally high numbers of individuals elevated all of the Sc subscales. When combined with the high mean scores for each of these scales, a high proportion of these people appear to be suffering from severe and prolonged distress.

Table 6.9

Percentage of elevations of Clinical Scale and Sub-Scale Scores for k-means PTSD Cluster 3 (n = 31)

Scale		n	Mean	SD	% of cases 65 or above
L		**5**	**55.84**	**12.29**	**16**
F		**27**	**84.97**	**15.91**	**87**
Fb		**27**	**90.90**	**20.82**	**87**
Fp		**10**	**62.00**	**18.89**	**32**
K		1	44.68	12.46	3
Hs		**31**	**90.87**	**7.11**	**100**
D		**31**	**96.13**	**7.36**	**100**
	D1	**30**	**96.97**	**11.28**	**97**
	D2	**26**	**71.87**	**9.73**	**84**
	D3	**29**	**83.84**	**13.82**	**94**
	D4	**31**	**97.61**	**10.42**	**100**
	D5	**31**	**85.32**	**9.23**	**100**
Hy		**31**	**93.87**	**12.21**	**100**
	Hy 1	0	42.68	8.78	0
	Hy2	2	46.45	10.77	6
	Hy3	**31**	**95.55**	**6.40**	**100**
	Hy4	**31**	**98.48**	**10.42**	**100**
	Hy5	1	48.97	10.91	3
Pd		**25**	**73.26**	**9.64**	**81**
	Pd1	**16**	**62.26**	**11.77**	**52**
	Pd2	1	49.81	9.62	3
	Pd3	1	43.29	9.66	3
	Pd4	**25**	**74.45**	**12.58**	**81**
	Pd5	**30**	**77.35**	**6.60**	**97**
Mf		**5**	**53.45**	**9.94**	**16**
Pa		**29**	**86.87**	**14.14**	**94**
	Pa1	**23**	**80.45**	**18.98**	**74**
	Pa2	**25**	**72.65**	**10.21**	**81**
	Pa3	**6**	**50.84**	**10.90**	**19**
Pt		**31**	**92.71**	**7.09**	**100**
Sc		**31**	**97.06**	**9.76**	**100**
	Sc1	**27**	**79.45**	**14.57**	**87**
	Sc2	**31**	**94.61**	**16.91**	**100**
	Sc3	**30**	**93.26**	**10.97**	**97**
	Sc4	**31**	**92.39**	**11.37**	**100**
	Sc5	**29**	**78.26**	**11.06**	**94**
	Sc6	**30**	**95.35**	**16.81**	**97**
Ma		**5**	**53.61**	**9.71**	**16**
	Ma1	**4**	**51.35**	**10.11**	**13**
	Ma2	3	52.52	7.74	10
	Ma3	2	40.74	10.93	6
	Ma4	**6**	**54.77**	**11.92**	**19**
Si		**25**	**75.58**	**8.45**	**81**
	Si1	**20**	**66.55**	**8.24**	**65**
	Si2	**27**	**68.61**	**5.56**	**87**
	Si3	**20**	**67.65**	**11.53**	**65**

Note. Cluster 3 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are highlighted in bold typeface.

Table 6.10

Percentage of elevations of Content Scale and Subscale Scores for k-means PTSD Cluster 3 (n = 31)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**31**	**83.90**	**6.90**	**100**
FRS		**18**	**66.71**	**13.08**	**58**
	FRS1	**26**	**81.13**	**17.08**	**84**
	FRS2	**7**	**53.65**	**12.87**	**23**
OBS		**23**	**68.39***	**9.12**	**74**
DEP		**30**	**84.10**	**9.01**	**97**
	DEP1	**31**	**88.06**	**12.21**	**100**
	DEP2	**30**	**85.06**	**8.47**	**97**
	DEP3	**24**	**72.81**	**9.99**	**77**
	DEP4	**23**	**97.19**	**26.86**	**74**
HEA		**31**	**89.52**	**9.32**	**100**
	HEA1	**27**	**83.97**	**15.66**	**87**
	HEA2	**31**	**93.32**	**13.44**	**100**
	HEA3	**27**	**79.29**	**9.51**	**87**
BIZ		**20**	**69.97**	**14.33**	**65**
	BIZ1	**15**	**64.81**	**18.25**	**48**
	BIZ2	**21**	**72.55**	**15.39**	**68**
ANG		**12**	**63.19**	**11.27**	**39**
	ANG1	**7**	**60.32**	**11.04**	**23**
	ANG2	**20**	**62.77**	**9.01**	**65**
CYN		**6**	**54.90**	**11.13**	**19**
	CYN1	**5**	**53.52**	**10.98**	**16**
	CYN2	**6**	**54.48**	**10.41**	**19**
ASP		4	49.61	11.85	13
	ASP1	3	49.03	11.90	10
	ASP1	3	48.55	9.50	10
TPA		4	53.61	11.27	13
	TPA1	**9**	**59.29**	**9.25**	**29**
	TPA2	2	44.74	10.30	6
LSE		**23**	**78.42**	**13.04**	**74**
	LSE1	**25**	**78.32**	**12.12**	**81**
	LSE2	**16**	**63.45**	**12.28**	**52**
SOD		**27**	**74.48**	**10.08**	**87**
	SOD1	**28**	**73.58**	**7.75**	**90**
	SOD2	**16**	**62.90**	**9.94**	**52**
FAM		**14**	**59.94**	**12.35**	**45**
	FAM1	**11**	**57.03**	**12.64**	**35**
	FAM2	**6**	**54.00**	**12.33**	**19**
WRK		**28**	**78.97**	**10.69**	**90**
TRT		**28**	**81.16**	**11.57**	**90**
	TRT1	**29**	**86.10**	**15.07**	**94**
	TRT2	**13**	**61.42**	**8.86**	**42**

Note. Cluster 3 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are indicated in bold typeface.

A similarly high proportion of these individuals also appear to be experiencing anxiety, and to lesser degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For 90 percent of the individuals in this cluster, their PTSD appears to negatively impact on their ability to carry out their workplace responsibilities. Because of the high percentage of individuals that elevated the TRT1 (low motivation), and TRT2 (inability to disclose) subscales treatment may a problematic issue.

6.5 General Summary and Conclusion

The results indicate that there are three MMPI-2 profiles in this forensic PTSD sample. Cluster 1 was a WNL subgroup. Closer scrutiny, however, revealed a significant proportion of cluster members in fact displayed clinical elevations of several of the Basic and Content scales and subscales. Clusters 2 and 3 were general elevation clusters, displaying high elevations on scales Hs, Hy, D, Pt, and Sc reflecting the expected combination of clinical symptoms typically associated with PTSD: somatic distress, the duality of denial alternating with anxiety, and intrusive recollection, and depression. These clusters were similar in profile shape and elevation to those found in previous research by Elhai et al. (2003), and Forbes et al. (2003).

Similar to the previous CP and TBI studies, the three clusters generated in this study again appear to reflect two general dimensions of distress and disturbance, with each cluster reproducing these difficulties, but with ever increasing magnitude. In the following chapter the results of the CP, TBI, and PTSD studies will be compared to determine whether individuals from each of the aforementioned diagnostic group exhibit distinct MMPI-2 patterns.

CHAPTER 7

Comparison of Diagnostic Group Profiles

7.1 Overview

The fundamental aim of this dissertation was to determine whether unique patterns of psychosocial functioning exist as a consequence of differential diagnosis. This was achieved by examining the MMPI-2 performance of three different diagnostic groups under the assumption that individuals with unrelated physical and psychological conditions would exhibit different patterns of MMPI-2 performance, as a result of the dissimilarity of their medical diagnosis. The purpose of the current chapter is to consolidate and compare the findings of the previous studies.

Three studies were undertaken in Chapters 4, 5 and 6 that examined the concept of unique MMPI-2 profiles occurring in medicolegal samples of individuals with Chronic Pain, Traumatic Brain Injury, and Post Traumatic Stress Disorder. The following section briefly summarises and then compares the results of the previous three studies.

The first study employed cluster analysis to identify common patterns of emotional functioning based on performance across the 10 clinical scales of the MMPI-2. Although the clusters were distinguished based upon the Basic scales alone, the patterns of performance associated with Validity, Basic, and Content scales were also examined.

While the Validity scales are not used for clinical interpretation, they can have a substantial impact on how interpretation proceeds. While elevated in those who attempt to misrepresent themselves on the test, they also elevate in the presence of psychological difficulties. Although they were not included in the cluster analysis

they were examined with regard to their implication for cluster interpretation.

Although the Clinical scales are more utilitarian in their association with particular diagnostic groups, examination of the Content scales for each cluster was also carried out. Even though the Content scales have substantial overlap with the Basic scales at both construct and item levels, they were examined because they are more readily interpretable due to their high face validity.

The findings of the CP k-means cluster analysis indicated that there were three patterns of performance. Cluster 1 was described as a Within Normal Limits (WNL) profile, with no clinical elevations of any of the validity, clinical, or content scales. Cluster 2 was characterised by elevations on scales Hs, Hy, D, and Pt, and was described as a High Distress / Low Disturbance subgroup. Consistent with this, elevations were also noted for content scales HEA and DEP on this cluster. Cluster 3 was a general elevation profile and represented a High Distress / High Disturbance subgroup. Clinical elevations were present for eight of the ten clinical scales, and seven of the fifteen content scales.

Study two identified four patterns of performance for the TBI sample. As with the CP sample, Cluster 1 was identified as a WNL profile. Cluster 2 was characterised by elevations on clinical scales D, Pt, and Sc with elevations also noted on content scales TRT and WRK. This cluster was identified as a Depressed / Anxious subgroup. Cluster 3 was described as a generally elevated High Distress / High Disturbance profile. Elevations were present for clinical scales Hy, Hs, Pt, and Sc. Elevations were also present for content scales ANX, DEP, HEA, and WRK. Similarly, Cluster 4 was described as a generally elevated High Distress / High Disturbance profile, which differed from Cluster 3 primarily in magnitude.

Study three identified three subgroups for the PTSD sample. Again, a WNL profile was found for Cluster 1. Cluster 2 was identified as a generally elevated profile with elevations on seven of the ten clinical scales, and eight of the fifteen content scales. Cluster 3 was also identified as a generally elevated High Distress / High Disturbance profile with clinical elevations on eight of the ten basic scales, and thirteen of the fifteen content scales. Both groups were similar in profile shape, but differed in profile magnitude.

When the patterns from the three aforementioned samples were compared a remarkable similarity of profiles across the three diagnostic groups was evident, with correlations ranging from $\underline{r} = .67$ to $\underline{r} = .99$. Table 7.1 presents the intercorrelations among the different clusters for the three groups, and highlights both the similarities and dissimilarities in these profiles. Clusters were grouped together on the basis of high intercorrelations, indicating a high degree of similarity between profiles.

If profiles in one group corresponded to only one profile in each of the other two groups then Table 7.1 would depict only significant correlations (in bold typeface) just below the leading diagonal. As can be clearly seen, significant correlations were also found elsewhere in the matrix, and indicate that in terms of

Table 7.1

Correlations Between Diagnostic Group Profiles

Group		CP 1	TBI 1	PTSD 1	CP 2	TBI 3	PTSD 2	CP 3	TBI 2	TBI 4	PTSD 3
	CP 1	1.00									
WNL	TBI 1	**.87****	1.00								
	PTSD 1	**.88****	**.74***	1.00							
	CP 2	.93**	.79**	.96**	1.00						
HDs/LDb	TBI 3	.85**	.74*	.97**	**.96****	1.00					
	PTSD 2	.40	.36	.73*	**.67***	**.79****	1.00				
	CP 3	.54	.46	.83**	.78**	.87**	.98**	1.00			
	TBI 2	.39	.44	.63	.62	.71*	.93**	**.89****	1.00		
HDs/HDb	TBI 4	.18	.13	.58	.46	.62	.91**	**.89****	**.80****	1.00	
	PTSD 3	.52	.40	.81**	.77**	.86**	.95**	**.99****	**.84****	**.90****	1.00

Note: CP = Chronic Pain; TBI = Traumatic Brain Injury; PTSD = Post Traumatic Stress Disorder; WNL = within normal limits; HDs/LDb = High distress-low disturbance; HDs/HDb = High distress – High disturbance. ** = Significant < .01; * = Significant < .05. All tests two-tailed.

cluster shape substantial similarities were also found with other clusters in each diagnostic group. For example, the CP Cluster 2 profile bears as great a similarity to the WNL grouping as it does to its own High Distress/Low Disturbance (HDs/LDb) group. As was discussed in previous chapters, this occurs because the cluster analysis approach used in this research determines cluster membership based on both profile shape and magnitude, and can generate distinct clusters that differ in profile magnitude (scale elevation), but not in profile shape (correlation). Thus, the CP2 cluster has a similar shape to the WNL clusters, resulting in significant correlations with those measures, but differs in score magnitude, which led to its characterisation as a HDs/LDb group.

7.2 Graphic Comparisons

Graphic comparisons of similar profiles are presented in Figures 7.1, 7.2, and 7.3. These figures depict the Validity and Basic Scales (a), and Content Scale (b) configurations for the profile types observed across the three diagnostic groups.

7.2.1 Within Normal Limits Profiles

As can be seen in Figures 7.1, the WNL validity and clinical profiles (Fig. 7.1a) of the three diagnostic groups were similar in both shape and magnitude, and highly correlated with each other.

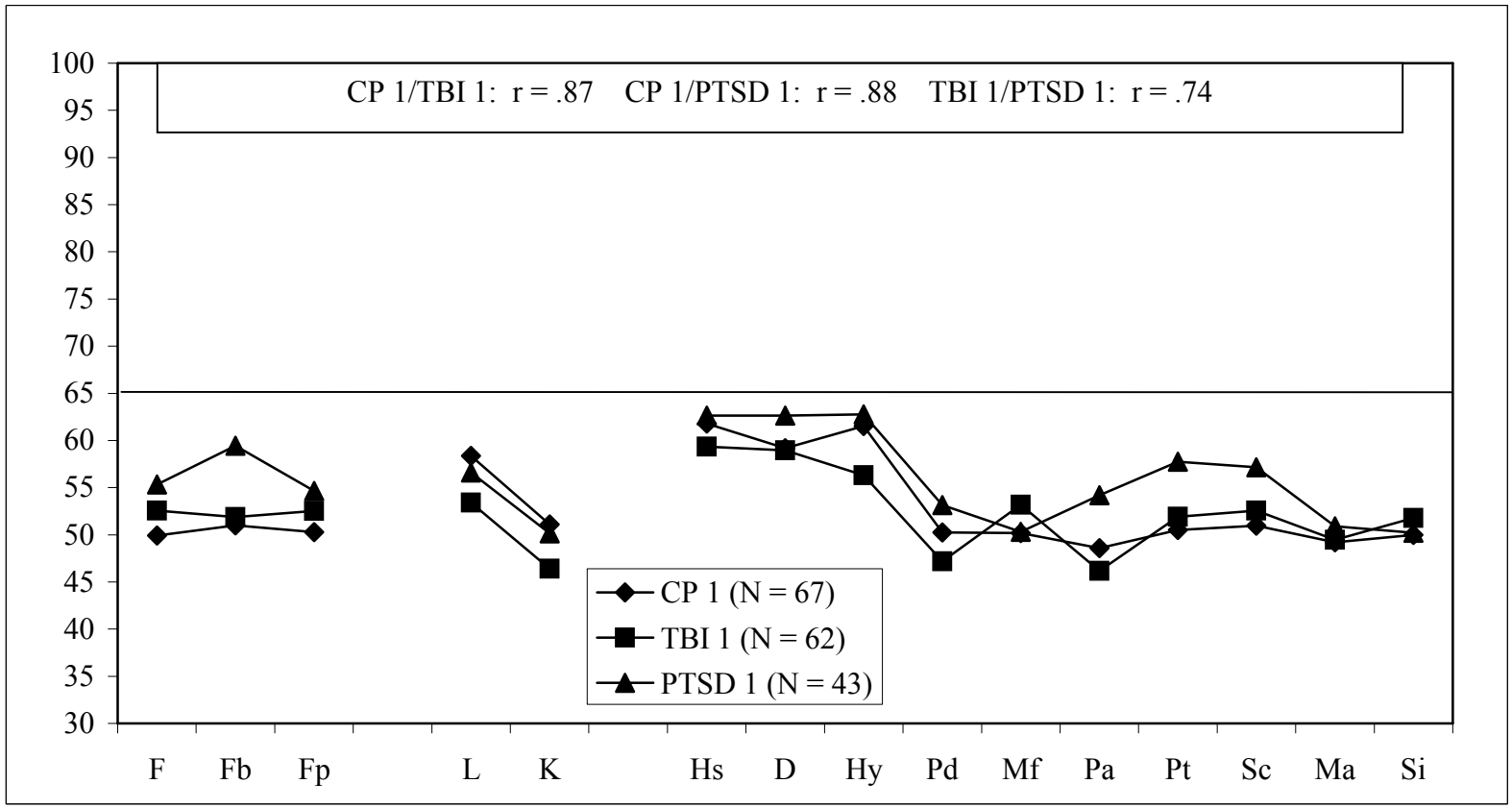

Figure 7.1a Comparison of Within Normal Limits clusters – Validity and Basic Scales

