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The purpose of this study was to assess the validity of an instrument designed to assist in the diagnosis of mental illness in individuals diagnosed with mental retardation titled "The Psychopathology Inventory for Mentally Retarded Adults (PIMRA)." Procedures included conducting an exploratory factor analysis (EFA) to identify a more parsimonious model and a series of confirmatory factor analyses (CFA) to test the hypotheses of factorial invariance, first, with two random samples, and then with three groups based on level of mental retardation. A series of logistic regression analyses were conducted to assess the ability of each scoring model to predict the "true" mental health diagnosis.

Results of CFA of the PIMRA found the model to be ill fitting. Examination of the factor correlations, item correlations and item R^2 values found significant problems such that the scoring model of the PIMRA was found to be unsupported. Results of the EFA identified an interpretable six factor solution. A confirmatory factor analysis of the six factor solution revealed a model that approached adequacy after deleting ten items. The hypothesis of factorial invariance was not supported in two random samples and three groups based on level of mental retardation. Results of the logistic regressions revealed that both models were better predictors of schizophrenia, affective disorder and psychosexual disorder than other mental health disorders. Both models are better predictors of lack of diagnosis rather than diagnosis. The six factor model was only slightly better than the PIMRA.

These results suggest that neither the PIMRA nor the six-factor scoring model provide any diagnostic in determining the mental health status of an individual with mental retardation.

EXAMINATION OF THE SCORING STRUCTURE OF THE PSYCHOPATHOLOGY INVENTORY FOR MENTALLY RETARDED ADULTS (PIMRA)

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

This study is an investigation of the scoring validity of an instrument designed to assist in the diagnosis of mental illness in persons also diagnosed with mental retardation. This instrument called the Psychopathology Instrument for Mentally Retarded Adults (PIMRA, Matson, 1988) is one of a few instruments available to assist care providers involved in the decision-making process of referring individuals with mental retardation to psychological and psychiatric services. The instrument may also be used by mental health professionals in gathering information necessary to diagnosis specific mental illnesses that lead to proper treatment.

Our social service system has long ignored the issue of co-existing diagnoses of mental retardation and mental illness. The first professionally published acknowledgment that people with mental retardation were living in psychiatric settings occurred about sixty years ago (Duncan, Penrose, & Turnbull, 1936; Herskovitz & Plesset, 1941; Rautman, 1943). Earliest prevalence rates suggested that as much as 40% of people placed in psychiatric hospitals were "feeble-minded" (Pollock, 1945; Weaver, 1946). Despite this acknowledgement, this population was virtually ignored. Professional discussion of the possibility of concurrent diagnoses of mental retardation and mental illness did not occur until the 1980's (Singh, Sood, Sonekar, & Ellis, 1991). The separation of mental health and mental retardation services at all levels of federal, state,

and local governments have perpetuated the discontinuity of services for people experiencing both mental retardation and mental illness (Beasley & DuPree, 2003; Chaplin, 2004; Marcos, Gill, & Vazquez, 1986; Reiss, 1982). Mental retardation professionals lacked knowledge of mental illness and mental health professionals lacked knowledge of mental retardation. Consequently, neither professional group has assumed responsibility for providing services to people who have been dually diagnosed with mental retardation and mental illness. In fact, because of the competition for funds, the two separate systems have claimed ownership of particular types of clients and established barriers to the development of a multi-system approach to treatment of people who experience both mental retardation and mental illness (Woodard, 1993).

Professionals need a system to distinguish between maladaptive behaviors that arise as a consequence of diminished cognitive capacity and those that arise from mental health issues. Despite the realization that people with mental retardation were being placed in psychiatric hospitals across the country, a majority of psychiatrists believed that people with mental retardation did not possess the necessary cognitive ability and psychological processes necessary in order to acquire a mental illness (Borthwick-Duffy, 1994; Chitty, Boo, & Jamieson, 1993; Sovner & Hurley, 1987). Even today, with evidence to dispute this claim, some psychiatrists still believe this is true. Instead of attributing maladaptive behaviors to a potential mental illness, the maladaptive behaviors are simply considered to be impaired development, characteristic of people with mental retardation (Borthwick-Duffy & Eyman, 1990; Borthwick-Duffy, 1994; Silka & Hauser, 1997). This tendency to attribute maladaptive behaviors of people with mental retardation

to the mental retardation instead of recognizing potential symptoms of mental illness is called diagnostic overshadowing. The diagnosis of mental retardation overshadows all other potential causal factors for the display of maladaptive behaviors. Not only do mental health professionals have the tendency to attribute maladaptive behaviors to the mental retardation; disability service providers, family, and friends also tend to make that attribution (Borthwick-Duffy & Eyman, 1990).

It has become increasing important to recognize potential mental illness in people with mental retardation. Deinstitutionalization of people with mental retardation from large state facilities into community-based settings places responsibility of mental health services for people with mental retardation onto community mental health centers (Moretti, Molten, Papetti, & Vallani, 1995; Sovner & Hurley, 1987; Woodard, 1993). Therefore it is necessary for professionals who work with individuals with mental retardation to understand basic mental health issues in order to advocate for the appropriate services.

In addition to community-related consequences of not recognizing and treating mental illness among people with mental retardation, there are personal consequences as well. Without an accurate diagnosis, it is not possible to provide adequate treatment. Appropriate diagnosis is essential to providing effective treatment of mental illness and avoiding the consequences of not treating it (Dosen & Day, 2001; Gardner & Hunter, 2003; Vitello & Behar, 1992). There is a wealth of research indicating that psychotropic medications are often prescribed for treatment of mental illness, but they have also been used to treat maladaptive behaviors of people with mental retardation even without a

mental illness diagnosis (Baumeister, Todd, & Sevin, 1993; Beasley & Dupree, 2003; Jacobson, 1988; Russell, 1989; Tyrer & Hill, 2001; Wressell et al, 1990). The prevalence of treating maladaptive behavior of people with mental retardation with psychotropic medication is controversial. As much as 80% of people with mental retardation are believed to be receiving some form of psychotropic medication, but only 25% of those receiving these medications have a corresponding mental illness diagnosis (Jacobson, 1988; Linaker, 1990). Hill, Balow, & Bruininks (1985) found 38% of the study sample was receiving at least one psychotropic medication but only 15% of those had a psychiatric diagnosis. A major problem with using powerful psychotropic medications is the side effects. Although many of the newer medications used to control psychotic symptoms are safer than ever before, side effects still exist. Some side effects, once displayed, are permanent and can be very debilitating, interfering with the completion of common daily tasks. A valid diagnostic instrument appropriate for individuals with mental retardation is necessary to providing appropriate treatment by distinguishing between individuals with a psychiatric diagnosis and those without as not to continue to overuse medication.