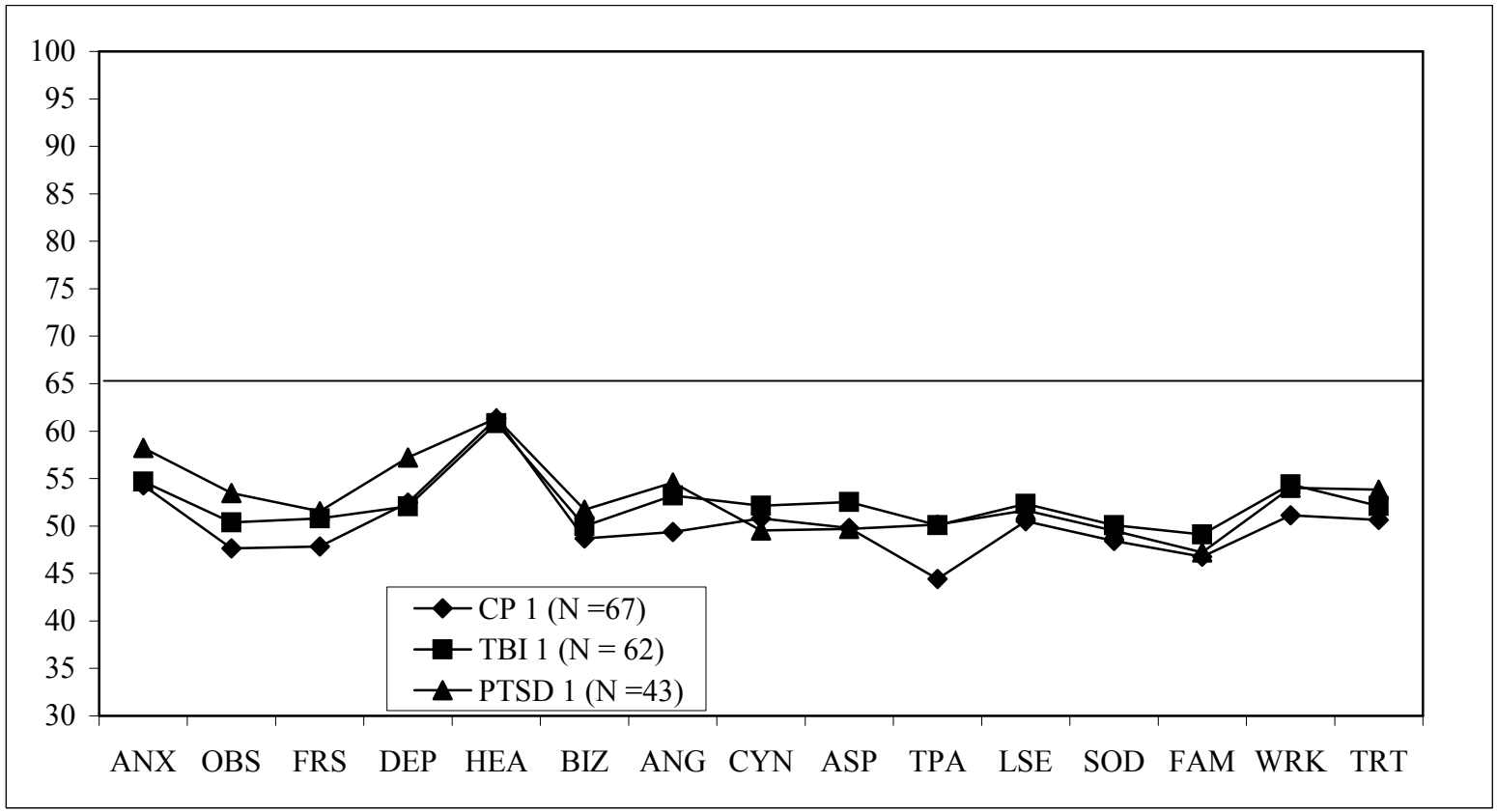

Figure 7.1b Comparison of Within Normal Limits Clusters – Content Scales

7.2.2 High Distress Profiles. Comparison of the profiles represented in Figures 7.2 (a and b) revealed three profiles that again were similar in shape, but differed in magnitude. PTSD Cluster 2 was the most elevated profile. Examination of Clinical scales (Fig. 7.2a) Hs, D, and Hy revealed similar elevations on scales Hs and Hy for the TBI Cluster 3 and CP Cluster 2 profiles. The PTSD Cluster 2 profile, however, displayed a high peak on scale D with elevations on scales Hs and Hy lower by 13 points and 11 points, respectively.

Profiles on the disturbance scales Pa, Pt, Sc, Ma, and Si evidenced high elevations for PTSD Cluster 2 except for the Ma scale. Overall this cluster reflected the expected combination of symptoms typically associated with PTSD: somatic distress, anxiety, intrusive thoughts, and depression. For TBI Cluster 3 elevations were present for scales Pt and Sc. Whilst the CP Cluster 2 profile was of similar shape on the aforementioned disturbance scales, no clinical elevations were evident for this group. An examination of the content scales (Fig. 7.2b) again revealed three similar profile patterns, varying in their magnitude. The PTSD Cluster 2 profile was again the most elevated on all scales except the HEA scale. The highest elevation for this scale was recorded by TBI Cluster 2.

7.2.3 High Distress / High Disturbance Profiles. Comparison of the HDs/HDb profiles presented in Figures 7.3 (a and b), revealed extreme levels of Distress and Disturbance for three of the four groups. The individuals that make up Cluster 3 appear to be more distressed and disturbed than all other groups. The apparent exception in this cluster is TBI Cluster 2. Whilst this cluster

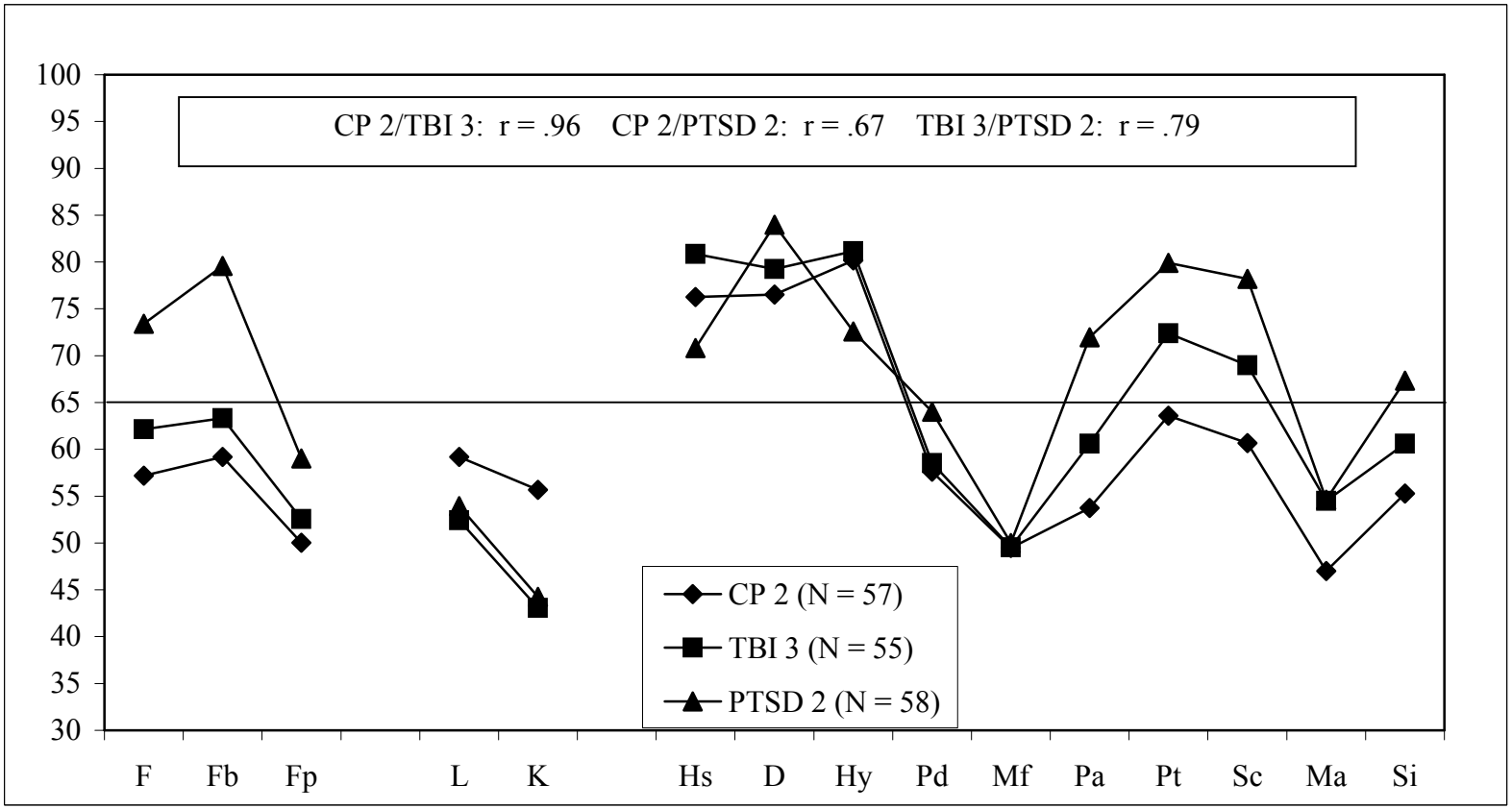

Figure 7.2a Comparison of High Distress / Low Disturbance Clusters– Validity and Basic Scales

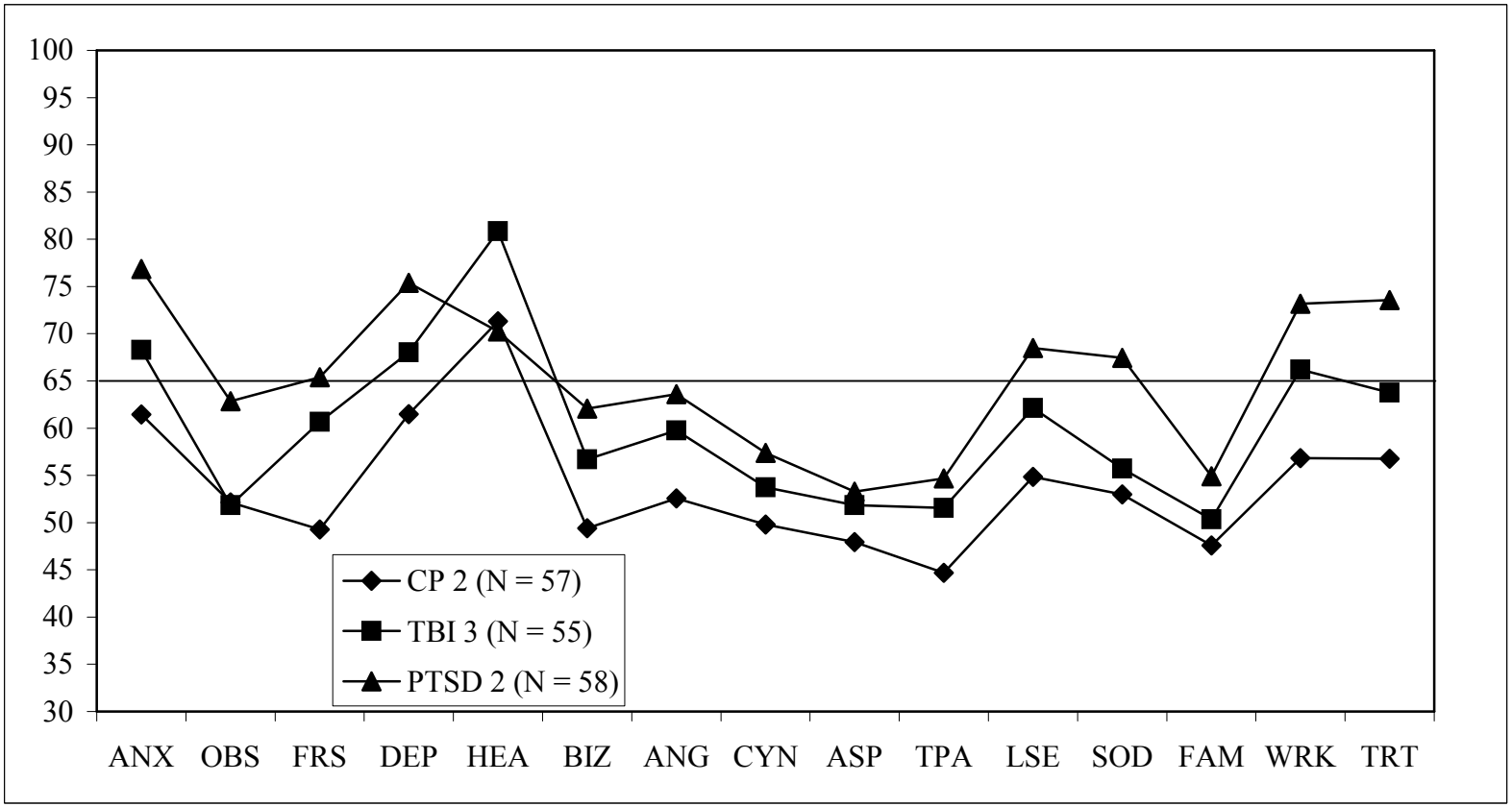

Figure 7.2b Comparison of High Distress / Low disturbance Clusters – Content Scales

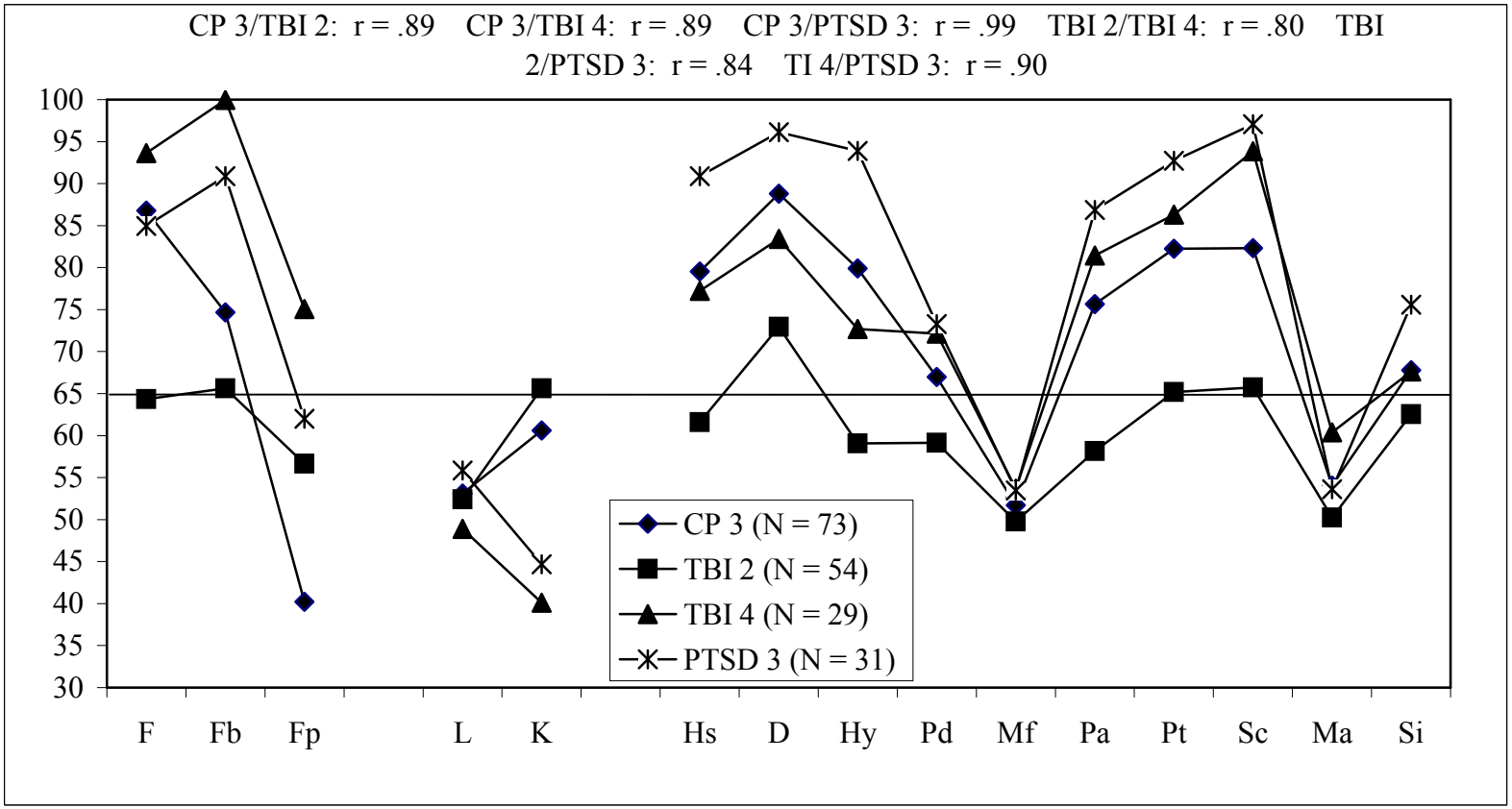

Figure 7.3a Comparison of High Distress / High Disturbance Clusters– Validity and Basic Scales

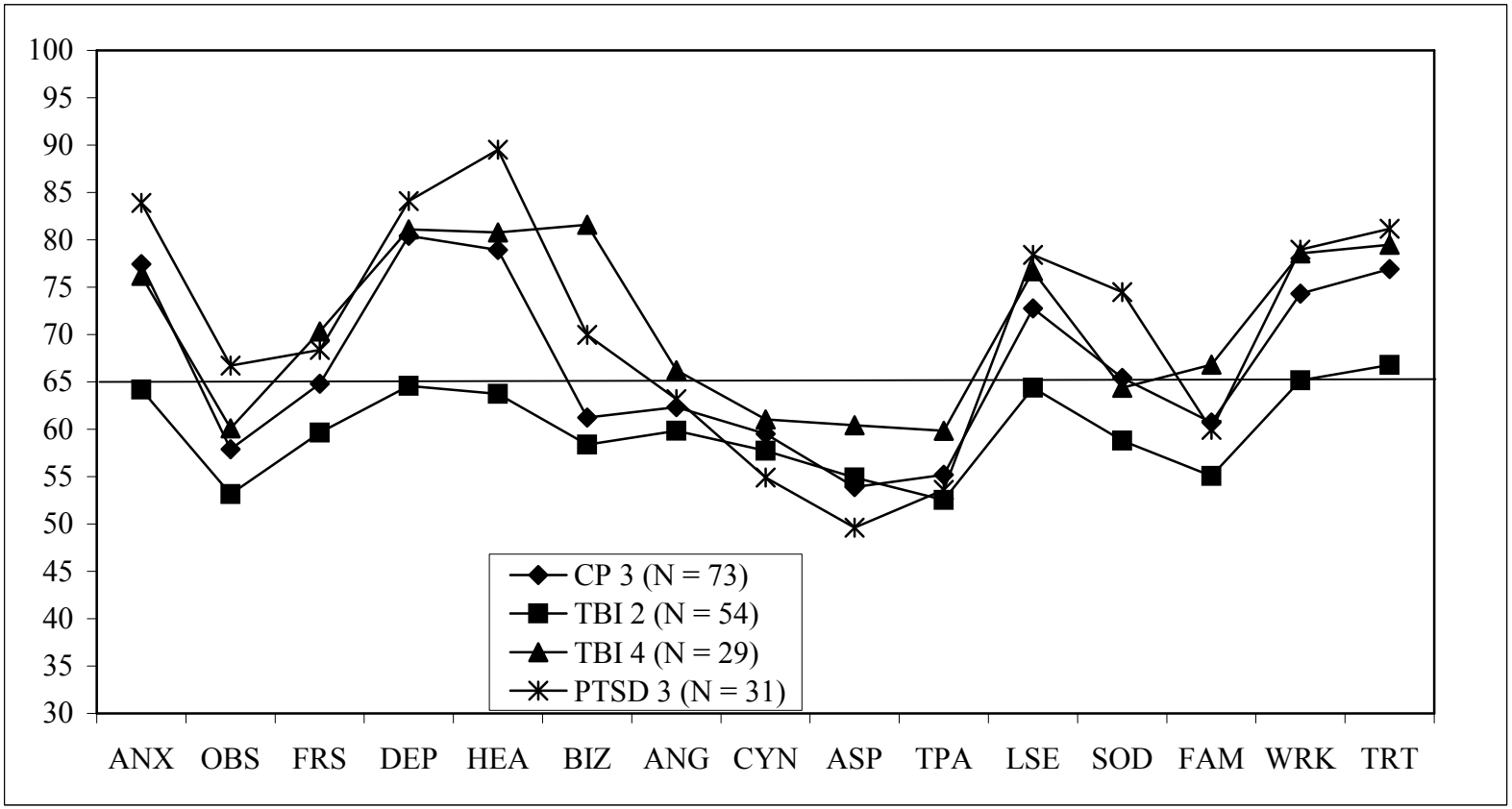

Figure 7.3b Comparison of High Distress / High Disturbance Clusters – Content Scales

correlated highly with all clusters in this comparison, it was uncorrelated with most other subgroups.

These findings highlight two distinct issues that should be explicated separately. First, there are no unique patterns associated with a particular diagnosis i.e. each disorder is characterised by at least three patterns. Second, the patterns are not specific to a diagnosis and appear across multiple diagnoses. Whilst multiple patterns of performance were generated within individual diagnostic groups, these profiles were highly interrelated, hence the contention that individuals from different diagnostic groups exhibit different patterns of MMPI-2 performance is not supported. The clusters seem to represent a continuum of generalised distress and disturbance across the three samples. Whilst this is certainly an endorsement of the MMPI-2 to reflect such difficulties, the previous findings call into question the utility of the instrument to differentiate between various clinical groups.

These studies were carried out with the premise that different diagnostic groups should display distinct patterns of MMPI-2 performance. The results demonstrated that the different patterns that were found to occur in CP, TBI, and PTSD in fact bore a striking resemblance to each other. MMPI-2 scales evaluate the frequency of reported symptoms, attitudes, beliefs, and behaviours that have been grouped or organised along consistent themes which can be detrimentally impacted by pathology. Under this assumption, only themes that themselves are unique to a particular disorder would be expected to generate unique patterns. MMPI and MMPI-2 scales were designed to be sensitive to the conditions upon which they were based, but cannot be considered specific or exclusive to those conditions.

Most disorders have the potential for the manifestation of physical symptoms. Most disorders have the potential for generating severe emotional distress. Most disorders have the potential for disrupting the lives of individuals and affecting their ability to adapt and cope. Consequently, it is not surprising that distinct conditions such as CP, TBI, and PTSD would demonstrate such a high degree of similarity in patterns of responses on the MMPI-2. The three most striking patterns observed across the three samples were: individuals who tended to endorse low levels of psychological distress and disturbance; those who reported greater psychological distress than disturbance; and those who reported high, or comparable levels of distress and disturbance. Regardless of the origin of their condition, individuals from these three diagnostic groups seem to respond psychosocially to their pathology in one of these three characteristic ways.

If the specific aetiology of their condition does not lead to differential patterns of responding on the MMPI-2, then the need for separate evaluation of the three samples is no longer necessary, and combining the samples would provide a greater potential for deriving more stable and robust clusters.

In the following chapter the data used in the previous analyses were combined, and analysed to generate representative MMPI-2 clusters. The specificity of these patterns could then again be considered in light of the clinical diagnosis.

CHAPTER 8

Cluster Analysis of the Combined Forensic CP, TBI, and PTSD Samples

As seen in Chapter 7, the relationships between the subgroups in the three samples suggested a distinct lack of independence. In this chapter the data from these groups were combined and cluster analysed in order to generate more representative and stable cluster groups. Based on the results of the previous studies, these patterns would be expected to be relatively evenly distributed across the three samples.

8.1 Combined Forensic Sample Cluster Analysis Results

A hierarchical cluster analysis of the combined group (n =529) was conducted and the inverse scree plot was examined (Figure 8.1). This indicated a flattening of the curve at a four cluster solution (marker A) which became more pronounced at a three cluster solution (marker B), suggesting that either a three or four cluster solution would be likely.

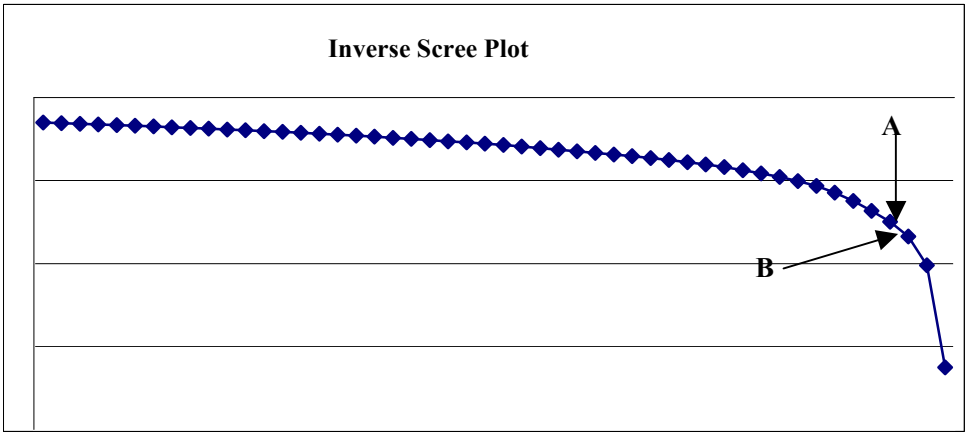

Figure 8.1 Inverse Scree Plot of the final 50 Agglomeration Coefficients for the Combined Sample

The agglomeration coefficient (see Table 8.1) shows that the percentage change jumps when moving from the five to the four cluster solution, after relatively small increases. This identifies the four cluster solution as the more appropriate result.

Table 8.1

Percentage Change in the Agglomeration Coefficients for the Combined Sample Hierarchical Analysis

Number of Clusters	Agglomeration Coefficient	Percentage Change
8	419691.50	4.18
7	437259.38	4.76
6	458100.63	5.46
5	**483137.22**	**6.47**
4	**514441.00**	**10.29**
3	567385.25	16.88
2	663183.50	56.50
1	1307916.38	------

Examination of group membership at the four cluster solution indicated that all clusters included greater than 5% (n = 27) of the sample size, and were therefore considered meaningful based on adequate group membership (Range n = 84 to n = 177). Consequently, based on the inverse scree plot and the percentage change in the agglomeration coefficient, a four cluster solution was considered to be most appropriate for the combined data set. See Appendix J for a complete table of descriptive statistics for the hierarchical analysis.

8.2 k-means Cluster Analysis Results

A k-means cluster analysis specifying a four cluster solution was then carried out. Descriptive statistics for the Basic scales used to derive the k-means clusters are presented in Table 8.2. A more comprehensive table including subscales and Content scales can be found in Appendices K and L .

Table 8.2

Mean MMPI-2 Scores for the k-means (k) Cluster Solutions

	Cluster 1 (N=177)		Cluster 2 (N=84)		Cluster 3 (N=145)		Cluster 4 (N=123)	
	M	SD	M	SD	M	SD	M	SD
Scale								
Hs	62.77	10.47	61.06	9.63	78.11	8.87	81.59	10.92
D	60.88	9.36	70.35	10.95	82.56	8.90	89.98	9.87
Hy	61.69	11.69	57.48	9.31	80.30	9.78	82.97	13.69
Pd	49.37	8.43	62.64	8.90	58.08	8.53	71.68	10.62
Mf	50.41	10.71	51.24	10.47	50.23	7.55	52.28	8.47
Pa	48.34	8.74	64.26	9.77	59.30	9.65	82.80	12.63
Pt	51.95	7.53	69.96	9.77	72.02	7.99	87.10	8.06
Sc	51.82	7.58	73.37	9.48	66.94	8.74	90.76	10.55
Ma	48.37	8.28	57.73	11.58	48.63	9.44	57.00	10.76
Si	51.01	8.91	61.67	11.28	61.84	10.56	69.63	10.39

Note: k = k-means cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits. Cluster 2 = Distress / Anxiety. Cluster 3 = High Distress / High Disturbance Group 1. Cluster 4 = High Distress / High Disturbance Group 2.

Whilst cluster solutions with substantial numbers of cases appear to have been generated, as with the previous analyses of individual samples, correlational analysis indicates a degree of interdependence among the derived clusters formed along the dimensions of profile shape and magnitude (see Figures 8.2, 8.3). The cluster intercorrelations are presented in Table 8.3, and indicate a high degree of association between Cluster 1 and Cluster 3 ($r = .88$, $p<.01$). These two clusters demonstrate highly similar shapes, but differ substantially in terms of mean elevation (magnitude).

The lack of significant correlations between Cluster 1 and Clusters 2 and 4 indicate that these patterns differ in shape from Cluster 1.

Cluster 2 correlates significantly with Cluster 4 (r = .83, $p<.01$), again, indicating the similarity of profile shape, and dissimilarity in magnitude, as is the case with the significant correlation between Cluster 3 and Cluster 4 (r = .81, $p<.01$).

Table 8.3

Correlations between the Combined Sample k-means clusters

Cluster	Cluster1	Cluster 2	Cluster 3	Cluster 4
Cluster 1		.70	**.88***	.48
Cluster 2			.47	**.83***
Cluster 3				**.81***
Cluster 4				

Note: All tests two tailed. * = significant < .01.

8.3 Scale Base Rates

In order to determine the likely interpretative significance of these clusters, the proportion of elevated scores was computed for each scale and subscale. Comparisons were conducted separately for each scale using a test of significance of the difference between two independent proportions (Ferguson & Takane, 1989), with Bonferroni adjustment of the critical alpha level ($p< .001$) to correct for the large number of scale comparisons. In a normative sample about 6.5% of the sample would be expected to have scores that are more than 1.5 standard deviations above the mean. By using this method, the percentage of cases elevating any scale in excess of

11% constitutes a significantly greater proportion of elevations than would be expected in a normal sample.

While 11% would indicate a statistically significant proportion of elevations, it is difficult to confidently interpret an elevation in a scale that is found in little more than 1 in 10 cases. Due to the large number of scales elevated by 11% or more of participants in this study (eg., 100% of Cluster 2 Content Scales), the more stringent criterion of 25% was employed in order to assert a clinically meaningful interpretation.

Table 8.4 (Validity and Basic Scales), and Table 8.5 (Content Scales) along with the graphical representations of the clinical and content scales will be used to consider the clinical implications of each of these clusters.

In examining the implications of each profile no attention has been given to the response bias measures of the MMPI-2. The primary reason for this, as discussed earlier, is that response-bias evaluation occurs at an earlier point in the interpretative process than would be appropriate for the use of these clusters. Additionally, recent changes in the interpretative guidelines, particularly regarding F and Fb leave substantial uncertainty regarding what criteria should be currently applied to the determination of response bias (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 2001). As can be seen in Table 8.4, the total number of cases excluded from each of the diagnostic groups on the basis of elevated response bias scores would have been quite small.

Table 8.4

Proportion of cases that elevated response bias scales

Scale	Cluster1 (N=177)	Cluster 2 (N=84)	Cluster 3 (N=145)	Cluster 4 (N=123)
F>= 110	0.00	0.06	0.00	0.07
F - Fb	0.00	0.00	0.00	0.00
Fp>= 90	0.00	0.06	0.01	0.09

Note: Cluster 1 = Within Normal Limits; Cluster 2 = Depressed/Anxious; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

To consider all of the relevant issues regarding potential bias would be to divert the focus of this research away from the communality of MMPI-2 profiles to the appropriate determination of response bias. Again, it is assumed that any clinician wishing to consider the implications of this research for their interpretation of the MMPI-2 would be doing so only after having determined that the protocol is valid by whatever criteria they deem appropriate.

8.3.1 k-means Cluster 1. There were no mean elevations of any of the clinical scales, or clinical subscales in this cluster. The highest clinical scale was Hs, followed by Hy and D. This cluster is described as the Within Normal Limits (WNL) profile, and consisted of 177 individuals (33%). A complete summary of the percentage of scales with elevations significantly different to the normative sample is presented in Tables 8.5 and 8.6, respectively.

Table 8.5

Percentage of Elevations of Clinical Scale and Subscale Scores for Cluster 1 (n = 177)

Scale		n	Mean	SD	% of cases 65 or above
L		**55**	**57.27**	**10.92**	**31**
F		16	51.23	8.35	9
Fb		13	50.73	8.85	7
Fp		**23**	**51.51**	**10.34**	**13**
K		15	49.73	10.75	8
Hs		**83**	**62.77**	**10.47**	**47**
D		**62**	**60.88**	**9.36**	**35**
	D1	**41**	**57.87**	**9.08**	**23**
	D2	**20**	**53.29**	**9.10**	**11**
	D3	**53**	**59.03**	**10.65**	**30**
	D4	**62**	**59.41**	**10.94**	**35**
	D5	17	52.33	9.34	10
Hy		**77**	**61.69**	**11.69**	**44**
	Hy 1	0	52.06	9.27	0
	Hy2	12	49.36	10.04	7
	Hy3	**82**	**63.29**	**10.88**	**46**
	Hy4	**59**	**59.86**	**11.46**	**33**
	Hy5	8	48.22	10.60	4
Pd		11	49.37	8.43	6
	Pd1	14	49.43	8.51	8
	Pd2	14	51.20	9.60	8
	Pd3	15	52.01	9.41	8
	Pd4	9	49.15	8.81	5
	Pd5	7	48.80	9.09	4
Mf		**20**	**50.41**	**10.71**	**11**
Pa		6	48.34	8.74	3
	Pa1	6	49.93	7.98	3
	Pa2	5	47.71	9.13	3
	Pa3	15	49.57	9.78	8
Pt		7	51.95	7.53	4
Sc		9	51382	7.58	5
	Sc1	12	47.66	8.67	7
	Sc2	14	49.98	8.81	8
	Sc3	**55**	**56.56**	**12.51**	**31**
	Sc4	**35**	**53.51**	**9.12**	**20**
	Sc5	16	50.07	8.75	9
	Sc6	**37**	**55.71**	**10.62**	**21**
Ma		7	48.37	8.28	4
	Ma1	16	50.19	9.02	9
	Ma2	4	47.59	9.38	2
	Ma3	**21**	**51.48**	**10.77**	**12**
	Ma4	7	48.18	9.62	4
Si		12	51.01	8.91	7
	Si1	16	48.73	9.41	9
	Si2	**23**	**50.54**	**9.71**	**13**
	Si3	15	50.65	10.19	8

Note. Cluster 1 = Within Normal Limits. Scales with significantly different base rates are highlighted in bold typeface.

Table 8.6

Percentage of Elevations of Content Scale and Subscale Scores for Cluster 1 (n = 177)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**23**	**53.66**	**9.02**	**13**
FRS		10	48.94	9.22	6
	FRS1	14	49.78	9.31	8
	FRS2	11	46.11	10.58	6
OBS		14	48.62	9.65	8
DEP		15	52.17	8.30	8
	DEP1	**23**	**53.13**	**9.56**	**13**
	DEP2	**28**	**53.17**	**10.26**	**16**
	DEP3	12	50.91	8.75	7
	DEP4	1	48.38	6.81	1
HEA		**63**	**61.80**	**8.59**	**36**
	HEA1	16	51.01	9.74	9
	HEA2	**61**	**59.53**	**13.34**	**34**
	HEA3	**74**	**63.19**	**11.71**	**42**
BIZ		8	48.78	7.89	4
	BIZ1	**22**	**50.03**	**9.05**	**12**
	BIZ2	10	46.99	8.31	6
ANG		17	50.94	10.85	10
	ANG1	10	48.80	9.37	6
	ANG2	**33**	**52.36**	**10.87**	**19**
CYN		12	49.92	8.99	7
	CYN1	17	50.11	9.81	10
	CYN2	5	48.90	8.85	3
ASP		14	49.17	9.55	8
	ASP1	11	48.99	9.71	6
	ASP2	11	48.70	9.58	6
TPA		11	46.67	10.47	6
	TPA1	9	47.47	10.44	5
	TPA2	4	41.99	9.43	2
LSE		12	50.58	9.53	7
	LSE1	11	49.94	9.72	6
	LSE2	15	48.75	9.78	8
SOD		11	49.33	9.39	6
	SOD1	17	49.56	9.22	10
	SOD2	15	48.72	10.08	8
FAM		7	46.79	8.85	4
	FAM1	11	46.20	10.30	6
	FAM2	**19**	**50.26**	**9.20**	**11**
WRK		**20**	**52.30**	**9.16**	**11**
TRT		9	50.72	8.86	5
	TRT1	**23**	**51.12**	**9.51**	**13**
	TRT2	8	47.19	8.49	5

Note. Cluster 1 = Within Normal Limits. Scales with a significantly proportion of elevations to the normative sample are highlighted