In addition, valid diagnostic procedures are necessary in order to provide accurate prevalence data as a measure of consumer demand for treatment (Chitty, Boo, & Jamieson, 1993; Jacobson, 1990), measure treatment outcomes (Fletcher, 1993; Watson, Aman, & Singh, 1988), and to establish priorities that direct and improve professional training (Chitty, Boo, & Jamieson, 1993; Jacobson, 1990).

Overview of the Psychopathology Instrument for Mentally Retarded Adults

The PIMRA (Matson, 1988) was developed to: a) help develop a mental health treatment plan, b) help evaluate the treatment effects, c) aid in the diagnostic process in confirming the need for mental health services and d) provide psychological symptomology for professional training. The PIMRA is based on the Diagnostic Statistical Manual III (DSM, American Psychiatric Association, 1980). The DSM is the official manual of mental disorders and provides descriptions and differential diagnostic criteria for professionally recognized clinically significant behavioral or psychological syndromes. The PIMRA is described by the author to be used to as one measure to assist in the diagnosis of seven types of pathology listed in the DSM-III including schizophrenia, affective disorder, psychosexual disorder, adjustment disorder, anxiety disorder, somatoform disorder, and personality disorder. It provides a total score and subscale scores of seven common mental illnesses. An eighth scale of "inappropriate adjustment" is included without further explanation. The PIMRA is currently one of only a few instruments developed for the specific purpose of providing assistance in the identification of behaviors symptomatic of mental health problems. The two forms, Rating-by-Others and Self-Report, may be used in conjunction with each other or separately.

Overview of Validity

Validity is an evaluative judgment based on empirical evidence that supports the inferences made as the result of assessment scores (Bryant, 2002; Messick, 1989). It is a continual process of collecting convergent and divergent evidence to support score

meaning and discount other possible interpretations. Validity is the "most fundamental consideration in developing and evaluation tests" (AERA, APA, & NCME, 1999).

There are any number of ways to statistically evaluate the nature of tests in relation to content, criterion and construct validity and the consequences of such an assessment. Empirical evidence in support of construct validity is the basis of score interpretation (Messick, 1995). One aspect of construct validity is substantive evidence that supports the theoretical rationale for the consistency of score responses. Exploratory and confirmatory factor analyses are techniques that can be used to contribute substantative evidence of score consistency. A second aspect of construct validity is consequential evidence that evaluates the implications of score interpretation. Using regression to assess the predictive value of score interpretation can provide evidence of consequential validity of score interpretation.

Research Purpose

The purpose of this study is to contribute to the body of evidence of the validity of the PIMRA. Currently, research validating the use of the PIMRA in providing accurate diagnostic information is negligible. In addition to information presented in the manual accompanying the PIMRA, seven research studies contribute evidence of reliability (e. g., Aman, Watson, Singh, 1986; Balboni, Battagliesse & Pedrabissi, 2000; Linaker & Nitter, 1990; Matson, 1988, Sturmey & Ley, 1990; Van Minnen, Savelsberg & Hoogduin, 1994; Watson, Aman, Singh, 1988) and eight research studies contribute evidence validity of the use of this instrument (e. g., Balboni, Battagliesse & Pedrabissi, 2000; Linaker, 1991; Linaker & Helle, 1994; Matson, 1988; Sturmey & Ley, 1990; Swiezy, Matson,

Kirkpatick-Sanchez & Williams, 1995; Van Minnen, Savelsberg & Hoogduin, 1994; Watson, Aman, Singh, 1988). These studies present information on reliability estimates such as test-retest correlations, Cronbach's alpha, Spearman-Brown split-half, item-subscale correlations, and inter-rater reliability. Evidence for validity include correlations with other scales that estimate maladaptive behaviors in this population, discriminant analysis and logistic regression using the Diagnostic Statistical Manual (DSM) diagnostic criteria, ANOVA estimates of differential diagnoses between groups (age, level of mental retardation and gender) and exploratory factor analysis. A logical next step in the investigation of the PIMRA is a confirmatory factor analysis of this instrument as one diagnostic tool for detecting mental illness in individuals also diagnosed with mental retardation. Whereas a few researchers have explored the structure through exploratory factor analysis procedures, the use of a confirmatory methodology has not yet been attempted.

The research questions for this study include: a) How well does the PIMRA scoring model fit the data of PIMRA scores?, b) Is there an alternate model that provides a better fit to the data of PIMRA scores?, c) How well do the two models (PIMRA and alternate) fit subgroups of individuals based on level of mental retardation?, and d) What are the consequences of using the PIMRA instrument to identify mental health diagnosis?

Supporting evidence of the PIMRA can benefit those who provide services to individuals diagnosed with mental retardation by giving them an additional decision-making tool to use when contemplating psychiatric referral. It can benefit mental health

professionals in the diagnostic process of individuals who may not be able to adequately express their symptoms and for individuals with severe disabilities who are non-verbal.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The first section of this chapter reviews prevalence and theories of mental illness in individuals with mental retardation leading to the need for a valid instrument to assist in such diagnosis. The second section reviews previous research examining the properties of the PIMRA (Matson, 1988) with individuals with mental retardation. A third section reviews literature on the importance of validity evidence. The final section reviews the use of confirmatory factor analysis and logistic regression in collecting evidence in support of scoring validity. Contributing to the body of evidence concerning the use of the PIMRA in assisting in the diagnosis of individuals with mental retardation who may require psychiatric services is an important issue.

Prevalence and Theories of Mental Illness in Persons with Mental Retardation

It is difficult to know just how prevalent mental illness is in persons with mental retardation, but it is apparent that they are more susceptible than the general population. Meyers (1986) matched inpatients of a psychiatric hospital with developmental disabilities to those without developmental disabilities on gender, race, and age. Results indicate that the population of people with developmental disabilities was significantly more likely to experience psychosis, affective disorders, and adjustment disorders than their non-disabled counterparts. Jacobson (1990) also found higher rates of psychosis, neurosis and personality disorder diagnoses in persons with developmental disabilities

than those without. It is believed that people with mental retardation are twice as likely to develop a form of mental illness as compared to the general population (Menolascino & Fleisher, 1991).

Fourteen studies have investigated prevalence rates of mental illness in persons with mental retardation. Unfortunately they raise more questions than answers. The studies vary in methodology, sample selection, and definitions of mental retardation and mental illness. The studies also assess mental illness in four different ways. Five studies use a standard intake mental status exam by a psychiatrist at the time of the study (Benson, 1985; Charlotte, Doucette, & Mezzacappa, 1993; Eaton & Menolascino, 1982; Myers, 1986; Reiss, 1982). Four studies used a retrospective review of official records to determine how many had previous mental illness diagnoses (Borthwick-Duffy & Eyman, 1990; Galligan, 1990; Jacobson, 1990; Phillips & Williams, 1975). Another four studies utilized a screening measure developed for the purpose of assisting in the diagnosis of mental illness in persons with mental retardation. Two of the studies used the PIMRA instrument (Iverson & Fox, 1989; Linaker & Nitter, 1990). Studies by Chitty, Boo, & Jamieson (1993) and Reiss (1990) used the Reiss Screen for Maladaptive Behavior (Reiss, 1987).