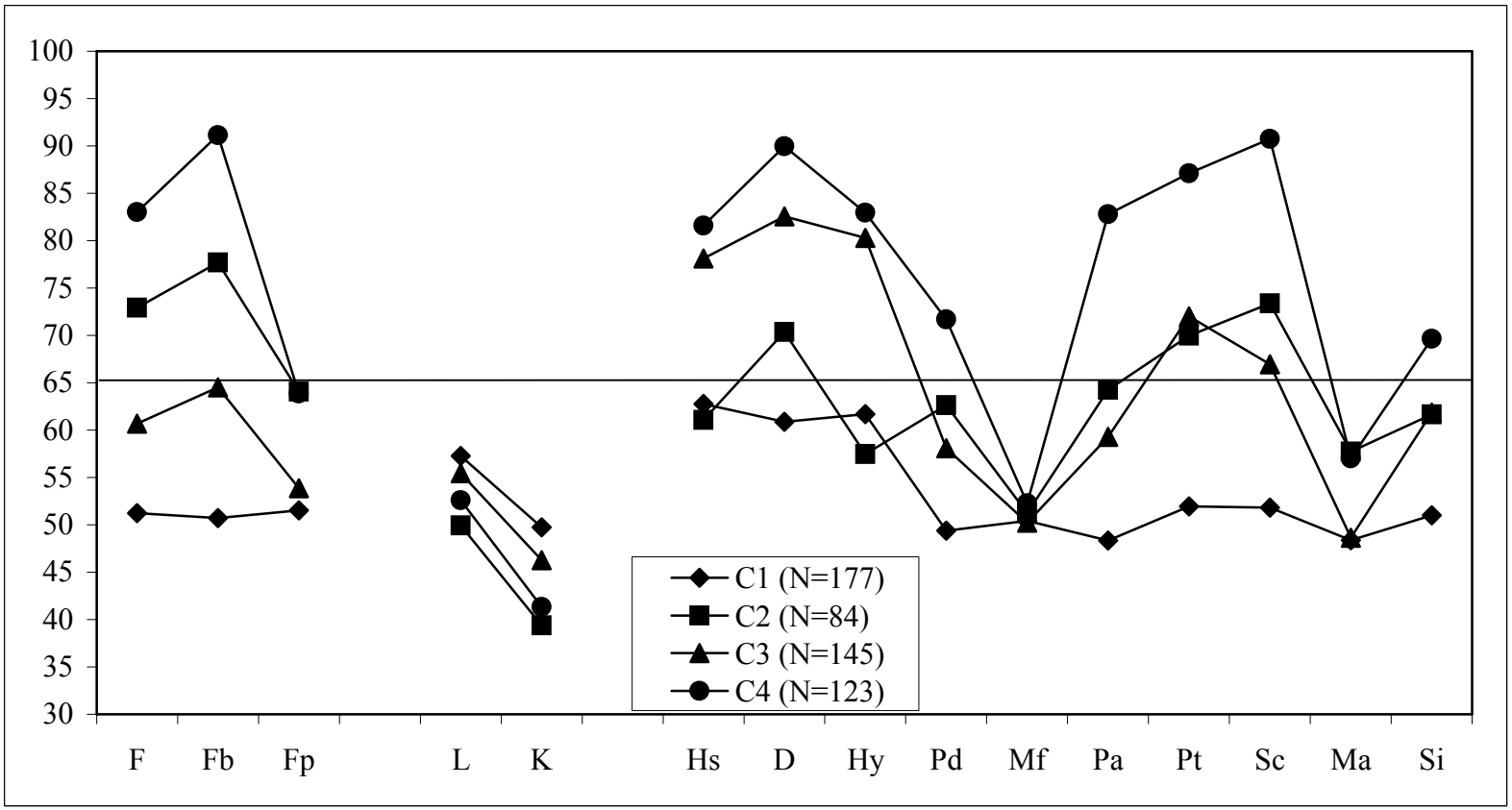

Figure 8.2 Mean K-corrected T-Score for Clinical Scales

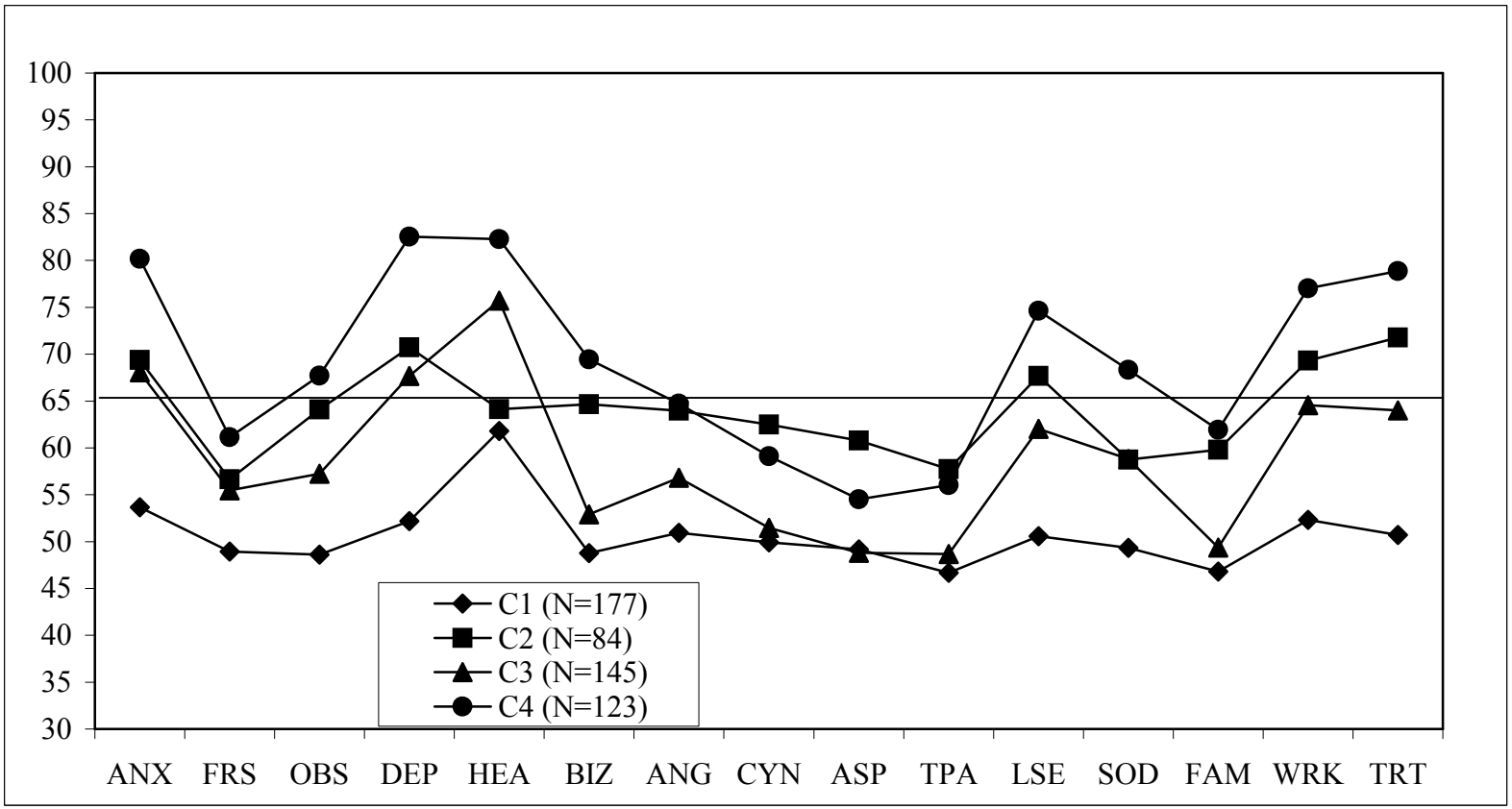

Figure 8.3 Mean K-Corrected T-Scores for the Content Scales

The Cluster 1 mean content scales also revealed no clinical elevations, with the highest score being the HEA scale. Examination of the Content subscales also revealed no clinical elevations, with the highest subscale being HEA3. Closer analysis, however, revealed that some cluster members did in fact elevate several scales above the 65 cut-off point. Those Cluster 1 scales and subscales which were elevated by 25% or more of the sample related predominantly to physical symptoms and health concerns: HEA (36%), HEA2 (34%), HEA3 (42%), Hs (47%), Hy (44%), Hy3 (46%), D3 (30%), and attention and concentration difficulties: D4 (35%), D (35%), Sc3 (31%).

Whilst described as a WNL cluster, more than one in four cases in this cluster exhibit some concern about their health and report a number of physical symptoms and somatic complaints. It was further noted that 35% of participants also elevated the Depression scale. The majority of these individuals elevated scale D3 and D4, indicating that they are generally apathetic, and concerned and preoccupied with their poor health. As content scales ANX and DEP were not elevated by significant numbers, these individuals do not appear to be experiencing any negative affect as a result of their health concerns.

8.3.2 k-means Cluster 2. Cluster 2 reflects high levels of interpersonal distress. There were 84 individuals (16%) in this cluster. The highest clinical scale was scale D, followed by Sc and Pt. This cluster was interpreted as a Distressed / Anxious group. There were also significant elevations of the Depression subscales D1, D4, and D5. Whilst not generating an overall mean clinical elevation, significant numbers of individuals (39%) in this cluster elevated the D3 subscale. All of the Sc subscales also recorded quite high percentages of clinical elevations. The percentage

of clinical elevations on each clinical scale and subscale are presented in Table 8.7. A subsequent examination of the Cluster 2 mean content and content subscale scores revealed elevations on scales ANX, DEP, LSE, WRK, and TRT, along with all of the DEP subscales, HEA2, LSE1, and TRT1. A complete table of the percentage of individuals that elevated content and content subscales in presented in Table 8.8.

A significant proportion of individuals in this cluster appear to exhibit high levels of depression and anxiety. For over two thirds of the individuals in this cluster, their distress appears to negatively impact on their ability to carry out their workplace responsibilities. These individuals also appear to be experiencing a high degree of negative affect as a result of their health concerns. Treatment may also be a problematic issue for this group.

8.3.3 k-means Cluster 3. Cluster 3 reflects high levels of interpersonal distress together with psychological disturbance, with elevations on five of the ten clinical scales. This group contained 145 (27%) individuals. This profile was interpreted as a High Distress / High Disturbance subgroup.

The highest clinical scale was scale D, followed by Hy and Hs. Many elevations were also evident on a majority of the clinical subscales. The highest subscale was Hy3, followed by D1, and D4. A closer examination, however, revealed significant numbers of cluster members also elevated clinical subscales. A complete table of the percentage of individuals that elevated clinical scales is presented in Table 8.9.

Table 8.7

Percentage of Elevations Clinical Scale and Sub-Scale Scores for of Cluster 2 (n = 84)

Scale		n	Mean	SD	% of cases 65 or above
L		10	49.93	10.68	8
F		**51**	**72.92**	**17.42**	**61**
Fb		**60**	**77.71**	**20.46**	**71**
Fp		**36**	**64.06**	**17.58**	**43**
K		2	39.39	9.10	2
Hs		**35**	**61.06**	**9.63**	**42**
D		**56**	**70.35**	**10.95**	**67**
	D1	**68**	**74.89**	**11.01**	**81**
	D2	**23**	**56.02**	**11.80**	**11**
	D3	**33**	**61.80**	**11.17**	**39**
	D4	**69**	**77.69**	**13.73**	**82**
	D5	**56**	**69.57**	**10.85**	**67**
Hy		**15**	**57.48**	**9.31**	**18**
	Hy 1	0	44.23	9.13	0
	Hy2	0	39.35	7.67	0
	Hy3	**65**	**72.48**	**11.47**	**77**
	Hy4	**37**	**63.37**	**13.29**	**44**
	Hy5	5	43.74	10.27	6
Pd		**35**	**62.64**	**8.90**	**42**
	Pd1	**27**	**59.89**	**10.49**	**32**
	Pd2	**11**	**54.67**	**9.04**	**13**
	Pd3	1	44.68	9.33	1
	Pd4	**49**	**66.74**	**10.08**	**58**
	Pd5	**49**	**68.51**	**9.06**	**58**
Mf		**11**	**51.24**	**10.47**	**13**
Pa		**38**	**64.26**	**10.47**	**45**
	Pa1	**48**	**68.98**	**13.52**	**57**
	Pa2	**40**	**63.06**	**10.81**	**48**
	Pa3	4	42.73	9.86	5
Pt		**61**	**69.96**	**9.77**	**73**
Sc		**73**	**73.37**	**9.48**	**87**
	Sc1	**51**	**68.36**	**12.22**	**61**
	Sc2	**55**	**69.63**	**16.26**	**64**
	Sc3	**72**	**78.61**	**12.81**	**86**
	Sc4	**73**	**75.21**	**11.96**	**87**
	Sc5	**55**	**67.36**	**11.14**	**65**
	Sc6	**59**	**72.35**	**15.10**	**70**
Ma		**26**	**57.73**	**11.58**	**31**
	Ma1	**19**	**55.15**	**10.43**	**23**
	Ma2	**15**	**55.15**	**9.73**	**18**
	Ma3	3	44.98	9.88	4
	Ma4	**25**	**59.15**	**11.12**	**30**
Si		**38**	**61.67**	**11.28**	**45**
	Si1	**21**	**57.23**	**9.39**	**25**
	Si2	**22**	**54.15**	**11.85**	**26**
	Si3	**47**	**65.38**	**10.95**	**56**

Note. Cluster 2 = Depressed/Anxious group. Scales with significantly different base rates are highlighted in bold typeface.

Table 8.8

Percentage of Elevations of Content Scale and Subscale Scores for Cluster 2 (n = 84)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**60**	**69.38**	**10.56**	**71**
FRS		**21**	**56.65**	**12.21**	**25**
	FRS1	**35**	**62.52**	**15.48**	**42**
	FRS2	**9**	**49.69**	**11.34**	**11**
OBS		**37**	**64.11**	**11.13**	**44**
DEP		**61**	**70.74**	**10.76**	**73**
	DEP1	**61**	**72.75**	**13.99**	**73**
	DEP2	**53**	**69.70**	**12.62**	**63**
	DEP3	**48**	**66.98**	**10.23**	**57**
	DEP4	**29**	**65.32**	**22.85**	**35**
HEA		**37**	**64.13**	**10.13**	**44**
	HEA1	**17**	**55.92**	**11.86**	**20**
	HEA2	**43**	**65.02**	**13.45**	**51**
	HEA3	**28**	**62.68**	**11.09**	**33**
BIZ		**35**	**64.64**	**14.80**	**42**
	BIZ1	**38**	**64.17**	**19.93**	**45**
	BIZ2	**37**	**63.98**	**14.69**	**44**
ANG		**43**	**63.95**	**12.55**	**51**
	ANG1	**36**	**63.08**	**12.81**	**43**
	ANG2	**47**	**60.99**	**10.62**	**56**
CYN		**36**	**62.48**	**12.06**	**43**
	CYN1	**35**	**60.54**	**9.90**	**42**
	CYN2	**26**	**58.88**	**9.71**	**31**
ASP		**27**	**60.77**	**11.84**	**32**
	ASP1	**21**	**59.23**	**10.25**	**25**
	ASP2	**17**	**55.12**	**10.48**	**20**
TPA		**22**	**57.74**	**11.78**	**26**
	TPA1	**21**	**56.86**	**10.32**	**25**
	TPA2	**10**	**50.92**	**10.87**	**12**
LSE		**45**	**67.67**	**11.92**	**54**
	LSE1	**49**	**66.65**	**11.84**	**58**
	LSE2	**24**	**59.25**	**11.36**	**29**
SOD		**27**	**58.75**	**12.19**	**32**
	SOD1	**28**	**57.81**	**12.64**	**33**
	SOD2	**17**	**55.82**	**9.81**	**20**
FAM		**29**	**59.79**	**9.98**	**35**
	FAM1	**36**	**59.93**	**10.82**	**43**
	FAM2	**18**	**55.15**	**11.38**	**21**
WRK		**57**	**69.30**	**11.03**	**68**
TRT		**62**	**71.79**	**12.63**	**74**
	TRT1	**58**	**72.70**	**14.85**	**69**
	TRT2	**32**	**59.58**	**10.60**	**38**

Note. Cluster 2 = Depressed / Anxious group. Scales with significantly different base rates are indicated in bold typeface.

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Examination of the Cluster 3 content scales revealed clinical elevations for scales ANX, DEP, HEA. Elevations were also evident for the content subscales DEP1, DEP2, HEA2, HEA3, and TRT1. A complete table of the percentage of individuals that elevated these scales are presented in Table 8.10.

The numerous clinical elevations in this cluster suggest that these people are experiencing substantial distress and dysfunction in their lives. The pattern of scores on the scales Hs, D, and Hy is similar to that of Cluster 2, but of a higher magnitude. These individuals appear to report a number of localised physical symptoms and somatic complaints, and appear to be experiencing a high degree of negative affect as a result of their health concerns. Similarly, a high proportion of these individuals also appear to be experiencing anxiety, and to slightly lesser degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For over seventy percent of the individuals in this cluster, their condition appears to negatively impact on their ability to carry out their workplace responsibilities. Because of the high percentage of individuals that elevated the TRT1 (low motivation) subscale, treatment may a problematic issue.

Table 8.9

Percentages of Elevations of Clinical Scale and Subscale Scores for of Cluster 3 (n = 145)

Scale		n	Mean	SD	% of cases 65 or above
L		**25**	**55.45**	**9.91**	**17**
F		**44**	**60.68**	**10.10**	**30**
Fb		**68**	**64.51**	**14.78**	**47**
Fp		**20**	**53.86**	**10.69**	**14**
K		6	46.26	9.46	4
Hs		**136**	**78.11**	**8.87**	**94**
D		**143**	**82.56**	**8.90**	**99**
	D1	**140**	**79.63**	**9.65**	**97**
	D2	**72**	**63.15**	**10.87**	**50**
	D3	**107**	**71.98**	**10.94**	**74**
	D4	**137**	**79.70**	**9.99**	**95**
	D5	**90**	**67.99**	**9.54**	**94**
Hy		**140**	**80.30**	**9.78**	**97**
	Hy 1	0	47.92	9.20	0
	Hy2	4	48.84	9.70	3
	Hy3	**142**	**84.01**	**9.19**	**98**
	Hy4	**128**	**77.53**	**12.37**	**88**
	Hy5	5	48.42	9.12	3
Pd		**28**	**58.08**	**8.53**	**19**
	Pd1	**28**	**52.43**	**10.90**	**19**
	Pd2	13	49.94	10.62	9
	Pd3	2	47.31	9.71	1
	Pd4	**36**	**57.63**	**9.93**	**25**
	Pd5	**58**	**62.08**	**9.67**	**40**
Mf		8	50.23	7.55	5
Pa		**42**	**59.30**	**9.65**	**29**
	Pa1	**21**	**55.90**	**9.90**	**14**
	Pa2	**39**	**57.03**	**9.77**	**27**
	Pa3	**22**	**50.03**	**10.49**	**15**
Pt		**116**	**72.02**	**7.99**	**65**
Sc		**94**	**66.94**	**8.74**	**65**
	Sc1	**33**	**55.63**	**10.64**	**23**
	Sc2	**72**	**64.94**	**13.21**	**50**
	Sc3	**99**	**71.10**	**13.37**	**68**
	Sc4	**111**	**71.86**	**11.47**	**77**
	Sc5	**39**	**58.12**	**11.24**	**27**
	Sc6	**88**	**69.45**	**14.59**	**61**
Ma		10	48.63	9.44	7
	Ma1	11	49.24	9.04	8
	Ma2	5	47.39	8.92	3
	Ma3	5	46.92	9.43	3
	Ma4	5	48.78	9.62	3
Si		**58**	**61.84**	**10.56**	**40**
	Si1	**38**	**56.08**	**9.90**	**26**
	Si2	**55**	**57.99**	**11.32**	**38**
	Si3	**40**	**59.09**	**10.04**	**28**

Note. Cluster 3 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are highlighted in bold print.

Table 8.10

Percentages of Elevations of Content Scale and Subscale Scores for of Cluster 3 (n = 145)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**96**	**68.06**	**9.71**	**66**
FRS		**34**	**55.48**	**11.06**	**23**
	FRS1	**43**	**59.43**	**14.97**	**30**
	FRS2	**16**	**49.59**	**10.96**	**11**
OBS		**39**	**57.25**	**11.59**	**27**
DEP		**97**	**67.69**	**9.02**	**67**
	DEP1	**96**	**70.50**	**12.24**	**66**
	DEP2	**103**	**71.77**	**13.23**	**71**
	DEP3	**36**	**60.30**	**7.95**	**25**
	DEP4	**37**	**61.28**	**19.59**	**26**
HEA		**126**	**75.72**	**9.93**	**87**
	HEA1	**56**	**63.16**	**14.74**	**39**
	HEA2	**104**	**74.97**	**17.41**	**72**
	HEA3	**121**	**75.74**	**9.45**	**83**
BIZ		**18**	**52.90**	**10.12**	**12**
	BIZ1	**25**	**52.30**	**12.95**	**17**
	BIZ2	**20**	**51.87**	**10.59**	**14**
ANG		**34**	**56.81**	**10.48**	**23**
	ANG1	**19**	**52.56**	**11.14**	**13**
	ANG2	**52**	**59.01**	**9.34**	**36**
CYN		**19**	**51.47**	**10.09**	**13**
	CYN1	**16**	**51.19**	**10.35**	**11**
	CYN2	10	50.66	9.85	7
ASP		7	48.81	8.67	5
	ASP1	6	48.47	9.25	4
	ASP2	**16**	**49.32**	**10.20**	**11**
TPA		8	48.66	9.00	6
	TPA1	12	53.59	9.20	8
	TPA2	2	41.83	8.85	1
LSE		**62**	**62.03**	**10.97**	**43**
	LSE1	**57**	**62.44**	**11.02**	**39**
	LSE2	**21**	**53.17**	**10.83**	**14**
SOD		**52**	**58.83**	**12.18**	**36**
	SOD1	**51**	**58.92**	**12.19**	**35**
	SOD2	**37**	**54.88**	**10.27**	**26**
FAM		8	49.37	9.46	6
	FAM1	10	48.96	10.01	7
	FAM2	15	48.57	9.93	10
WRK		**75**	**64.57**	**10.95**	**52**
TRT		**63**	**63.99**	**11.49**	**43**
	TRT1	**83**	**67.92**	**14.80**	**57**
	TRT2	**17**	**51.379**	**10.08**	**12**

Note. Cluster 3 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are highlighted in bold print.

8.3.4 k-means Cluster 4. Cluster 4 reflects even higher levels of interpersonal distress and psychological disturbance than was found in Cluster 3, with elevations on 8 of the 10 clinical scales. This group contained 123 (23%) individuals. This profile was interpreted as another High Distress / High Disturbance subgroup, but of a much higher magnitude. The highest clinical elevation was scale Sc followed by D and Pt. Many elevations were also evident on the clinical subscales. The highest subscale was D4, followed by Hy3 and D1. The percentages of individuals with elevated clinical scales and subscale scores are presented in Table 8.11.

Examination of the Cluster 4 content scales revealed clinical elevations on 9 of the scales. Numerous elevations were also present on 13 of the content subscales. Clinical elevations in this cluster suggest that these individuals are experiencing a great deal of dysfunction in their lives. The pattern of scores is similar to that of Cluster 3, but of a much higher magnitude. Similar to Cluster 3, these individuals appear to report a number of physical symptoms and somatic complaints. These individuals also appear to be experiencing a high degree of negative affect as a result of their health concerns. Ninety nine percent of participants elevated the Depression clinical scale and content subscales, indicating that they are generally depressed, lack energy to cope with their problems, display apathy, and are concerned with their poor health. All of the individuals elevated the D4 subscale, indicating that they lack of energy and are experiencing attention/concentration difficulties.

A similarly high proportion of these individuals also appear to be experiencing anxiety, and to slightly lesser degree, anger, low self-esteem, self-doubt, poor motivation and a high degree of social alienation and familial discomfort. For over ninety percent of the individuals in this cluster, their condition appears to negatively

impact on their ability to carry out their workplace responsibilities. Because of the high percentage of individuals that elevated the TRT1 subscale (low motivation), treatment may also be a problematic issue for the individuals in this group. Scales with significantly higher base rates of clinical elevations when compared to the normal population are highlighted in Table 8.12.

8.4 Diagnostic Distribution across the Four Clusters

Table 8.13 displays the distribution of the three different diagnostic groups across the four clusters derived from the combined sample. The four clusters appear with similar frequency in the total sample ranging from 16% to 34%. This pattern generally holds across each of the three diagnostic groups although it is noteworthy that Cluster 2 is less than half as likely in chronic pain (8%) than in traumatic brain injury (21%) or post-traumatic stress disorder (20%). Similarly, Cluster 1 is half as likely in PTSD (18%) than in TBI (37%) or CP (40%). Cluster 4 is also two to three times more likely in the PTSD group (39%), than CP (21%), or TBI (15%).

Regardless of these asymmetries, the frequency of occurrence in each of the diagnostic groups is too high to consider any cluster to be prototypical of any diagnosis, with virtually all clusters appearing with a frequency of 1 in 7 cases or better.

Table 8.11

Percentage of Elevations of Clinical Scale and Sub-Scale Scores for k-means PTSD Cluster 4 (n = 123)

Scale		n	Mean	SD	% of cases 65 or above
L		**16**	**52.59**	**10.56**	**13**
F		**108**	**83.02**	**16.97**	**88**
Fb		**112**	**91.14**	**19.36**	**91**
Fp		**50**	**63.85**	**17.33**	**41**
K		2	41.33	9.22	2
Hs		**116**	**81.59**	**10.92**	**94**
D		**122**	**89.98**	**9.87**	**99**
	D1	**122**	**91.96**	**9.83**	**99**
	D2	**74**	**67.08**	**10.96**	**60**
	D3	**100**	**78.74**	**13.14**	**81**
	D4	**123**	**93.81**	**9.98**	**100**
	D5	**116**	**82.21**	**9.13**	**94**
Hy		**112**	**823.97**	**13.69**	**91**
	Hy 1	0	42.18	8.68	0
	Hy2	2	42.80	9.55	2
	Hy3	**123**	**92.53**	**8.12**	**100**
	Hy4	**115**	**83.40**	**14.36**	**93**
	Hy5	4	47.20	10.02	3
Pd		**89**	**71.68**	**10.62**	**72**
	Pd1	**63**	**62.68**	**13.71**	**51**
	Pd2	11	51.80	10.28	9
	Pd3	2	42.79	8.95	2
	Pd4	**101**	**75.61**	**11.37**	**82**
	Pd5	**117**	**75.78**	**7.50**	**95**
Mf		10	52.28	8.47	8
Pa		**115**	**82.80**	**12.63**	**93**
	Pa1	**96**	**82.16**	**18.53**	**78**
	Pa2	**94**	**71.12**	**9.58**	**76**
	Pa3	**13**	**47.34**	**10.70**	**11**
Pt		**123**	**87.10**	**8.06**	**100**
Sc		123	90.76	10.55	10
	Sc1	**102**	**76.67**	**12.25**	**83**
	Sc2	**117**	**88.92**	**14.90**	**95**
	Sc3	**118**	**89.65**	**11.10**	**96**
	Sc4	**123**	**89.17**	**9.72**	**100**
	Sc5	**100**	**74.67**	**12.17**	**81**
	Sc6	**113**	**89.04**	**16.10**	**92**
Ma		**34**	**57.00**	**10.76**	**28**
	Ma1	**17**	**52.73**	**9.62**	**14**
	Ma2	**17**	**54.77**	**8.65**	**14**
	Ma3	2	42.85	9.22	2
	Ma4	**30**	**56.11**	**12.46**	**24**
Si		**81**	**69.63**	**10.39**	**66**
	Si1	**56**	**62.29**	**9.20**	**46**
	Si2	**72**	**62.64**	**11.07**	**59**
	Si3	**85**	**68.14**	**9.26**	**69**

Note. Cluster 4 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are highlighted in bold typeface.

Table 8.12
Percentage of Elevations of Content Scale and Subscale Scores for k-means PTSD Cluster 4 (n = 123)

Scale		n	Mean	SD	% of cases 65 or above
ANX		**122**	**80.17**	**7.01**	**99**
FRS		**48**	**61.16**	**13.89**	**39**
	FRS1	**76**	**72.65**	**19.50**	**62**
	FRS2	**18**	**60.38**	**11.71**	**15**
OBS		**83**	**67.72**	**9.14**	**67**
DEP		**122**	**82.53**	**8.42**	**99**
	DEP1	**121**	**86.07**	**11.22**	**99**
	DEP2	**116**	**82.37**	**9.28**	**94**
	DEP3	**97**	**72.69**	**8.92**	**79**
	DEP4	**82**	**88.75**	**27.56**	**67**
HEA		**114**	**82.28**	**11.36**	**93**
	HEA1	**75**	**72.28**	**17.80**	**61**
	HEA2	**108**	**84.66**	**15.89**	**88**
	HEA3	**106**	**77.04**	**9.22**	**86**
BIZ		**73**	**69.46**	**15.14**	**59**
	BIZ1	**66**	**69.97**	**23.28**	**54**
	BIZ2	**77**	**69.68**	**14.56**	**63**
ANG		**57**	**64.72**	**11.08**	**46**
	ANG1	**44**	**61.80**	**12.30**	**36**
	ANG2	**80**	**63.73**	**7.94**	**65**
CYN		**42**	**59.12**	**10.94**	**34**
	CYN1	**33**	**56.95**	**9.76**	**27**
	CYN2	**33**	**58.29**	**9.29**	**27**
ASP		**26**	**54.51**	**12.40**	**21**
	ASP1	**17**	**53.43**	**11.38**	**14**
	ASP2	**21**	**52.56**	**10.86**	**17**
TPA		**21**	**56.01**	**10.63**	**17**
	TPA1	**28**	**59.38**	**8.26**	**23**
	TPA2	10	48.12	10.18	8
LSE		**94**	**74.63**	**11.35**	**76**
	LSE1	**99**	**75.50**	**10.73**	**80**
	LSE2	**50**	**59.82**	**12.02**	**41**
SOD		**81**	**68.34**	**13.05**	**66**
	SOD1	**82**	**67.76**	**12.36**	**67**
	SOD2	**42**	**59.37**	**9.64**	**34**
FAM		**57**	**61.92**	**13.54**	**46**
	FAM1	**52**	**59.17**	**13.26**	**46**
	FAM2	**36**	**56.33**	**13.28**	**29**
WRK		**115**	**77.04**	**8.39**	**93**
TRT		**111**	**78.86**	**10.48**	**90**
	TRT1	**113**	**82.44**	**13.89**	**92**
	TRT2	**47**	**60.60**	**8.88**	**38**

Note. Cluster 4 = High Distress / High Disturbance Group 2. Scales with significantly different base rates are highlighted in bold typeface.

The one exception as noted before is that of Cluster 2 in CP. This cluster alone occurs in less than 1 in 12 CP cases, and may be sufficiently rare to be considered uncharacteristic. This suggests that should this profile occur, it is far less likely to be found in an individual experiencing chronic pain than TBI or PTSD.

Table 8.13

Distribution of Diagnostic Groups by k-means Cluster

Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4	
	(N=177)	(N=84)	(N=145)	(N=123)	
Group		Percentage of Group Members			N
CP	40	8	31	21	197
TBI	37	21	28	15	200
PTSD	18	20	23	39	132
Total	34	16	27	23	529

Note: Cluster 1 = Within Normal Limits. Cluster 2 = High Distress. Cluster 3 = High Distress/High Disturbance Group 1. Cluster 4 = High Distress/High Disturbance Group 2.

8.5 Summary and Conclusion

Overall, the four clusters generated in this study again represent two general dimensions of psychological distress and interpersonal dysfunction, with each cluster reflecting these difficulties, but with increasing magnitude. It is clear from the results that more than one profile exists in this mixed forensic sample. The distribution of diagnostic groups for each cluster reveals that overall they are reasonably evenly distributed, indicating that no single pattern of performance was an accurate discriminator of any of the three groups examined here. Multiple patterns of MMPI-2 performance are characteristic of the combined sample, and each of the three

diagnostic groups. The findings of this study do not support the notion that unique patterns of MMPI-2 performance exist as a consequence of diagnostic category.

To this point it has been demonstrated that the assumption of unique patterns of performance existing across diagnostic groups is without merit. The following chapter provides a general discussion of the previously conducted studies. Limitations are also discussed, together with implications for clinical practice.

CHAPTER 9

General Discussion and Implications for Clinical Practice

9.1 Overview

An assumption that appears prevalent in the MMPI-2 research literature is that individuals with various organic and psychological disorders form relatively homogeneous diagnostic groups. In much of the past research, however, personality characteristics of clinical groups have been based on mean profiles (i.e., the pattern of scale scores found when the profiles of a group of individuals are averaged together). Senior and Douglas (2001), however, found a significant degree of association with high correlations between the mean MMPI-2 profiles of three different diagnostic groups. Similarly, when Munley et al. (1995) compared the mean MMPI-2 profiles of a group of individuals suffering Post Traumatic Stress disorder with a general psychiatric group, they found that the PTSD group's mean profile on the MMPI-2 clinical scales did not differ significantly from the mean profile of the psychiatric comparison group.

Given the multiply determined nature of the problems faced by individuals who have suffered a physical or psychological injury, it appears reasonable to assume that grouping these individuals according to mean profiles or codetypes will lead to no more than minimal improvements in the accuracy of classification. It is also reasonable to assume that the utility of the MMPI-2 as a classification tool may be limited in its capacity to delineate patterns of emotional performance from one diagnostic group to another.

The fundamental aim of this dissertation was to determine whether unique

MMPI-2 patterns exist in medico-legal samples as a consequence of differential diagnosis. This was investigated by examining the MMPI-2 performances of individuals from three clinically distinct diagnostic groups. Three studies were carried out which examined the basis of MMPI-2 profiles in individuals suffering from Chronic Pain (CP), Traumatic Brain Injury (TBI), and Post Traumatic Stress Disorder (PTSD). Each analysis revealed three to four distinct patterns or profiles for each diagnosis. When these profiles were compared across the diagnostic groups, a high degree of similarity was indicated. This raised the intriguing idea that these were, in fact, the same MMPI-2 profiles appearing in each group. The three groups were combined into a larger sample, and stable clusters were derived for the sample as a whole. The analysis generated the same four patterns and demonstrated that the distribution, whilst not exactly equal in frequency in each diagnostic group, occurred with sufficiently high base rates to undermine any assumptions regarding prototypical or diagnostically-related MMPI-2 profiles.

The remainder of this chapter will discuss and summarise the findings of these studies in greater detail along with methodological limitations and implications for clinical practice.

9.2 General Discussion and Summary of Results

The first chapter of this dissertation identified a method of analysis capable of identifying unique patterns of performance. Surprisingly, given the potentially valuable information derived from cluster analysis, very few studies have been conducted on the MMPI-2 with this method. Chapter 2 highlighted this potential, as well as the limitations of cluster analysis to differentiate profiles within a data set. Conceptual issues and difficulties were discussed, together with solutions to

overcome these problems. Such problems included amongst others, how to identify the appropriate number of cluster profiles, and the best way to allocate cluster membership to derive representative clusters.

9.2.1 Study One. The first study employed cluster analysis to identify patterns of psychosocial functioning in chronic pain claimants based on performance across the ten clinical scales of the MMPI-2. The sample (n = 197) consisted of individuals diagnosed as suffering from Chronic Pain (CP), and who were in litigation at the time of assessment. The results indicated that there were three patterns of MMPI-2 performance. Profile one was characterised by the absence of clinical elevations on any of the Clinical, or Content scales, and was described as Within Normal Limits. Profile two was characterised by clinical elevations on primarily health-related scales. This profile was described as High Distress / Low Disturbance. For profile three, elevations were evident on seven of the ten clinical scales, and on seven Content scales. This profile was described as High Distress / High Disturbance.

The results of this study indicated that there was more than one pattern of MMPI-2 performance that was representative of individuals who were suffering from CP, at least in a medicolegal context. If only one pattern was indeed representative of this particular population, then only one pattern should have emerged. This was clearly not the case. These findings were also consistent with previous research, and replicated clusters found in previous MMPI (Costello et al., 1987), and MMPI-2 research carried out with mixed (Keller & Butcher, 1991), and low back pain samples (deBeus, 1997; Riley, 1993, 1998), suggesting that the patterns observed in the medicolegal context are indeed characteristic of this condition in general.

9.2.2 Study Two. Chapter five investigated MMPI-2 patterns in a medico-legal sample of individuals suffering from a Traumatic Brain Injury (TBI, n = 200). Cluster analysis revealed four subgroups within this sample. Cluster one was identified as a Within Normal Limits profile displaying an absence of clinical elevations on the Clinical and Content scales. Cluster 2 was characterised as a Distressed / Anxious sub group, with elevations of scales D and Pt. Scales indicating health concerns were not elevated in this cluster. Clusters 3 and 4 displayed high levels of Distress and Disturbance, with numerous elevations across the clinical and content scales. Whilst Clusters 2, 3, and 4 displayed elevated levels of Distress and Disturbance, the profiles differed primarily in magnitude.