The sample of individuals used to estimate prevalence rates have been drawn from three main sources. The subjects of five of the studies were drawn from large congregate care facilities. Four of the five resided at an institution for individuals with developmental disabilities (Charlotte, Doucette, & Mezzacappa, 1993; Chitty, Boo, & Jamieson, 1993; Galligan, 1990; Linaker & Nitter, 1990). One study drew subjects from a

psychiatric hospital (Meyers, 1986). The second source for subjects is community mental health clinic referrals (Benson, 1985; Benson & Reiss, 1984; Eaton & Menolascino, 1982; Phillips & Williams, 1975; Reiss, 1990). The third and largest groups of participants are studies of county-wide (Iverson & Fox, 1989) or state-wide databases of consumers receiving developmental disability services (Borthwick-Duffy & Eyman, 1990; Jacobson, 1990).

To compound the problems of synthesizing information from studies that have drawn from differing populations and assessed mental illness in varying methods, the operational definitions of mental retardation and the different forms of mental illness also vary widely. Some researchers did not distinguish between the different diagnostic levels of mental retardation of mild, moderate, severe, and profound (Borthwick-Duffy & Eyman, 1990; Chitty, Boo, & Jamieson, 1993; Galligan, 1990; Jacobson, 1990; Linaker & Nitter, 1990; Meyers, 1986). Other researchers did consider level of mental retardation, but sometimes collapsed levels into groups such as mild-to-moderate or severe-to-profound (Benson, 1985; Benson & Reiss, 1984; Charlotte, Doucette, Mezzacappa, 1993; Eaton & Menolascino, 1982; Iverson & Fox,1989; Phillips & Williams, 1975; Reiss, 1982; Reiss, 1990).

Distinguishing the differing operational definitions of mental illness is more subtle. Although most of the researchers do state the version of the Diagnostic Statistical Manual (DSM) used when conducting the standard mental status exams at the time of the study, studies that used retrospective records do not know at what time the diagnosis was made. Therefore, one must be aware of the changes made between versions of the DSM,

such as the change of the term neurotic disorder to anxiety disorder. Even when the version of the DSM is stated, the breadth of the number of different diagnoses under study is not always known.

When attempting to estimate prevalence rates of mental illness in persons with mental retardation it is necessary to consider the problems with the epidemiological studies. Some general trends can be drawn from diverse literature. First, prevalence rates of mental illness, in general, within populations of people with mental retardation are higher when the samples are drawn from institutions than from larger state-wide databases. Institutional prevalence rates estimate that up to 50 – 69% of persons with mental retardation can also be diagnosed with some form of mental illness (Charlotte, Doucette, & Mezzacappa, 1993; Chitty, Boo, & Jamieson, 1993; Galligan, 1990; Linaker & Nitter, 1990). Studies that used state-wide databases reflect prevalence rates between 10 – 12% (Borthwick-Duffy & Eyman, 1990; Jacobson, 1990). Prevalence estimates drawing from community mental health clinics fall in the middle, estimating prevalence rates at 25–30% (Benson, 1985; Jacobson, 1990). A second general trend that appears in the prevalence literature is that males are rated as having mental illness more often than females (Benson & Reiss, 1984; Galligan, 1990; Iverson & Fox, 1989).

There are a number of proposed theories regarding why people with mental retardation are more susceptible to psychopathology. Bregman (1991) describes three of these theories. They include neurological, genetic, and psychosocial factors associated with mental retardation. The presence of neurological factors such as seizure disorder and head trauma may predispose an individual to acquire a mental illness. Genetic factors

theorized to predispose an individual to mental illness include syndromes such as Prader Willi or Fragile X. Psychosocial factors associated with mental retardation such as repeated failure and social ostracism might also impact the probability of acquiring a mental illness.

Matson and Sevin (1994) organized theories regarding the development of mental illness in people with mental retardation into four categories including organic, behavioral, developmental, and sociocultural. Organic models emphasize the presence of structural brain pathologies caused by biochemical, genetic, or physiological disorders that increase the probability of acquiring a mental illness. Mental retardation is often associated with other structural brain pathologies such as seizure disorders, microcephaly, or hydrocephaly. Brain dysfunction may itself cause mental illness or it may simply play a role by decreasing the capability of people with mental retardation to successfully dealing with symptoms of psychological imbalance. Behavioral models theorize that deviant behavior is learned through complex interaction between the individual and their environment via classical, operant, and social models of learning. People with mental retardation spend most of their life surrounded by other people with mental retardation; integration, interaction, and participation with other members of society are often limited. Their role models and social learning environments are not comparable to the role models and learning environments of people without mental retardation. The developmental model of susceptibility of mental illness among people with mental retardation emphasizes the importance of viewing the person's behavior within the context of their developmental level. Sequences of development are believed to be universal. Prevalence

of behavioral and emotional problems of people with mental retardation may be more prevalent when compared to peers of the same chronological age, but may not be so different when compared to children of the same developmental level. The socio-cultural models of psychopathology stress the importance of negative social conditions often experienced by people with mental retardation. People with mental retardation are exposed to an excessive number of negative experiences that may affect mental health such as segregation into large residential care facilities, employment restrictions, and stigma associated with the label of mental retardation.

Many individuals with mental retardation present themselves with a wide variety of maladaptive behaviors through a variety of factors such as genetics, environment, and lack of social skills making it difficult to distinguish between maladaptive behavior attributable to mental retardation and symptoms of mental illness. This difficulty can lead to diagnostic overshadowing. Diagnostic overshadowing is the attribution of maladaptive behavior to the existence of mental retardation excluding consideration of mental illness (Borthwick-Duffy, 1994; Borthwick-Duffy & Eyman, 1990; Silka & Hauser, 1997). With increasing recognition of the existence of mental illness in individuals with mental retardation it has become increasing important to find tools to assist in this co-existing diagnosis.

Deinstitutionalization of people with mental retardation from large state facilities into community-based settings places responsibility of mental health services for people with mental retardation onto community mental health centers (Moretti, Molten, Papetti, & Vallani, 1995; Sovner & Hurley, 1987; Woodard, 1993). There is little research to

guide community health professionals in the treatment of these individuals (Beasley & DuPree, 2003; Chaplin, 2004). It is necessary to have appropriate diagnostic tools in order to advocate for the appropriate services. Beasley and DuPree conducted a series of 35 program evaluations of community service systems. They found a lack of expertise and training in the community professionals providing mental retardation and mental illness services. Mental retardation was not a part of the curriculum in 75% of clinical psychology programs across the country and very few psychiatric residency programs offered mental retardation training. Hence, many of the mental health records of the individuals with mental retardation lacked diagnostic and treatment information and yet they were being prescribed antipsychotic medications.

Without an accurate diagnosis, it is not possible to provide adequate treatment Dosen & Day, 2001). Yet little attention has been paid to the creation of valid and reliable instruments for assessment of psychiatric status of individuals with mental retardation (Hatton, Haddock, Taylor et al, 2005). A recent study by Holden & Gitlesen (2004) to clarify the association between severity of mental retardation and psychiatric symptomology used a diagnostic tool called the PAS-ADD (Moss, 2002). The authors state that their findings may be related to the instrument used in the study; about one-half of the items (i.e., excessive worry, unreasonable thoughts, and verbal descriptions of symptoms) were impossible or difficult to demonstrate by individuals with severe mental retardation. Yet the use of multimodal standardized tools is a widely accepted as part of the diagnostic process and should include self-reporting and rating scales (American Academy of Child and Adolescent Psychiatry, 1999; Dosen & Day, 2001; Gardner &

Hunter, 2003; Russell, 1989). The American Academy of Child and Adolescent Psychiatry further states that the assessment on individuals with self-reporting difficulty should include information from informants.

The lack of appropriate diagnostic tools is also seen in the amount of reports of inappropriate use of psychotropic medications. These powerful medications are being used to treat maladaptive behaviors of people with mental retardation even without a mental illness diagnosis (Baumeister, Todd, & Sevin, 1993; Beasley & Dupree, 2003; Jacobson, 1988; Russell, 1989; Tyrer & Hill, 2001; Wressell et al, 1990). The prevalence of treating maladaptive behavior of people with mental retardation with psychotropic medication is controversial. As much as 80% of people with mental retardation are believed to be receiving some form of psychotropic medication, but only 25% of those receiving these medications have a corresponding mental illness diagnosis (Jacobson, 1988; Linaker, 1990). Hill, Balow, & Bruininks (1985) found 38% of the study sample was receiving at least one psychotropic medication but only 15% of those had a psychiatric diagnosis. A major problem with using powerful psychotropic medications is the side effects. Although many of the newer medications used to control psychotic symptoms are safer than ever before side effects still exist. Common side effects of powerful psychotropic medications include tardive dyskinesia and extrapyramidal symptoms (Sachdev, 1992; Tryer & Hill, 2001). Tardive dyskinesia (TDK) is the involuntary movement of the fine motor muscles. Common forms of TDK include rubbing index and thumb together in a circular motion known as “pill rolling” and protrusion and rolling of the tongue called choreoform movement. Extrapyramidal

symptoms (EPS) involve the gross motor muscles. This includes tics and immobility of joint movement. The inability to bend the knees is referred to as the “mellaril shuffle.” Once observed these side effects are permanent. Another medication, cogentin, is then required to mask the display of the muscle movements. It can be very debilitating and interfere with the completion of common daily tasks. This interference is particularly problematic for individuals who have difficulty completing these tasks due to mental retardation. Ferguson (1982) conducted a series of studies of individuals in four groupings of psychotropic drug use, no psychotropic drug use, abrupt withdraws of drug, and gradual withdraw of drug. He found that the use of the drugs most often did not reduce the behavior it was intended to reduce, drug use interfered with responding to reinforcement contingencies designed to reduce inappropriate behavior, and drug use interfered with work performance.

In addition, valid diagnostic procedures are necessary in order provide accurate prevalence data as a measure of consumer demand for treatment (Chitty, Boo, & Jamieson, 1993; Jacobson, 1990), measure treatment outcomes (Fletcher, 1993; Watson, Aman, & Singh, 1988), and to establish priorities that direct and improve professional training (Chitty, Boo, & Jamieson, 1993; Jacobson, 1990). The availability of a valid and reliable tool is also necessary to measure the response to treatment (Shedlack, Hennen, Magee, & Cheron, 2005). Response to psychotropic drug use is prevalent in the literature using a number of different instruments, none of which are established as being valid and reliable with adequate standardization (Aman, 1991). In addition to the PIMRA other available instruments specifically designed to assess mental illness in individuals with

mental retardation include the Diagnostic Assessment Schedule for Severely Handicapped (DASH II, Matson, Coe, Gardner et al, 1991), and the PAS-DD (Moss, 2002). There is very little statistical information available for the DASH II and PAS-DD. The PIMRA is the most studied instrument of the three available. Other instruments; such as the Reiss Screen for Maladaptive behavior (Reiss, 1988), the Developmental Behavior Checklist – Primary Carer version (Enfield & Tonge, 1992), and Aberrant Behavior Checklist (Aman & Singh, 1985) used in these studies are not measures of mental illness. These instruments are general measures of maladaptive behavior.

Research on the PIMRA Instrument

The PIMRA (Matson, 1988) utilizes the Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III, American Psychological Association, 1980) criteria to create the items and define the major categories of psychopathology included in the instrument. The DSM-III listing of mental illnesses based it's definitions of the differing disorders on research available at that time in attempt to create reliable and valid categories and descriptions. The manual is theoretical in regard to etiology because of the shear number of possibilities. The authors propose that it is possible for stakeholders to agree on the manifestations of a disorder without agreeing on the origins. The 56 PIMRA items were developed to assist in the diagnosis of seven mental disorders in light of the concept of "diagnostic overshadowing" and written in a manner relevant for individuals with mental retardation. It is designed to be a part of a structured interview similar to a mental status exam. There are two forms, Rating-by-Others and Self-Report that can be used together or separately. The Self-Reporting version is used when an individual can

read the items or the items can be read to them. The Rating-by-Others version can be used to supplement the self-report by enlisting the assistance of significant others involved in the individuals' life. It can also be used by itself when an individual is unable to understand the vocabulary of the instrument or is unable to respond to yes/no questions.

The seven categories of disorders included in the PIMRA scale are: schizophrenia, affective, psychosexual, adjustment, anxiety, somatoform and personality disorder. An eighth subscale called "inappropriate adjustment," is not related to a DSM category and it's inclusion in the scale is not discussed in the manual. A brief DSM-III (1980) definition of the seven categories of mental illness is presented in Table 1. These disorders are not necessarily distinct, discrete disorders with clear boundaries between other disorders or with no disorder. Some symptoms overlap diagnoses and other items can be especially relevant.

Table 1 DSM Descriptions of Diagnostic Categories Included in the PIMRA

Diagnostic Category	Description
Schizophrenia	Five types that involve delusions, hallucinations, and/or thought disturbances, behavior is deterioration from a previous level of functioning.
Affective Disorder	Nine types involve disturbances of mood with manic and/or depression states that may be long- or short-term or cyclic.
Psychosexual Disorder	Twenty-two types involving gender identity confusion, paraphilia, psychosexual dysfunction and other (i.e., homosexuality) that are not a result of organic factors.
Adjustment Disorder	Eight types that involve maladaption to an identified stressor that is in excess of the normal, expected reaction.