When compared with the results of Study One, there appeared to be remarkable similarities, with high correlations between the cluster profiles of the CP and TBI groups. Whilst there may have been multiple patterns of performance identified for the CP group, these profiles do not appear to be unique to that particular diagnosis, and were also identified in the TBI group.

The findings indicate that a single MMPI-2 pattern of performance does not exist in this group of individuals with TBI, further disconfirming the notion that individuals with the same type of disorder will display a similar pattern of MMPI-2 performance. Rather these findings tend to support the presence of multiple profiles within different diagnostic groups. Similar to CP Clusters 1, 2, and 3, many clinical elevations were found on Basic and Content scales, whose mean cluster scores indicated they were below clinical significance. Once again this result suggests that mean cluster profile scores continue to obscure individual differences in test performance.

9.2.3 Study Three. Chapter six examined the MMPI-2 profiles of a third diagnostic group (n = 132), one suffering from Post Traumatic Stress Disorder (PTSD). Three separate patterns of performance were found for this group. When taken as an average, none of the clinical scales or clinical subscales were elevated in the Within Normal Limits cluster. Although this subgroup was described as WNL, a significant percentage of individuals in this cluster elevated scales that indicate that they have some concern about their health and appear to be experiencing a significant degree of negative affect as a result of their health concerns. Cluster 2 reflects high levels of distress and disturbance, evidenced by clinical elevations on 7 of the 10 clinical scales. This profile was interpreted as a High Distress / High Disturbance group. Cluster 2 content and content subscales also revealed elevations on 8 major scales and 10 of the subscales. The numerous clinical elevations in this cluster suggest that these individuals are experiencing a great deal of distress and dysfunction in their lives.

Cluster 3 reflected even higher levels of distress and disturbance than was found in Cluster 2. High elevations were evident on eight of the ten clinical scales. This profile was interpreted as a generally elevated High Distress / High Disturbance subgroup. The numerous elevations in this cluster suggest that these individuals were experiencing a very high of distress and dysfunction in their lives. Similar to Cluster 2, these individuals appear to report a number of somatic complaints. They also appear to be experiencing an even higher high degree of negative affect.

Whilst relatively stable cluster solutions appear to have been generated by different cluster analytic methodology, correlational analysis of the k-means clusters generated in this study indicates that, similar to the previous CP and TBI studies, they

were formed along the dimension of profile shape and profile magnitude and reflect two general dimensions of distress and disturbance, with each cluster reproducing these difficulties, but with ever increasing magnitude. The results of this study again further reject the notion that individuals from the same diagnostic group will exhibit a similar pattern of MMPI-2 as a consequence of their particular disorder, and also calls into question the efficacy of the use of mean cluster profiles scores.

9.2.4 Study Four. When taken together the results of the three aforementioned studies do not appear to support the contention that individuals from different diagnostic groups exhibit different patterns of MMPI-2 performance. While multiple patterns of performance were generated within individual diagnostic groups, these profiles were found not to be unique to a particular diagnosis.

The derived clusters represent a continuum of generalised distress and disturbance across the three samples. While this is certainly an endorsement of the MMPI-2 to be able to reflect such difficulties, the previous findings call into question the utility of the instrument to differentiate between various clinical groups.

9.2.5 Study Five. In the final study, the data used in the previous analyses was combined and analysed on the premise that if there were distinguishable patterns then cluster analysis should separate them out with a relatively equal distribution in each diagnostic group. The results indicated that there were four MMPI-2 profiles in the combined forensic sample. Again, these clusters were similar in profile shape, but differed in elevation. The clusters appeared to reflect two general dimensions of psychological distress and interpersonal dysfunction, with each cluster reproducing these difficulties with increasing magnitude. The distribution of diagnostic groups for each cluster revealed that overall, they were reasonably evenly distributed. The

exception being Cluster 2 (Distressed / Anxious), which made up only 8% of the CP diagnostic group.

To this point it has been demonstrated that the concept of unique patterns of performance existing across diagnostic groups is without merit. One lesson from this was the distorted view that is achieved when one considers only group averages. In these samples, rather than a single group that would be best represented by a group mean on each scale, three to four patterns each with their own mean elevations best captures the variability in scores.

Given the numbers of individuals that elevated scales in the WNL clusters, however, classifying these clusters as WNL may be somewhat of a misnomer. Whilst mean scores fell below 65, the percentage of individuals indicating psychosocial difficulties was still high.

Whilst three to four MMPI-2 profiles were identified that were representative of individuals in litigation, it could not be determined whether or not these results were unique to a particular diagnostic group.

9.3 Conclusions

The results of these studies have provided some useful information regarding the use of cluster analysis and the potential problems associated with the assumption that unique patterns of MMPI-2 performance exist in different diagnostic groups. The following conclusions from the five studies in this investigation are summarised below.

1. Multiple profiles (three to four) were found within the three diagnostic groups, and indicate that a single pattern of MMPI-2 performance **does not** appear to be characteristic of a particular disorder. The notion of

homogeneity of test patterns (as far as the MMPI-2 is concerned) within a diagnostic group is not supported.

2. The MMPI-2 profiles identified in each of the three clinical classifications were not found to be unique to these groups and **commonly occurred across the three diagnostic groups.**
3. It is unclear at this stage how many common patterns exist across diagnostic groups, however, there appear to be at least three to four profiles which characterise individual performance on the MMPI-2.
4. Cluster analysis appeared to be a useful methodology to determine commonly occurring profiles within a specified population.
5. The current findings highlight the complexity of attempting to classify individual profile configurations in terms of a single diagnostic category, and directly challenge the utility of the MMPI-2 as an effective tool in this regard.

9.4 Limitations

The results of this investigation indicate that a strong relationship was found between profiles generated in the previous studies, and confirm the absence of unique patterns of MMPI-2 performance existing within different diagnostic groups. Although this investigation has directly contradicted many of the assumptions both in the MMPI-2, and Chronic Pain literature, with regard to using the instrument as a means of diagnostic classification, the studies described in this dissertation are not without their limitations.

For the type of analysis conducted in this investigation it is important to include a large number of individual MMPI-2 profiles for the cluster analysis procedure to be effective. Whilst a sufficiently large database was collected to satisfy the assumptions of cluster analysis, numbers were considered too small to allow cross validation of the cluster solutions.

In Australia, although clinics and hospitals have pass through their doors high numbers of people involved in specific forensic issues, these people are neither common in private practice, nor easily accessible in institutional settings. It is suggested that collection of sufficient numbers will require researchers to form networks through which small numbers of cases can be assembled into larger groups. Through this method sufficient numbers of cases can be collected from independent samples to allow the cross validation of cluster solutions in future studies.

These results also appear to be limited in their applicability to other diagnostic groups. Whilst it is clear that diagnosis does not appear to be a variable in determining patterns of MMPI-2 performance with the samples used here, not all groups commonly encountered in the forensic setting have been represented in the preceding studies. However, given the findings of this investigation, it would be surprising if other diagnostic groups exhibited unique patterns of performance. The examination of additional diagnostic groups would lend further support to this notion.

Whilst mean scores for the WNL clusters fell below 65, there were high numbers of individuals that elevated scales indicating psychosocial difficulties. Perhaps future studies could also focus on patterns of base rate responding, rather than

investigating mean cluster profiles which obscure individual performance. Base rate data for a wider range of clinical groups is badly needed.

9.5 Conclusion and Implications for Clinical Practice

The results of this investigation have challenged the utility of classifying groups according to mean MMPI-2 profiles. The findings have also challenged the assumption that unique patterns of MMPI-2 performance exist as a consequence of diagnostic category. To say that a particular pattern of MMPI-2 performance is consistent with a known disorder appears to be both erroneous and potentially misleading. Clinicians who assume that an MMPI-2 profile published in the literature is characteristic of a specific diagnostic group run the risk of making two fundamental errors. Individuals who do not have the condition but demonstrate the profile will be falsely assumed to be a member of the specific diagnostic group. Similarly, individuals who have the condition but do not demonstrate the profile will be erroneously assumed not to be a member of the specific diagnostic group. These errors can be particularly misleading and potentially catastrophic in the medicolegal setting where the courts rely on expert witnesses to aid in determining the underlying cause of a personal injury claimant's disability. Characteristically, in the adversarial context of the court, more than one hypothesis or diagnosis is being tendered by counsel for the plaintiff and defendant. As a psychologist in this context, it is appealing to think that the determination of whether a claimant is suffering from a chronic pain condition or a traumatic brain injury can be reliably determined by the degree to which the claimant's MMPI-2 profile better matches the mean group profile

for one of these two diagnostic groups. The current study demonstrates that the MMPI-2 profiles most likely to occur in individuals seeking compensation for traumatic brain injuries are indistinguishable from those seeking compensation for chronic pain conditions. It is the underlying assumption that there are distinct psychological test patterns that correspond to different diagnostic conditions that drives this expectation that is ultimately flawed and without merit.

The results of this investigation directly challenge the utility of the MMPI-2 as an effective instrument with which to derive group profiles. If clinicians continue to use this test as a classification instrument, then perhaps they should take a closer look at the methods they use to arrive at these classifications. Given that significant differences were not observed between profiles of the three clinical groups analysed in this study, the assumption that each subgroup stands for a unique constellation of behaviours is refuted. Perhaps analyses of the recently developed RC Scales that remove item overlap may reveal more distinct patterns of MMPI-2 performance. Alternatively future research could look for distinct patterns of MMPI-2 performance utilising Goh's (2006) newly developed structural summary approach.

In conclusion, the apparent inability of the MMPI-2 to differentiate diagnostic groups is not highlighted to undermine this specific test, but rather to challenge the assumption that individuals with the same disorder reflect homogeneous patterns of performance. In the past investigators have tried to delineate the general characteristics of various diagnostic groups. As has been outlined before, efforts have been made to understand these characteristics in terms of behaviours, or dysfunctions associated with a particular diagnosis.

Furthermore, it is difficult to determine the psychological makeup of individual cases in "averaged" diagnostic groups. Perhaps it is time that the use of the MMPI-2 clinical scales as a diagnostic marker is replaced with the view that they provide an insight into the co-morbid psychopathology of a disorder, rather than evidence for diagnostic group membership.

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Appendix A

Mean Validity, Clinical, and Content Scale Scores for the Hierarchical (h) CP Cluster Solutions

	CP1-h (n = 73)		CP2-h (n = 53)		CP3-h (n = 71)	
Scale	M	SD	M	SD	M	SD
Validity Scales						
L	59.93	11.48	57.53	9.20	52.62	8.76
F	50.43	8.49	56.91	9.43	75.65	15.16
Fb	49.32	7.89	58.28	12.42	88.03	17.04
Fp	51.58	10.31	55.17	11.04	61.01	12.26
K	51.86	11.07	48.25	10.10	39.62	7.38
Cinical Scales						
Hs	64.08	11.90	75.57	8.34	78.99	10.21
D	59.21	8.73	79.23	7.16	88.58	9.66
Hy	64.33	13.35	79.47	11.08	79.11	13.04
Pd	50.36	8.41	58.06	9.04	67.42	11.19
Mf	51.37	10.25	48.57	9.19	51.14	7.96
Pa	48.71	8.56	55.30	8.70	75.41	13.31
Pt	50.55	7.33	65.70	7.30	82.28	7.96
Sc	51.56	7.69	61.28	7.51	82.66	10.76
Ma	49.22	7.74	45.40	6.94	55.28	11.52
Si	49.30	7.37	57.70	8.05	67.49	10.99
Content Scales						
ANX	51.97	8.37	63.34	9.09	77.40	6.91
FRS	47.08	9.47	53.42	10.53	58.04	14.55
OBS	46.78	10.48	51.21	11.11	65.04	10.10
DEP	51.42	8.44	63.51	8.17	81.28	7.25
HEA	62.13	7.71	71.94	9.17	78.72	9.38
BIZ	48.29	8.20	49.79	9.60	61.76	12.79
ANG	48.12	11.28	53.68	10.18	63.23	10.98
CYN	49.34	9.98	50.40	9.81	60.73	12.61
ASP	47.89	9.42	48.70	8.30	55.28	12.61
TPA	43.41	9.69	45.45	8.45	55.97	10.95
LSE	48.71	9.72	57.62	9.07	73.41	10.93
SOD	47.63	7.98	55.91	9.41	64.80	14.04
FAM	45.74	8.59	48.77	9.45	61.32	13.36
WRK	50.43	8.91	58.23	9.18	74.99	7.90
TRT	46.37	9.05	59.17	10.19	77.48	10.57

Note: h = hierarchical cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits Group; Cluster 2 = High Distress / Low Disturbance Group; Cluster 3 = High Distress / High Disturbance Group.

Appendix B

Mean Validity, and Clinical Scale Scores for the k-means (k) CP Cluster Solutions

Scale	CP1-k (n = 67)		CP2-k (n = 57)		CP3-k (n = 73)	
	M	SD	M	SD	M	SD
Validity Scales						
L	58.37	11.00	59.18	10.60	53.10	8.72
Fb	50.99	9.24	59.18	10.02	74.66	15.49
Fp	50.28	10.37	50.04	11.61	40.21	7.78
F	49.93	8.28	57.19	13.05	86.78	18.06
K	51.10	9.67	55.67	11.33	60.60	12.49
Clinical Scales						
Hs	61.78	10.47	76.26	8.46	79.52	9.44
D	59.19	9.26	76.54	9.13	88.78	9.02
D1	55.82	9.20	72.49	10.66	89.78	8.53
D2	53.34	9.09	60.19	9.90	66.86	10.90
D3	59.31	11.70	71.32	9.16	77.75	11.95
D4	57.00	11.55	71.60	11.26	91.07	9.43
D5	52.13	9.54	62.175	11.33	79.73	8.54
Hy	61.52	11.68	80.18	10.34	79.90	12.50
Hy1	53.18	8.61	51.84	8.36	42.29	9.18
Hy2	49.16	10.40	52.97	11.05	43.49	9.81
Hy3	61.91	10.86	81.98	9.58	91.23	9.32
Hy4	58.30	9.16	71.26	11.74	81.37	13.01
Hy5	50.69	10.84	49.44	9.63	44.86	8.76
Pd	50.24	8.66	57.61	9.13	66.99	11.25
Pd1	49.18	8.61	51.82	10.96	60.34	13.88
Pd2	51.55	8.76	52.84	10.96	49.58	10.46
Pd3	53.27	8.77	50.91	9.80	42.99	8.93
Pd4	50.28	9.69	52.60	9.29	71.89	11.44
Pd5	49.31	9.86	57.46	11.36	71.51	7.85
Mf	50.18	10.85	49.46	9.04	51.70	7.59
Pa	48.58	8.74	53.75	7.90	75.64	12.69
Pa1	51.22	9.82	51.18	8.13	75.03	20.17
Pa2	47.75	9.26	51.09	10.19	66.96	9.72
Pa3	48.76	9.49	51.19	10.42	47.26	11.66
Pt	50.51	7.96	63.60	7.48	82.26	7.73
Sc	50.97	7.98	60.65	6.75	82.32	10.84
Sc1	48.06	10.21	49.33	9.13	71.67	12.13
Sc2	49.27	8.93	59.26	11.25	82.66	16.03

Appendix B (Continued)

Mean Validity, and Clinical Scale Scores for the k-means (k) CP Cluster Solutions

Scale		CP1-k (n = 67)		CP2-k (n = 57)		CP3-k (n = 73)	
		M	SD	M	SD	M	SD
	Sc3	53.10	11.82	61.11	12.20	82.47	12.48
	Sc4	51.88	10.19	62.82	10.44	85.89	10.46
	Sc5	50.54	9.45	52.07	9.22	67.08	11.93
	Sc6	54.57	10.10	63.16	12.74	79.84	16.78
Ma		49.21	9.11	47.02	8.13	54.07	10.75
	Ma1	49.94	9.00	48.39	9.69	52.33	9.54
	Ma2	47.73	9.84	45.89	9.57	52.33	9.71
	Ma3	53.67	9.92	50.84	11.31	43.63	8.79
	Ma4	48.67	10.52	46.30	10.35	53.64	12.04
Si		49.99	7.66	55.28	8.89	67.79	10.29
	Si1	47.76	8.75	51.09	9.45	60.81	9.35
	Si2	50.34	9.05	54.12	8.71	60.60	11.78
	Si3	49.87	10.59	51.95	10.51	67.08	8.53

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits Group; Cluster 2 = High Distress / Low Disturbance Group; Cluster 3 = High Distress / High Disturbance Group.