Diagnostic Category	Description
Anxiety Disorder	Ten types involving panic, phobic or obsessive-compulsive reactions to specific activities, situations, or objects or generalized anxiety state.
Somatoform Disorder	Five types involve physical symptoms suggesting a physical disorder without verifiable medical evidence or known physiological mechanisms to support the symptoms.
Personality Disorder	Twelve types involve disturbed patterns of thinking, perceiving, or relating to others in a wide range of contexts. These patterns are inflexible and maladaptive over a long period of time.

There are nine studies examining the properties of the PIMRA. There are several other studies published prior to the publication of the instrument that are provided in the manual. Table 2 summarizes the reliability estimates. Overall these estimates indicate low to good reliability. Five studies report Cronbach's alpha on the total instrument with a range from .64 to .90 (Aman, Watson, Singh et al, 1986; Balboni, Battagliesse & Pedrabissi, 2000; Matson, 1988; Sturmey & Ley, 1990; Van Minnen, Savelsberg & Hoogduin, 1994). Two studies report Cronbach's alpha on the seven subscales of instrument with a range from .45 to .77 (Watson, Aman, Singh, 1988; Van Minnen, Savelsberg & Hoogduin, 1994). Spearman Brown split half correlations range from .80 to .93 (Balboni, Battagliesse & Pedrabissi, 2000; Matson, 1988; Van Minnen, Savelsberg & Hoogduin, 1994). Item-total score biserials range from .02 to .65 with average biserials ranging from .35 to .46 (Aman, Watson, Singh, 1986; Matson, 1988; Watson, Aman, Singh, 1988). One study examining item-subscale score correlations report a range of .40 to .70 (Van Minnen, Savelsberg & Hoogduin, 1994). One study examining subscale-total score biserial correlations reported an average biserial of .38 (Sturmey & Ley, 1990). One

study examining test-retest correlation reported a correlation of .91 (Matson, 1988). Interrater reliability estimate is also acceptable at $\kappa = .64$ (Linaker & Nitter, 1990).

Table 2 Studies Reporting Reliability Estimates of the PIMRA

Study	Cronbach Alpha	Spearman-Brown split half	Item- total correlation	Subscale-total correlation	Test-retest	Item-Subscale correlation	Interrater Kappa
Aman, Watson, Singh, 1986	.64		Average .39				
Matson, 1988	.83	.88	Range .02 to .65, average .35		.91		
Watson, Aman, Singh, 1988	Subscale range .45 to.73, average .66		Subscale range .02 to .63, average .46				
Linaker & Nitter, 1990							85.7% agree, κ = .64
Sturmey & Ley, 1990	.85			Average .38			
Van Minnen, Savelsberg & Hoogduin, 1994	Total .90, subscale range .48 - .77, average .62	.93				Subscale range .40 to .77	
Balboni, Battagliesse & Pedrabissi, 2000	.81	.80					

The body of current evidence of validity consists of eight studies (see Table 3). Six studies reported relationships between true psychiatric diagnoses and PIMRA scores (Balboni, Battagliesse & Pedrabissi, 2000; Linaker, 1991; Linaker & Helle, 1994; Matson, 1988; Swiezy, Matson, Kirkpatick-Sanchez & Williams, 1995; Van Minnen, Savelsberg & Hoogduin, 1994). Higher PIMRA total scores appear to be highly correlated to existing diagnoses, in general, and specifically for anxiety, affective, and schizophrenia. As evidence of criterion validity, three studies examined the relationship between the PIMRA subscales and existing instruments measuring depression, anxiety and schizophrenia (Matson, 1988; Sturmey & Ley, 1990; Swiezy, Matson, Kirkpatick-Sanchez & Williams, 1995). The correlations between these instruments, ranging from .43 to .73, appear to be acceptable. The two studies provide some evidence for gender effects on PIMRA diagnoses, but are inconclusive in regard to the effects age and level of mental retardation (IQ) on PIMRA diagnoses. This may be a result of how the data are reported because Watson, Aman, & Singh (1988) report data separately for individuals living in community and facility residences while Van Minnen, Savelsberg & Hoogduin (1994) do not.

Four studies conducted a factor analysis using the same technique, a principal components analysis with varimax rotation, each factor had an eigenvalue greater than 1.5 and at least 5 items with a loading of .35 or greater (Balboni, Battagliesse & Pedrabissi, 2000; Matson, 1988; Linaker, 1991; Watson, Aman, Singh, 1988). Each study found a different solution ranging from 3 to 9 factors. Three of the four studies reported

factors for somatoform, schizophrenia/ psychosis, gender identity, adjustment, and anxiety thus providing some evidence for adequacy of five of the seven subscales.

Table 3 Studies Reporting Validity Estimates of the PIMRA

Study	True Diagnoses Classification	Criterion Validity	Factor Analysis	Group Differences
Matson, 1988	ANOVA significant, higher PIMRA score had psychiatric diagnosis	Hamilton r = .64, SPSS-I r = .43	3 factors affective, somatoform, psychosis	
Watson, Aman, Singh, 1988			4 factors anxiety, social adjustment, identity/reality concerns, unnamed	a) Community no age, gender effects, b) facility age positively associated with somatoform and negatively with other subscales, c) women significantly higher scores on psychosexual & anxiety, d) moderate mental retardation higher schizophrenia & total score, e) borderline/mild mental retardation higher affective disorder
Sturmey & Ley, 1990		ABC r = .73		
Linaker, 1991			9 factors somatoform, gender identity, anxiety, hostility, psychosis, self-conscious, adjustment, autistic, avoidant	

Study	True Diagnoses Classification	Criterion Validity	Factor Analysis	Group Differences
Linaker & Helle, 1994	Regression analysis, hit rate of items & DSM -III 75.5%, 68.4% true positive, 93.3% true negative			
Van Minnen, Savelsberg & Hoogduin, 1994	t-tests, individuals with psychiatric diagnosis significantly higher total score, significant differences between psychiatric diagnosis and no diagnosis on all subscales except somatoform			No age, IQ effects, female significantly higher psychosexual disorder than males
Swiezy, Matson, Kirkpatick-Sanchez & Williams, 1995	ANOVA each subscale & 3 groups (schizophrenia, affective, no diagnosis) all significant	DSM-III R checklist schizophrenia r = .43, affective disorder r = .58		
Balboni, Battagliesse & Pedrabissi, 2000	Individuals with diagnoses of anxiety and depression significantly scores that no diagnoses		7 factors anxiety, adjustment, somatoform, schizophrenic isolation, schizophrenic bizarre, soundness, gender identity	

While there is some evidence that the PIMRA is a reliable and valid instrument, far more work needs to be added to this growing body of literature in order to continue to support its' use a tool for psychiatric referrals. Information about the collection of validity evidence can provide direction to lead additional research.

Empirical Support of Validity

Validity is an evaluative judgment based on empirical evidence that supports the inferences made as the result of assessment scores (Bryant, 2002; Cronbach, 1990; Messick, 1998). Judgments are made not only on the empirical evidence in support of theoretical rational for the assessment, but also the appropriateness of the inferences and applications as a result of the use of the assessment. It is a continual process of collecting convergent and divergent evidence to support score meaning and discount other possible interpretations. Convergent evidence consists of support for the interpretations of score meaning while divergent evidence finds lack of support for alternative interpretations (Messick, 1998). The validity of an instrument is of paramount importance. Premier research organizations consider validity the "most fundamental consideration in developing and evaluating tests" (AERA, APA, & NCME, 1999).