Appendix C

Mean Content Scale Scores for the k-means (k) CP Cluster Solutions

Scale		CP1-k (n = 67)		CP2-k (n = 57)		CP3-k (n = 73)	
		M	SD	M	SD	M	SD
Content Scales							
ANX		54.28	8.21	61.44	10.80	77.43	7.40
FRS		47.64	9.71	52.14	10.49	57.88	14.59
	FRS1	48.79	8.37	52.49	11.26	64.41	19.83
	FRS2	44.73	10.72	49.09	11.21	49.66	11.42
OBS		47.85	10.55	49.28	11.19	64.82	10.30
DEP		52.48	9.09	61.49	10.05	80.41	8.34
	DEP1	53.32	10.67	63.12	12.39	85.74	10.35
	DEP2	52.91	9.84	65.19	14.53	80.55	8.81
	DEP3	51.04	10.45	57.30	8.58	70.32	8.73
	DEP4	49.25	7.93	56.88	18.90	83.62	27.60
HEA		61.33	7.10	71.33	9.21	78.93	9.0
	HEA1	50.24	9.10	58.32	13.70	67.18	16.66
	HEA2	58.58	12.01	70.12	17.15	81.49	15.42
	HEA3	64.63	12.32	74.60	9.64	77.42	9.26
BIZ		48.70	8.43	49.42	9.82	61.22	12.74
	BIZ1	49.58	9.13	48.77	9.44	62.18	20.49
	BIZ2	46.54	8.91	48.30	9.32	61.18	13.40
ANG		49.37	10.91	52.56	12.23	62.33	11.06
	ANG1	48.10	9.58	50.47	12.18	58.05	12.10
	ANG2	50.69	10.36	53.49	11.18	62.78	8.28
CYN		50.79	10.31	49.79	10.76	59.51	12.57
	CYN1	51.06	10.50	49.60	11.29	56.95	11.42
	CYN2	49.00	9.56	48.58	9.76	57.95	9.01
ASP		49.78	10.45	47.93	10.33	53.90	11.15
	ASP1	49.75	10.31	46.54	9.91	53.36	10.58
	ASP2	47.87	8.32	50.91	11.78	50.85	9.79
TPA		44.42	9.71	44.68	9.57	55.19	10.97
	TPA1	45.72	8.90	48.42	9.66	58.43	8.45
	TPA2	40.04	8.91	39.74	8.89	47.38	10.89
LSE		50.51	9.70	54.84	10.73	72.77	11.60
	LSE1	49.46	9.62	55.49	10.51	72.88	11.41
	LSE2	48.34	9.23	47.89	8.57	60.05	12.56
SOD		48.42	8.75	53.00	9.46	65.42	13.27
	SOD1	48.82	7.96	53.58	9.35	64.81	12.82

Appendix C (Continued)

Mean Content Scale Scores for the k-means (k) CP Cluster Solutions

Scale		CP1-k (n = 67)		CP2-k (n = 57)		CP3-k (n = 73)	
		M	SD	M	SD	M	SD
	SOD2	47.88	9.71	50.70	10.38	58.38	9.93
FAM		46.76	8.48	47.58	9.82	60.73	13.63
	FAM1	45.88	10.47	46.63	10.15	58.23	13.64
	FAM2	50.31	10.27	48.30	9.86	55.90	13.04
WRK		51.13	9.30	56.84	9.86	74.33	8.56
TRT		50.63	9.49	56.75	11.17	76.90	11.07
	TRT1	50.91	9.72	58.33	12.58	81.93	13.22
	TRT2	47.09	8.61	49.61	10.13	58.60	9.62

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits Group; Cluster 2 = High Distress / Low Disturbance Group; Cluster 3 = High Distress / High Disturbance Group.

Appendix D

Mean MMPI-2 Scores for the Hierarchical (h) TBI Cluster Solutions

	TBI 1-h		TBI 2-h		TBI 3-h		TBI 4-h	
N =	68		60		49		23	
	M	SD	M	SD	M	SD	M	SD
Validity Scales								
L	52.44	11.17	55.42	11.16	49.24	9.34	49.52	8.48
F	55.07	11.65	60.90	14.32	67.65	12.26	93.52	21.88
Fb	53.97	10.88	62.68	15.64	68.24	15.61	102.91	20.49
Fp	53.84	11.98	56.23	12.04	54.63	11.12	75.35	23.64
K	45.32	11.69	43.48	8.28	41.71	6.46	39.30	7.47
Cinical Scales								
Hs	58.43	8.91	67.08	11.46	81.10	6.72	74.78	13.32
D	58.59	7.82	75.48	6.99	79.67	10.45	84.91	10.22
Hy	55.21	9.63	65.68	12.40	80.00	9.80	71.22	12.74
Pd	50.06	10.82	56.80	9.57	60.73	8.72	71.35	13.44
Mf	53.69	11.82	49.03	7.74	49.84	7.77	53.48	11.31
Pa	49.22	10.61	54.70	9.18	63.22	10.53	85.74	11.83
Pt	53.35	8.19	64.48	8.57	76.02	6.21	87.00	7.93
Sc	55.41	10.90	61.92	10.03	74.96	8.72	94.17	10.23
Ma	52.53	10.87	46.15	7.08	56.94	9.75	60.83	11.35
Si	51.21	9.53	62.73	8.77	62.49	10.17	68.48	9.47
Content Scales								
ANX	55.51	9.98	63.7	10.35	70.37	8.02	77.22	9.13
FRS	50.19	9.11	53.5	9.60	51.90	7.85	61.65	13.41
OBS	52.50	10.99	56.23	9.99	63.86	8.71	72.70	8.39
DEP	53.25	9.70	63.38	10.24	70.61	7.26	83.78	9.35
HEA	60.43	7.91	66.98	9.81	82.94	9.19	78.65	14.11
BIZ	52.28	10.63	54.55	11.43	61.98	13.85	81.35	18.81
ANG	54.62	10.49	57.78	11.96	62.47	8.80	65.04	11.85
CYN	53.71	10.96	54.93	10.55	55.47	9.95	61.30	9.68
ASP	54.43	11.71	51.08	9.85	53.80	8.52	61.78	13.81
TPA	51.68	10.83	50.67	10.17	53.31	9.69	60.13	10.42
LSE	52.91	10.44	63.35	11.04	64.84	10.12	77.70	8.82
SOD	49.63	9.59	58.37	9.98	57.90	12.58	65.17	11.11
FAM	50.72	10.73	51.90	10.23	53.92	9.47	66.17	15.35
WRK	55.29	10.88	63.00	9.99	69.77	7.65	80.48	9.02
TRT	54.20	10.82	63.33	13.19	66.59	9.71	82.48	7.53

Note: h = hierarchical cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

Appendix E

Mean MMPI-2 Clinical Scale Scores for the k-means (k) TBI Cluster Solutions

	TBI 1-k		TBI 2-k		TBI 3-k		TBI 4-k	
N =	62		54		55		29	
	M	SD	M	SD	M	SD	M	SD
Validity Scales								
L	53.42	11.02	52.41	10.95	52.42	10.85	48.90	8.81
F	52.56	8.99	64.33	14.36	62.13	10.57	93.62	18.89
Fb	51.89	9.17	65.63	15.56	63.31	12.88	99.97	20.92
Fp	53.53	11.91	56.65	11.60	52.55	10.70	75.07	20.58
K	46.40	11.40	41.30	8.39	43.07	7.60	40.10	6.84
Clinical Scales								
Hs	59.35	9.83	61.59	8.84	80.85	6.76	77.21	11.96
D	58.95	7.87	72.93	9.37	79.24	9.85	83.41	10.80
D1	58.39	8.03	74.00	9.06	77.84	10.39	87.17	9.82
D2	51.42	8.44	57.93	11.20	58.40	10.33	63.52	9.72
D3	55.63	9.51	62.96	10.69	69.60	12.33	74.10	12.85
D4	61.62	10.21	77.54	10.95	80.73	9.12	90.03	10.07
D5	52.48	8.94	65.30	10.48	67.33	9.78	79.14	9.88
Hy	56.32	10.07	59.07	8.83	81.15	9.47	72.69	12.17
Hy1	49.35	9.61	44.07	8.84	48.22	9.54	41.03	8.70
Hy2	47.06	9.83	42.13	9.03	46.78	8.99	39.66	6.86
Hy3	60.77	10.14	71.11	8.57	84.18	8.84	85.72	10.79
Hy4	59.69	13.37	63.44	10.40	83.07	12.25	80.24	13.14
Hy5	43.45	9.67	46.04	11.14	47.73	9.15	48.03	11.29
Pd	47.18	8.62	59.13	9.13	58.53	8.46	72.14	11.57
Pd1	50.73	8.92	58.65	10.37	52.55	10.18	68.00	13.69
Pd2	51.45	9.96	52.98	10.76	51.80	9.62	53.34	9.15
Pd3	49.35	9.53	44.46	8.31	47.95	10.79	40.59	9.29
Pd4	48.87	8.44	62.00	10.05	61.20	10.45	74.55	12.39
Pd5	48.61	9.46	62.15	9.55	64.18	10.11	75.31	10.10
Mf	53.18	11.57	49.76	9.12	49.53	8.11	53.69	9.82
Pa	46.18	8.54	58.17	9.32	60.60	11.08	81.45	13.58
Pa1	50.44	7.10	61.02	11.39	59.22	9.57	86.24	18.47
Pa2	47.71	8.12	59.17	10.73	58.98	10.71	71.03	10.38
Pa3	46.79	9.95	44.96	10.06	48.18	9.91	43.45	10.54
Pt	51.92	7.29	65.19	8.53	72.38	7.42	86.31	7.42
Sc	52.55	8.02	65.72	10.46	68.96	9.21	93.86	8.75
Sc1	49.24	8.89	60.74	12.63	57.07	10.15	78.52	11.32
Sc2	51.55	9.79	62.00	13.57	64.13	12.10	87.17	16.24

Appendix E (Continued)

Mean MMPI-2 Clinical Scale Scores for the k-means (k) TBI Cluster Solutions

		TBI 1-k		TBI 2-k		TBI 3-k		TBI 4-k	
N =		62		54		55		29	
		M	SD	M	SD	M	SD	M	SD
	Sc3	60.10	12.73	74.80	12.94	75.76	11.75	91.48	11.35
	Sc4	55.84	9.81	69.98	11.25	72.45	10.22	86.62	10.73
	Sc5	51.31	9.68	60.83	12.99	59.98	11.69	77.62	12.41
	Sc6	56.42	10.90	66.78	13.67	75.89	14.49	94.03	12.71
Ma		49.48	8.97	50.26	11.12	54.49	10.57	60.38	10.21
	Ma1	53.55	9.92	51.04	11.25	51.53	8.72	55.90	11.04
	Ma2	49.03	9.80	50.74	8.83	52.33	9.99	55.90	8.69
	Ma3	49.32	9.47	42.72	8.18	47.84	8.81	44.17	8.94
	Ma4	50.82	9.30	54.00	13.01	52.98	10.55	59.10	10.90
Si		51.79	10.20	62.56	8.96	60.60	10.36	67.62	9.59
	Si1	50.94	10.02	58.07	8.40	54.60	9.97	60.52	8.89
	Si2	48.61	10.05	55.26	10.75	55.24	12.90	58.14	10.21
	Si3	53.13	11.32	61.39	10.96	61.69	9.50	71.24	8.23

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

Appendix F

Mean MMPI-2 Content Scale Scores for the k-means (k) TBI Cluster Solutions

		TBI 1-k		TBI 2-k		TBI 3-k		TBI 4-k	
N =		62		54		55		29	
		M	SD	M	SD	M	SD	M	SD
Content Scales									
ANX		54.68	10.18	64.20	10.07	68.29	9.03	76.21	8.43
FRS		50.39	9.40	53.15	9.27	51.84	8.10	60.10	13.07
	FRS1	50.87	9.85	55.67	12.28	56.71	12.30	74.59	20.23
	FRS2	47.45	11.00	49.02	9.50	46.62	9.83	47.90	11.15
OBS		50.79	10.04	59.63	10.21	60.67	10.47	70.31	9.06
DEP		52.08	8.74	64.59	10.45	68.04	8.92	81.10	10.38
	DEP1	53.69	10.10	66.00	12.49	69.24	10.51	80.72	12.50
	DEP2	52.34	9.79	64.93	13.42	72.64	14.67	77.17	12.36
	DEP3	51.84	9.28	62.39	9.64	61.42	7.06	74.93	7.88
	DEP4	48.37	7.11	56.98	16.55	59.38	17.93	80.21	27.70
HEA		60.82	8.77	63.72	8.18	80.84	9.43	80.79	13.07
	HEA1	50.55	8.47	53.30	11.30	63.78	13.12	68.28	16.95
	HEA2	59.94	13.59	62.69	11.08	83.00	14.28	83.59	16.73
	HEA3	59.63	10.13	64.57	10.64	76.91	8.14	73.97	8.92
BIZ		49.98	7.60	58.37	11.79	56.71	12.93	81.59	17.29
	BIZ1	52.79	10.45	56.70	14.95	60.56	16.73	86.83	29.26
	BIZ2	48.29	8.85	58.24	12.85	53.96	12.34	77.17	13.76
ANG		53.21	10.02	59.85	11.26	59.75	10.43	66.24	10.46
	ANG1	49.79	9.43	57.44	12.38	56.56	11.37	64.48	13.56
	ANG2	54.89	10.61	59.85	9.84	60.75	9.70	64.62	8.10
CYN		52.13	9.55	57.74	11.33	53.75	10.34	61.03	9.03
	CYN1	52.47	10.24	57.30	9.82	53.51	9.36	59.31	8.66
	CYN2	50.48	8.38	55.13	10.23	51.95	10.93	60.21	7.59
ASP		52.52	10.78	54.89	10.40	51.84	9.89	60.41	13.06
	ASP1	52.48	10.52	54.15	10.35	51.42	9.99	58.83	11.66
	ASP2	50.19	11.23	53.02	11.30	50.76	9.29	57.10	11.25
TPA		50.08	10.02	52.54	11.23	51.56	10.11	59.83	9.13
	TPA1	49.90	11.08	54.37	10.62	54.49	9.47	60.48	8.98
	TPA2	44.79	8.95	46.37	10.19	44.96	8.82	53.79	9.01
LSE		52.34	10.37	64.39	11.04	62.13	9.54	76.69	9.69
	LSE1	52.29	10.45	64.91	11.58	62.71	10.22	76.79	10.71
	LSE2	50.35	10.98	56.30	10.41	53.02	10.28	61.45	10.67
SOD		50.08	10.30	58.81	9.93	55.73	11.88	64.38	11.33
	SOD1	49.02	9.99	58.13	10.88	55.80	12.03	64.10	10.89

Appendix F (Continued)

Mean MMPI-2 Content Scale Scores for the k-means (k) TBI Cluster Solutions

		TBI 1-k		TBI 2-k		TBI 3-k		TBI 4-k	
N =		62		54		55		29	
		M	SD	M	SD	M	SD	M	SD
	SOD2	51.26	10.39	56.70	9.16	53.18	10.37	57.76	9.31
FAM		49.11	10.04	55.07	10.16	50.36	9.27	66.83	12.66
	FAM1	49.16	11.27	55.13	11.04	50.96	10.49	63.59	12.89
	FAM2	51.32	9.56	54.00	10.04	48.24	9.59	60.38	12.18
WRK		54.37	9.99	65.15	10.76	66.22	9.60	78.58	8.55
TRT		52.11	8.59	66.78	12.95	63.76	10.64	79.48	10.20
	TRT1	52.35	9.64	66.98	15.01	67.22	14.13	82.38	13.67
	TRT2	48.71	8.80	56.37	11.15	51.78	10.59	61.59	8.90

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

Appendix G

Mean Validity, Clinical, and Content Scale Scores for the PTSD Hierarchical (h) Cluster Solutions

	PTSD 1-h (n = 46)		PTSD 2-h (n = 64)		PTSD 3-h (n = 22)	
Scale	M	SD	M	SD	M	SD
Validity Scales						
L	55.26	11.42	54.14	9.92	55.81	13.60
F	57.04	13.24	73.27	16.30	88.95	16.40
Fb	62.98	20.15	78.86	29.27	93.00	20.98
Fp	55.63	16.03	57.78	17.33	65.36	20.71
K	49.39	10.00	44.89	12.16	43.77	13.88
Cinical Scales						
Hs	62.70	10.55	73.32	11.28	92.77	6.65
D	62.52	9.90	85.89	10.17	98.64	5.21
Hy	62.72	12.58	75.84	13.83	94.50	13.55
Pd	55.19	10.12	63.72	11.03	75.27	8.79
Mf	50.83	10.08	49.56	7.10	54.95	10.04
Pa	56.76	12.22	71.52	12.06	91.32	12.73
Pt	58.65	10.31	82.09	8.83	92.73	7.92
Sc	59.09	12.55	79.50	10.96	99.86	9.64
Ma	52.63	11.76	53.92	11.61	52.18	9.51
Si	50.33	9.05	68.1	9.69	77.68	7.57
Content Scales						
ANX	60.09	12.26	76.95	8.52	85.18	6.84
FRS	54.72	11.36	62.81	12.42	67.05	13.44
OBS	52.87	11.53	64.97	10.50	70.00	8.52
DEP	58.84	11.59	75.56	9.46	86.23	8.64
HEA	62.30	10.46	71.92	12.34	91.73	9.08
BIZ	53.80	11.13	61.45	14.73	72.00	14.44
ANG	56.24	13.37	62.19	13.04	64.91	10.83
CYN	51.02	10.67	55.77	11.47	56.50	11.78
ASP	51.04	11.03	51.52	11.93	50.91	13.49
TPA	51.72	12.11	52.83	11.01	55.91	11.32
LSE	52.76	10.58	68.67	10.63	81.91	12.06
SOD	49.61	10.07	68.17	12.40	77.45	8.48
FAM	48.78	10.45	54.00	12.08	62.41	11.45
WRK	54.85	10.96	73.40	8.88	81.55	9.51
TRT	55.30	13.17	73.44	10.43	84.23	11.25

Note: h = hierarchical cluster analysis. The numbers displayed are mean K-corrected T- scores. Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / High Disturbance Group 1; Cluster 3 = High Distress / High Disturbance Group 2.

Appendix H

Mean Validity, and Clinical Scale Scores for the k-means (k) PTSD Cluster Solutions

Scale	PTSD 1-k (n = 43)		PTSD 2-k (n = 58)		PTSD 3-k (n = 31)	
	M	SD	M	SD	M	SD
Validity Scales						
L	56.60	10.71	52.93	10.50	55.84	12.29
F	55.33	11.98	73.40	16.80	84.97	15.91
Fb	59.44	15.79	79.59	21.02	90.90	20.82
Fp	54.65	16.25	59.02	17.83	62.00	18.89
K	50.14	9.72	44.26	12.55	44.68	12.46
Clinical Scales						
Hs	62.65	10.80	70.80	10.46	90.87	7.11
D	62.63	10.49	83.97	11.26	96.13	7.36
D1	61.51	11.43	84.29	10.45	96.97	11.28
D2	53.26	9.70	65.05	12.91	71.87	9.73
D3	59.84	12.06	69.81	10.89	83.84	13.82
D4	59.67	12.22	85.67	11.26	97.61	10.42
D5	55.63	10.13	75.93	10.01	85.32	9.23
Hy	62.77	12.51	72.57	12.92	93.87	12.21
Hy1	54.05	7.97	43.64	8.51	42.68	8.78
Hy2	48.30	9.16	43.52	10.08	46.45	10.77
Hy3	64.35	10.85	84.80	9.33	95.55	6.40
Hy4	60.26	12.11	72.50	15.58	98.48	10.42
Hy5	49.23	10.13	46.79	9.02	48.97	10.91
Pd	53.16	8.76	64.00	10.77	73.26	9.64
Pd1	49.16	9.30	55.50	11.73	62.26	11.77
Pd2	52.30	9.83	50.74	10.74	49.81	9.62
Pd3	53.95	7.80	43.62	8.36	43.29	9.66
Pd4	51.16	9.52	67.79	14.13	74.45	12.58
Pd5	53.42	10.63	71.33	10.30	77.35	6.60
Mf	50.30	10.04	49.98	7.11	53.45	9.94
Pa	54.19	9.74	71.97	11.64	86.87	14.14
Pa1	52.98	10.02	70.10	17.89	80.45	18.98
Pa2	50.93	9.57	66.56	10.81	72.65	10.21
Pa3	51.28	10.05	48.02	10.37	50.84	10.90
Pt	57.77	9.87	79.90	8.34	92.71	7.09
Sc	57.16	11.20	78.21	9.96	97.06	9.76
Sc1	50.74	11.58	69.24	12.90	79.45	14.57
Sc2	54.72	13.37	76.74	16.31	94.61	16.91

Appendix H (Continued)

Mean Validity, and Clinical Scale Scores for the k-means (k) PTSD Cluster Solutions

Scale		PTSD 1-k (n = 43)		PTSD 2-k (n = 58)		PTSD 3-k (n = 31)	
		M	SD	M	SD	M	SD
	Sc3	61.12	14.12	82.55	13.59	93.26	10.97
	Sc4	57.00	11.02	82.71	9.88	92.39	11.37
	Sc5	54.16	10.01	70.88	12.01	78.26	11.06
	Sc6	59.58	11.87	75.07	16.85	95.35	16.81
Ma		50.91	11.66	54.64	11.69	53.61	9.71
	Ma1	49.53	8.41	51.12	7.92	51.35	10.11
	Ma2	46.84	10.47	53.62	8.67	52.52	7.74
	Ma3	52.53	10.62	42.86	9.34	40.74	10.93
	Ma4	48.84	10.21	54.50	11.61	54.77	11.92
Si		50.23	9.10	67.34	10.47	75.58	8.45
	Si1	47.35	8.60	60.77	9.04	66.55	8.24
	Si2	51.63	10.00	63.07	11.95	68.61	5.56
	Si3	52.77	8.41	65.05	10.24	67.65	11.53

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / High Disturbance Group 1; Cluster 3 = High Distress / High Disturbance Group 2.

Appendix I

Mean Content Scale Scores for the k-means (k) PTSD Cluster Solutions

Scale		PTSD 1-k (n = 43)		PTSD 2-k (n = 58)		PTSD 3-k (n = 31)	
		M	SD	M	SD	M	SD
Content Scales							
ANX		58.23	10.83	76.86	8.35	83.90	6.90
FRS		53.47	11.05	62.84	12.02	66.71	13.08
	FRS1	56.60	13.03	73.50	14.65	81.13	17.08
	FRS2	48.44	11.89	52.00	11.44	53.65	12.87
OBS		51.56	10.10	65.40	10.96	68.39	9.12
DEP		57.21	9.95	75.40	9.61	84.10	9.01
	DEP1	57.88	12.87	79.88	13.12	88.06	12.21
	DEP2	59.30	11.28	77.47	11.45	85.06	8.47
	DEP3	52.16	9.98	66.69	10.30	72.81	9.99
	DEP4	54.49	15.15	72.10	25.95	97.19	26.86
HEA		61.35	10.26	70.24	11.50	89.52	9.32
	HEA1	54.33	11.41	64.50	16.39	83.97	15.66
	HEA2	58.88	11.56	67.17	17.11	93.32	13.44
	HEA3	60.81	13.18	69.69	10.99	79.29	9.51
BIZ		51.70	9.03	62.07	14.99	69.97	14.33
	BIZ1	49.60	8.10	59.79	19.47	64.81	18.25
	BIZ2	50.77	10.45	63.26	15.84	72.55	15.39
ANG		54.58	12.57	63.60	13.20	63.19	11.27
	ANG1	53.19	10.85	60.24	14.91	60.32	11.04
	ANG2	54.74	11.56	62.21	8.29	62.77	9.01
CYN		49.53	9.45	57.37	11.89	54.90	11.13
	CYN1	48.79	9.32	55.33	10.30	53.52	10.98
	CYN2	49.86	10.34	56.74	10.19	54.48	10.41
ASP		49.70	10.26	53.28	12.71	49.61	11.85
	ASP1	48.93	9.46	52.22	10.93	49.03	11.90
	ASP2	50.16	10.29	51.03	10.64	48.55	9.50
TPA		50.14	10.98	54.69	11.70	53.61	11.27
	TPA1	49.91	10.72	58.62	8.22	59.29	9.25
	TPA2	45.05	10.76	45.67	11.44	44.74	10.30
LSE		51.65	8.99	68.48	10.93	78.42	13.04
	LSE1	50.56	10.73	68.22	10.18	78.32	12.12
	LSE2	48.84	8.90	58.57	11.68	63.45	12.28
SOD		49.51	9.29	67.43	13.64	74.48	10.08
	SOD1	50.65	9.85	66.97	14.14	73.58	7.75

Appendix I (Continued)

Mean Content Scale Scores for the k-means (k) PTSD Cluster Solutions

Scale		PTSD 1-k (n = 43)		PTSD 2 (n = 58)		PTSD 3-k (n = 31)	
		M	SD	M	SD	M	SD
	SOD2	46.79	9.22	58.79	8.64	62.90	9.94
FAM		47.21	9.23	54.91	12.13	59.94	12.35
	FAM1	47.02	10.47	54.19	12.23	57.03	12.64
	FAM2	50.64	9.32	50.74	12.13	54.00	12.33
WRK		54.02	10.72	73.16	8.59	78.97	10.69
TRT		53.84	11.85	73.55	10.87	81.16	11.57
	TRT1	55.28	13.26	76.41	13.35	86.10	15.07
	TRT2	48.74	9.98	57.96	10.34	61.42	8.86

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / High Disturbance Group 1; Cluster 3 = High Distress / High Disturbance Group 2.

Appendix J

Mean MMPI-2 Scores for the Hierarchical (h) Combined Sample Cluster Solutions

	Cluster 1-h		Cluster 2-h		Cluster 3-h		Cluster 4-h	
N =	231		135		89		74	
	M	SD	M	SD	M	SD	M	SD
Validity Scales								
L	55.36	11.19	55.43	10.51	51.01	9.60	54.42	10.99
F	55.28	12.43	61.48	11.36	77.02	16.92	84.85	18.59
Fb	56.22	14.65	63.71	15.38	86.20	19.64	92.04	21.03
Fp	53.90	12.31	54.73	11.12	63.56	17.59	63.01	18.95
K	47.03	10.69	46.97	10.60	39.52	7.25	42.97	11.81
Cinical Scales								
Hs	61.98	10.43	79.20	8.27	68.55	9.18	87.72	7.05
D	62.67	10.34	80.87	9.93	83.00	9.48	93.80	7.69
Hy	60.03	11.37	81.03	9.03	68.33	9.46	90.65	11.52
Pd	52.01	9.87	58.55	8.35	66.29	10.09	73.24	11.10
Mf	50.67	10.52	49.75	7.75	52.43	8.40	52.07	9.35
Pa	51.05	9.96	59.41	9.71	75.00	12.15	84.46	13.72
Pt	55.22	9.61	71.61	8.18	80.20	7.59	90.11	7.35
Sc	55.59	10.41	67.53	8.85	82.63	10.22	93.16	10.85
Ma	50.04	10.18	49.74	9.43	57.25	11.40	55.46	10.37
Si	53.43	10.37	60.29	10.40	66.57	10.35	72.07	9.75
Content Scales								
ANX	57.02	10.63	66.88	10.29	76.43	8.48	81.77	6.48
FRS	50.65	10.29	55.19	11.29	57.54	13.00	63.76	13.33
OBS	51.92	11.14	56.51	12.09	67.48	9.66	67.47	9.64
DEP	56.16	10.88	66.33	9.32	79.09	9.33	83.43	8.49
HEA	62.17	8.51	76.56	9.97	70.26	11.29	87.51	8.83
BIZ	51.70	9.99	53.60	11.93	67.29	14.91	69.05	16.75
ANG	53.95	12.18	56.33	11.43	65.06	10.87	63.19	11.51
CYN	52.81	10.56	51.73	11.25	59.97	11.15	58.12	11.52
ASP	51.87	11.06	49.15	9.29	57.07	11.65	52.61	13.03
TPA	49.01	11.18	49.04	9.98	56.80	11.02	54.82	11.10
LSE	54.49	11.61	60.52	11.20	72.27	11.11	75.93	11.96
SOD	51.45	10.51	57.36	12.01	65.02	13.40	70.11	12.19
FAM	49.57	10.24	49.66	9.94	61.01	12.07	60.73	14.40
WRK	55.95	11.18	63.60	11.44	74.69	9.02	77.82	8.73
TRT	55.27	11.98	62.19	11.78	77.55	10.25	80.01	10.92

Note: h = hierarchical cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

Appendix K

Mean MMPI-2 Clinical Scale Scores for the k-means (k) Combined Sample Cluster Solutions

N =	Cluster 1-k 177		Cluster 2-k 84		Cluster 3-k 145		Cluster 4-k 123	
	M	SD	M	SD	M	SD	M	SD
Validity Scales								
L	57.27	10.92	49.93	10.68	55.45	9.91	52.59	10.56
F	51.23	8.35	72.92	17.42	60.68	10.10	83.02	16.97
Fb	50.73	8.85	77.71	20.46	64.51	14.78	91.14	19.36
Fp	51.51	10.34	64.06	17.58	53.86	10.69	63.85	17.33
K	49.73	10.75	39.39	9.10	46.26	9.46	41.33	9.22
Clinical Scales								
Hs	62.77	10.47	61.06	9.63	78.11	8.87	81.59	10.92
D	60.88	9.36	70.35	10.95	82.56	8.90	89.98	9.87
D1	57.87	9.08	74.89	11.01	79.63	9.65	91.96	9.83
D2	53.29	9.10	56.02	11.80	63.15	10.87	67.08	10.96
D3	59.03	10.65	61.80	11.17	71.98	10.94	78.74	13.14
D4	59.41	10.94	77.69	13.73	79.70	9.99	93.81	9.98
D5	52.33	9.34	69.57	10.85	67.99	9.54	82.21	9.13
Hy	61.69	11.69	57.48	9.31	80.30	9.78	82.97	13.69
Hy1	52.06	9.27	44.23	9.13	47.92	9.20	42.18	8.68
Hy2	49.36	10.04	39.35	7.67	48.84	9.70	42.80	9.55
Hy3	63.29	10.88	72.48	11.47	84.01	9.19	92.53	8.12
Hy4	59.86	11.46	63.37	13.29	77.53	12.37	8.34	14.36
Hy5	48.22	10.60	43.74	10.27	48.42	9.12	47.20	10.02
Pd	49.37	8.43	62.64	8.90	58.08	8.53	71.68	10.62
Pd1	49.43	8.51	59.89	10.49	52.43	10.90	62.68	13.71
Pd2	51.20	9.60	54.67	9.04	49.94	10.62	51.80	10.28
Pd3	52.01	9.41	44.68	9.33	47.31	9.71	42.79	8.95
Pd4	49.15	8.81	66.74	10.08	57.63	9.93	75.61	11.37
Pd5	48.80	9.09	68.51	9.06	62.08	9.67	75.78	7.50
Mf	50.41	10.71	51.24	10.47	50.23	7.55	52.28	8.47
Pa	48.34	8.74	64.26	10.47	59.30	9.65	82.80	12.63
Pa1	49.93	7.98	68.98	13.52	55.90	9.90	82.16	18.53
Pa2	47.71	9.13	63.06	10.81	57.03	9.77	71.12	9.58
Pa3	49.57	9.78	42.73	9.86	50.03	10.49	47.34	10.70
Pt	51.95	7.53	69.96	9.77	72.02	7.99	87.10	8.06
Sc	51.82	7.58	73.37	9.48	66.94	8.74	90.76	10.55
Sc1	47.66	8.67	68.36	12.22	55.63	10.64	76.67	12.25
Sc2	49.98	8.81	69.63	16.26	64.94	13.21	88.92	14.90

Appendix K (Continued)

Mean MMPI-2 Clinical Scale Scores for the k-means (k) Combined Sample Cluster Solutions

		Cluster 1-k		Cluster 2-k		Cluster 3-k		Cluster 4-k	
N =		177		84		145		123	
		M	SD	M	SD	M	SD	M	SD
	Sc3	56.56	12.51	78.61	12.81	71.10	13.37	89.65	11.10
	Sc4	53.51	9.12	75.21	11.96	71.86	11.47	89.17	9.72
	Sc5	50.07	8.75	67.36	11.14	58.12	11.24	74.67	12.17
	Sc6	55.71	10.62	72.35	15.10	69.45	14.59	89.04	16.10
Ma		48.37	8.28	57.73	11.58	48.63	9.44	57.00	10.76
	Ma1	50.19	9.02	55.15	10.43	49.24	9.04	52.73	9.62
	Ma2	47.59	9.38	55.15	9.73	47.39	8.92	54.77	8.65
	Ma3	51.48	10.77	44.98	9.88	46.92	9.43	42.85	9.22
	Ma4	48.18	9.62	59.15	11.12	48.78	9.62	56.11	12.46
Si		51.01	8.91	61.67	11.28	61.84	10.56	69.63	10.39
	Si1	48.73	9.41	57.23	9.39	56.08	9.90	62.29	9.20
	Si2	50.54	9.71	54.15	11.85	57.99	11.32	62.64	11.07
	Si3	50.65	10.19	65.38	10.95	59.09	10.04	68.14	9.26

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.

Appendix L

Mean MMPI-2 Content Scale Scores for the k-means (k) Combined Sample Cluster Solutions

N =		Cluster 1-k 177		Cluster 2-k 84		Cluster 3-k 145		Cluster 4-k 123	
		M	SD	M	SD	M	SD	M	SD
Content Scales									
ANX		53.66	9.02	69.38	10.56	68.06	9.71	80.17	7.01
FRS		48.94	9.22	56.65	12.21	55.48	11.06	61.16	13.89
	FRS1	49.78	9.31	62.52	15.48	59.43	14.97	72.65	19.50
	FRS2	46.11	10.58	49.69	11.34	49.59	10.96	50.38	11.71
OBS		48.62	9.65	64.11	11.13	57.25	11.59	67.72	9.14
DEP		52.17	8.30	70.74	10.76	67.69	9.02	82.53	8.42
	DEP1	53.13	9.56	72.75	13.99	70.50	12.24	86.07	11.22
	DEP2	53.17	10.26	69.70	12.62	71.77	13.23	82.37	9.28
	DEP3	50.91	8.75	66.98	10.23	60.30	7.95	72.69	8.92
	DEP4	48.38	6.81	65.32	22.85	61.28	19.59	88.75	27.56
HEA		61.80	8.59	64.13	10.13	75.72	9.93	82.28	11.36
	HEA1	51.01	9.74	55.92	11.86	63.16	14.74	72.28	17.80
	HEA2	59.53	13.34	65.02	13.45	74.97	17.41	84.66	15.89
	HEA3	63.19	11.71	62.68	11.09	75.74	9.45	77.04	9.22
BIZ		48.78	7.89	64.64	14.80	52.90	10.12	69.46	15.14
	BIZ1	50.03	9.05	64.17	19.93	52.30	12.95	69.97	23.28
	BIZ2	46.99	8.31	63.98	14.69	51.87	10.59	69.68	14.56
ANG		50.94	10.85	63.95	12.55	56.81	10.48	64.72	11.08
	ANG1	48.80	9.37	63.08	12.81	52.56	11.14	61.80	12.30
	ANG2	52.36	10.87	60.99	10.62	59.01	9.34	63.73	7.94
CYN		49.92	8.99	62.48	12.06	51.47	10 09	59.12	10.94
	CYN1	50.11	9.81	60.54	9.90	51.19	10.35	56.95	9.76
	CYN2	48.90	8.85	58.88	9.71	50.66	9.85	58.29	9.29
ASP		49.17	9.55	60.77	11.84	48.81	8.67	54.51	12.40
	ASP1	48.99	9.71	59.23	10.25	48.47	9.25	53.43	11.38
	ASP2	48.70	9.58	55.12	10.48	49.32	10.20	52.56	10.86
TPA		46.67	10.47	57.74	11.78	48.66	9.00	56.01	10.63
	TPA1	47.47	10.44	56.86	10.32	53.59	9.20	59.38	8.26
	TPA2	41.99	9.43	50.92	10.87	41.83	8.85	48.12	10.18
LSE		50.58	9.53	67.67	11.92	62.03	10.97	74.63	11.35
	LSE1	49.94	9.72	66.65	11.84	62.44	11.02	75.50	10.73
	LSE2	48.75	9.78	59.25	11.36	53.17	10.83	59.82	12.02
SOD		49.33	9.39	58.75	12.19	58.83	12.18	68.34	13.05
	SOD1	49.56	9.22	57.81	12.64	58.92	12.19	67.76	12.36

Appendix L (Continued)

Mean MMPI-2 Content Scale Scores for the k-means (k) Combined Sample Cluster Solutions

		Cluster 1-k		Cluster 2-k		Cluster 3-k		Cluster 4-k	
N =		177		84		145		123	
		M	SD	M	SD	M	SD	M	SD
	SOD2	48.72	10.08	55.82	9.81	54.88	10.27	59.37	9.64
FAM		46.79	8.85	59.79	9.98	49.37	9.46	61.92	13.54
	FAM1	46.20	10.30	59.93	10.82	48.96	10.01	59.17	13.26
	FAM2	50.26	9.20	55.15	11.38	48.57	9.93	56.33	13.28
WRK		52.30	9.16	69.30	11.03	64.57	10.95	77.04	8.39
TRT		50.72	8.86	71.79	12.63	63.99	11.49	78.86	10.48
	TRT1	51.12	9.51	72.70	14.85	67.92	14.80	82.44	13.89
	TRT2	47.19	8.49	59.58	10.60	51.79	10.08	60.60	8.88

Note: k= k-means cluster analysis. The numbers displayed are mean K-corrected T- scores.
Cluster 1 = Within Normal Limits; Cluster 2 = High Distress / Low Disturbance; Cluster 3 = High Distress / High Disturbance Group 1; Cluster 4 = High Distress / High Disturbance Group 2.