Validity is a multi-faceted construct. A necessary, but not sufficient criteria for evidence of validity is the reliability of the assessment (Messick, 1998). Reliability refers to the stability and consistency of the scores obtained from administration of the assessment. Scores obtained from the administration of the assessment must have internal stability and consistency over time.

Validity evidence has historically been divided into three aspects: content, construct and criterion (Bryant, 2002). Content validity examines the aspects of the domain the assessment is intended to measure. Evidence of content validity attempts to answer questions about whether or not the assessment thoroughly covers all relevant aspects of the domain it is measuring. Construct validity examines the degree to which the assessment assesses the conceptual variable or actually measures something else. The construct need to be clearly defined. Criterion validity evaluates how well the instrument predicts an identified criterion. The separate validity constructs has more recently been abandoned for a more unified theory first posited by Messick (1989). Messick contends that validity is a single, integrated concept under construct validity.

Messick (1995, 1998) describes types of construct validity evidence as: a) content, b) substantive, c) structural, d) generalizability, e) external, and f) consequential. Content validity evidence consists of evidence of its relevance, representativeness and technically quality of the assessment. Although much of this research traditionally consisted of expert judgment, there are many other statistical methods to evaluate content relevance. Substantive evidence evaluates the theoretical rationale behind the consistency of processes underlying test scores. Structural evidence tests the degree to which score structure reflects the structure of the construct domain. Generalizability evidence appraises the extent the score properties and interpretations consistent across tasks, populations, and settings. External evidence examines the relationship between the test in question and other tests of the same test behavior and between the test in question and other tests of non-test behaviors. Consequential validity evidence evaluates the intended

and unintended social consequences as a result of score interpretation. This includes issues of bias, fairness and distributive justice.

Messick (1989) also describes methods by which to evaluate validity of an instrument. First, is relevance and representativeness of the test content in relation to the domain of interest and the inferences drawn from test utilization. Second, is the relationship of the test responses to the test items or parts of the test to examine the internal structure of the test. Third, is the relationship of the test responses to the test items or parts of the test to examine the external structure of the test. Fourth, is an examination of the processes underlying responding patterns to the items. Fifth, is an investigation of the similarities and differences the structure and responding patterns over time, across groups or across settings. Sixth, is an examination of the degree that test scores are appropriate or vary as expected as a result of an intervention or manipulation of variables. Finally, Messick advocates for scrutiny of the implications or social consequences on the intended outcomes and unintended side effects as a result of test utilization. This includes consequences that result from irrelevant test variance. Irrelevant test variance is a source of test invalidity. It tells us that the test is too broad and contains an excess of reliable variance. An additional source of test invalidity results from construct underrepresentation (Messick, 1995). In this case the test is too narrow and does not include important dimensions of the construct.

There are any number of ways to statistically evaluate the validity and invalidity of an assessment. Exploratory factor analysis and principal components analysis can be used to examine the content domains of an assessment (Bryant, 2002). It can tell us what

facets the items tap, how relevant the items are to the domain and how the domains relate to each other. Confirmatory factor analysis can be used to test alternate hypotheses of how the domains relate to the construct by imposing specific constraining models of how the items relate to the domains (Jöreskog, 1971; Reise, Widaman, & Pugh, 1993). Test scores can be compared to other identified criteria in a predictive, concurrent or retrospective fashion. Predictive analyses use data collected prior to the criterion. This typically involves the use of regression, correlations or structural equations modeling. These analyses express the predictive power of the test. Logistic regression is used when the variables of interest are dichotomous. Concurrent analyses collect the test score and criterion at the same time through the use of regression and canonical correlations analysis. This method is not considered optimal because collection of both the criterion and test responses at the same time can inflate the relationships (Cook & Campbell, 1979). Retrospective analyses involve collecting the test score after the criterion using multiple and logistic regression analyses.

Evaluation of the degree that the measure assesses the construct can be convergent, discriminant or incremental. Convergent evidence consists of assesses the degree to which multiple measures of the same construct agree. Bivariate correlations, confirmatory factor analysis with goodness-of-fit indices are methods that can be used to assess convergent evidence. Discriminant analyses assess the degree to which multiple measures are distinct from each other. Bivariate correlations, multiple regression, principal components analysis, and confirmatory factor analysis can assist in such analyses. Logistic regression is helpful in discriminant evidence in examining the

classification accuracy of scores that discriminate between groups. Incremental evidence examines whether one instrument explains more than another measure in predicting a criterion. Hierarchical multiple regression and partial correlations are statistical methods useful for gathering incremental evidence.

Application of Latent Variable Analysis

Latent variable analysis is the study of variables of unobserved variables as the cause or consequence of observed behavior (Hoyle & Duvall, 2004). It uses patterns of association in correlation or covariance matrices in factor analysis, path analysis and structural equation modeling (Loehlin, 1998). Whereas four studies have examined the structural properties of the PIMRA instrument utilizing an exploratory factor analysis with some validation of some of the scales of the PIMRA (Balboni, Battagliesse & Pedrabissi, 2000; Matson, 1988; Linaker, 1991; Watson, Aman, Singh, 1988), a confirmatory factor analysis has not yet been applied. The aim of exploratory factor analysis (EFA) is reduce the number of variables to describe the relationships among the larger set of items. It searches for latent variable structure that accounts for the intercorrelations of the observed variables. In contrast, confirmatory factor analysis (CFA) examines the measurement model within the structure in the larger context of structural equations modeling. It examines the association between the observed indicator variable and the latent unobserved variable and estimates the paths between them. Another distinction between exploratory and confirmatory factor analysis is that in confirmatory factor analysis the underlying model is specified by freeing or constraining some of the paths. The value of conducting a confirmatory factor analysis is that is serves

as a validation of a scoring model, such as the PIMRA, by allowing the model to be defined and the tested. EFA simply is a tool for data reduction and does not provide a means for testing the model.

The typical CFA model expresses a relationship between each measured variable as a linear function of a latent variable and the error associated with measured variable represented as

$$X_m = \lambda_{mp}\xi_p + \delta_m$$

Where X_m is the measured variable, λ_{mp} is the regression coefficient representing the regression of X_m on ξ_p, ξ_p is the latent variable and δ_m is the error term of the measured variable *m*.

The model to be tested using confirmatory analysis can be illustrated in a diagram format (Jöreskog & Sörböm, 1996; Thompson, 2004). Free parameters to be estimated are indicated by arrows and constrained parameters that are not to be estimated have no paths drawn between them. To examine the fit of a model, a series of models are compared as constraints between the factor loadings, factor correlations and error variances are freed or fixed (Hoyle & Duvall, 2004; Thompson, 2004). One method for doing this is testing the hypothesis of measurement invariance across groups (Jöreskog, 1971; Reise, Widaman, & Pugh, 1993). There are a variety of constraining models available depending upon the research question. One model specifies full measurement invariance whereby it is assumed that the model holds perfectly in the population across groups. In this model all the parameters are invariant across groups. Other models relax one or more parameters while maintaining some constraint on the other parameters. One

begins by specifying the least constrained model and progressively adding constraint to the most constrained model. Reise, Widaman, & Pugh represented these subsequent models as hypotheses of partial measurement invariance.

This sequence of models are then evaluated for goodness of fit. First, the model being tested must be able to be identified or solved. An identified model is one where a single set of parameters is obtained (Thompson, 2004). One necessary condition in order for a model to be identified is that the number of parameters needs to be equal to or less than the degrees of freedom. If it can not be identified a model can be classified as underidentified, just-identified, or overidentified. A model that is underidentified has an infinite number of parameter estimates that are plausible and therefore cannot be solved. A model that is just-identified can be solved, but can not produce any statistics. An overidentified model has more information than parameters. A model may be misspecified when there are measured variables used in the model when they should not be. A model may also be misspecified when there are measured variables omitted from the model that should not be omitted. Misspecification can also occur if parameter estimates are constrained when they should not be and if parameters are free when they should not be. If a model is not identified reconsider the selection of indicators used in the model or modify the model itself. Other possibilities for lack of identification of a model is high correlation between the factors leading to linear dependency, negative error variance or no error variance (Wothke, 1993). Confirmatory factor analysis can identify these problems so they may be adjusted in future models. LISREL 8 (Jöreskog &

Sörböm, 1996) provides a set of modification indices that can be used to adjust the model.

The maximum likelihood method (MLE) of parameter estimation is most common. MLE attempts to estimate the true population parameters using the sample covariance matrix to derive factors that reproduce the true population covariance matrix rather than simply using the sample covariance matrix. For dichotomous data the Generally Weighted Least Squares (WLS) method is suggested to produce an asymptotic covariance matrix (Jöreskog & Sörböm, 1996).

Once the models are estimated it is necessary to judge the applicability of the model through goodness-of-fit indices. There are many types of goodness of fit indices, some are more useful that others (Thompson, 2004). The five most common indices are the likelihood ratio chi-square statistical significance test, the normed fit index (NFI), comparative fit index (CFI), and root-mean-square error of approximation (RMSEA) and the adjusted goodness of fit index (AGFI). The likelihood ratio chi-square statistical significance test estimates how much of the covariance matrix is reproduced by the parameter estimates. In this case the researcher does not want to reject the null hypothesis that there is a significant difference between the estimates. This test will reject models as not fitting when there is a large sample size, so the best use of this fit index is when comparing the fit of multiple models. The NFI (Bentler & Bonnett, 1980) compares the chi-square for a model against a baseline model that assumes that the measured variables are completely independent of each other. An NFI estimate of 1.0 is most desirable with .95 an indication of good fit. The CFI (Bentler, 1990) is proportionate index of improved

fit that compares the chi-square to a baseline null model that specifies no commonality among the indicators using a noncentral chi-square distribution. A CFI value of 1.0 is most desirable, with .95 indicating good fit (Hu & Bentler, 1999). The RMSEA (Steiger & Lind, 1980) estimates how well the parameter estimates of the sample reproduce the population covariance matrix. It is an index of discrepancy between the observed model and implied model. In this case the researcher wants a low RMSEA value with 0 indicating a perfect fit. There is some discrepancy of what value represents an acceptable fit. Thompson (2004) suggests a value of less than .06 while Hoyle & Duvall (2004) suggest a value of .08 is acceptable with .05 as superior. Hu & Bentler (1999) indicate that values less than .05 indicate a good fit. The AGFI evaluates fit based on the degrees of freedom relative to the number of variables. AGFI increases with a more parsimonious fit. A value of .9 is indicative of good fit.

Application of Logistic Regression

Shepard (1989) states that validity evaluations should be organized in response to the question, “What does the testing practice claim to do?” It the testing purpose is to identify a handicap, she believes the most important question pertains to the predictive accuracy and consequence of the test score. A validity evaluation of such a test should also demonstrate the groups are better off as a result of the consequences than they would be without the test-based consequences. With this in mind it is of prime importance that the PIMRA result in accurate predictions of potential mental health diagnoses that can lead to proper treatment.

Regression analysis analyzes the variability of a dependent variable using information from one or more independent variables (Pedhazur, 1982). Regression analysis may be used for the purpose of predicting a given outcome. When data are binary or dichotomous rather than continuous the method is called logistic regression. Logistic regression examines the relationship between probabilities and the predictor variable using observed proportions rather than sample means (Christensen, 1996). When using the linear probability model the mean is restricted by using 0 and 1, but the linear predictor is not and can therefore fall outside a logical range (DeMaris, 2004). In addition, the linear probability model assumes that errors have a mean of 0 and a constant variance. This is not the case when using binary data. Logistic probabilities in the middle of the scale are the same probabilities as typical regression, but at the extremes the 1, 0 scale the likelihood probabilities are not the same. Error can vary with the values of the indicator variable and are heteroscedastic making the linear probability model with binary data have a larger sampling variance and biased standard errors. Therefore, it is necessary to use a nonlinear probability model that utilizes a different distribution, the standard logistic distribution. The logit distribution has a greater spread than the standard normal distribution such that the curve approaches 0 and 1 more gradually. This model can be linearized by using a link function. The formula for the logit regression model is:

$$\ln \frac{\pi_i}{1-\pi_i} = \Sigma \beta_k X_{ik}$$

Where ln is the logit link, π_i is the probability of being in the interest category, and β is the change in probability for unit increase of X_i.

Again it is suggested to use the maximum likelihood method of estimation because it tends to produce unbiased, consistent and normally distributed parameter estimates for large samples (DeMaris, 2004). The idea behind using MLE with logistic regression is to find the β values that maximize the likelihood function through a series of nonlinear equations estimating b. This produces a Hessian matrix. The inverse of the negative expected value of the Hessian matrix is then used to produce the variance-covariance matrix of the estimated parameters (Long, 1997).

Interpreting the logistic regression model in the same manner as nonbinary logistic regression can be confusing since the 0, 1 scale is just a proxy for an underlying continuous variable (DeMaris, 2004). Instead of interpreting the logit coefficients in terms of its effect on Y, it may make more sense to interpret the coefficients as the probability of being in the interest category of Y. The best interpretation of the βs in logit model is "the multiplicative impact on odds of an event for a unit increase in $X_{k,}$ net of the other covariates" (p. 264). Whereas odds is the ratio of the probability of experiencing an event to the probability of not experiencing an event is called relative risk. It is interpreted as an increase of odds rather than an increase of probability. It is possible to also estimate change in the probability of an event occurring given 0, 1 presence/absence of the predictor.

In addition to the odds ratio there are several tests useful for judging the adequacy of the model (DeMaris, 2004). First is the modeled chi-square which tests against the null hypothesis the βs for all the explanatory variables are 0. A significant modeled chi-square indicates that at least one of the βs is not 0. With a large *n*, a *z* test can be used to test the

null hypothesis that β equal 0. The square of this z statistic is called the Wald statistic. The Nagelkerke R^2 and Snell and Cox R^2 statistics are a value similar to the variance in multiple regression such that a value of .230 is interpreted as explaining 23.0% of the variation in the dependent variable. Snell and Cox R^2 tends to be more conservative than the Nagelkerke R^2.

CHAPTER III

METHODOLOGY

This chapter describes the procedures and analyses to be used to answer the following research questions in an attempt to simplify the PIMRA and find a simple scoring structure model to be used for identifying individuals who may require psychiatric services.

1) How well does the PIMRA scoring model fit the data of PIMRA scores?
2) Is there an alternate model that provides a better fit to the data of PIMRA scores?
3) How well do the two models (PIMRA and alternate) fit to subgroups of individuals based on level of mental retardation?
4) What are the consequences of using the PIMRA instrument to identify mental health diagnosis?

Sample

Thomas S. class members are persons who have lived in psychiatric hospitals and who have been diagnosed as having mental retardation (Dudley, Calhoun, Ahlgrim-Delzell, 2002). The mental retardation system in North Carolina had no provisions for the care or treatment of such individuals which thus resulted in a class action lawsuit against the state of North Carolina in Thomas S. v Flaherty (1986). Subsequent to the court

hearing and after many appeals the state was found to have violated the constitutional rights of the plaintiff class members and was ordered to remedy the violations of mistreatment. In 1993, all the appeals had been exhausted and a Special Master was appointed to oversee the progress of remedial actions by the state. An independent evaluation team from the University of North Carolina at Charlotte was contracted to track the progress of state remedies by interviewing class members and their caregivers each year through the life of the court order. The court order was dismissed in April 2000.

In 1986 the state estimated approximately 400 individuals would be classified as Thomas S. class members, but the definition of qualified individuals agreed upon between the state and plaintiff attorneys led to 1,266 qualified participants by the May 1999. Of the qualified participants, 1,185 class members were interviewed at least once by the research team. Nine hundred fifty three of them were interviewed using the PIMRA. Also included in the interview were demographic information; medical, diagnostic and pharmacology changes; scales for challenging behavior and adaptive behavior; programming details; and satisfaction interviews with the class members themselves.

Table 4 displays the demographic breakdown of the class members. The average age of the Thomas S. class members at the time of the first interview was 45.86 years with a minimum age of 20 and maximum age of 101. A majority of the class members are male (63.6%), Caucasian (56%) with mild mental retardation (46.1%) who were living in community settings (63%).

Table 4 Demographic Characteristics of the Thomas S. Class Members

Demographic Characteristics	Percent
Gender	
Male	63.6
Female	36.4
Ethnic Background	
Caucasian	56.0
African-American	43.2
Other	.8
Age	
20 to 30 years	13.4
31 to 40 years	28.5
41 to 50 years	23.5
51 to 60 years	17.1
61 to 70 years	11.2
71 to 101 years	6.1
Level of Mental Retardation	
Mild	46.1
Moderate	24.9
Severe/Profound	14.2
Mental Health Diagnoses	
Adjustment Disorder	3.5
Affective Disorder	15.9
Anxiety Disorder	2.7
Conduct Disorder	6.6
Impulse Control Disorder	9.9
Organic Disorder	6.7
Paranoid Disorder	.3
Psychosexual Disorder	1.3
Psychotic Disorder	19.5
Schizophrenic Disorder	31.7
Somatoform Disorder	.1
Other	2.8

The mental health diagnoses were provided by qualified mental health professionals either in the state facility where the class member resided or community mental health center. Both groups of professionals utilized the most current DSM manual available at the time the diagnosis was provided (Dudley, Calhoun, Ahlgrim-Delzell,

2002). Mental health diagnoses are categorized into groups designated as Axis I and Axis II (American Psychiatric Association, 1980). Axis I contains clinical syndromes such as psychoses and neuroses. Axis II contains two classes of mental disorders personality and specific developmental disorders. It is possible for an individual to have more than one diagnosis in more than one Axis. It was possible for an individual to become a class member without such a diagnosis due to the definition agreed upon by the parties early in the oversight process. One part of the definition included where the individual resided within the state mental health facility. Two facilities provided segregated and designated sections within the facility to house individuals with mental retardation. The individuals residing in these sections of the facility were automatically included in the class regardless if they had a mental illness diagnosis or not.

A vast majority (82.7%) of the class members had at least one mental health diagnosis. The most common diagnosis of this group of class members is schizophrenia (31.7%). Eighteen percent had more than one mental illness diagnosis.

The Psychopathology Inventory for Mentally Retarded Adults (PIMRA)

The PIMRA Instrument (1980) has two forms Rating By Others and Self-Report, the results should be completed by an individual familiar with psychopathology and used in the context of a complete mental health evaluation. This study used the Rating By Others forms due to the nature of the individuals. The communication skills and abstract reasoning skills of individuals with mental retardation are limited, depending upon the level of mental retardation. Therefore, many individuals were not able to accurately describe their symptoms or verbally report symptoms at all. Subjects were interviewed by

"the individual who knew the class member the best." Most often this interview was conducted with the Direct Care Assistant or Direct Care Assistant Supervisor of the unit (or home) where the class member resided. The data were collected between 1994 and 2000.

The PIMRA (1980) Rating By Others instrument contains 56 items that are rated either "yes" or "no" by the informant. The manual describes four purposes: a) aid in diagnosis, b) treatment planning, c) evaluation of treatment once a course of action has been established, and d) training on psychiatric aspects of mental retardation. The instrument provided eight subscores, seven of which are mental health diagnoses based on DSM III content. The seven mental health diagnoses included in the instrument are Schizophrenia, Adjustment Disorder, Anxiety Disorder, Psychosexual Disorder, Affective Disorder, Somatoform Disorder, and Personality Disorder. The eighth scale is inappropriate adjustment. Each of the eight subscores has seven corresponding items. A positive "yes" score for four of the seven items within a scale is considered evidence for a diagnosis for that disorder.

The PIMRA manual reports evidence of reliability and validity of two samples of 209 individuals with mental retardation who were referred to two university-affiliated mental health centers for evaluation. Internal consistency was judged to be high with a coefficient alpha of .83 and Spearman-Brown split-half of .88. A test-retest correlation for an interval of five months ranged from a high of 1.0 for Psychosexual Disorder to .65 for Schizophrenia, the other scales ranging between .74 to .85. The mean item-total score

correlation was .35, $p < .001$. Forty-one of the 56 items correlated significantly with the total score.

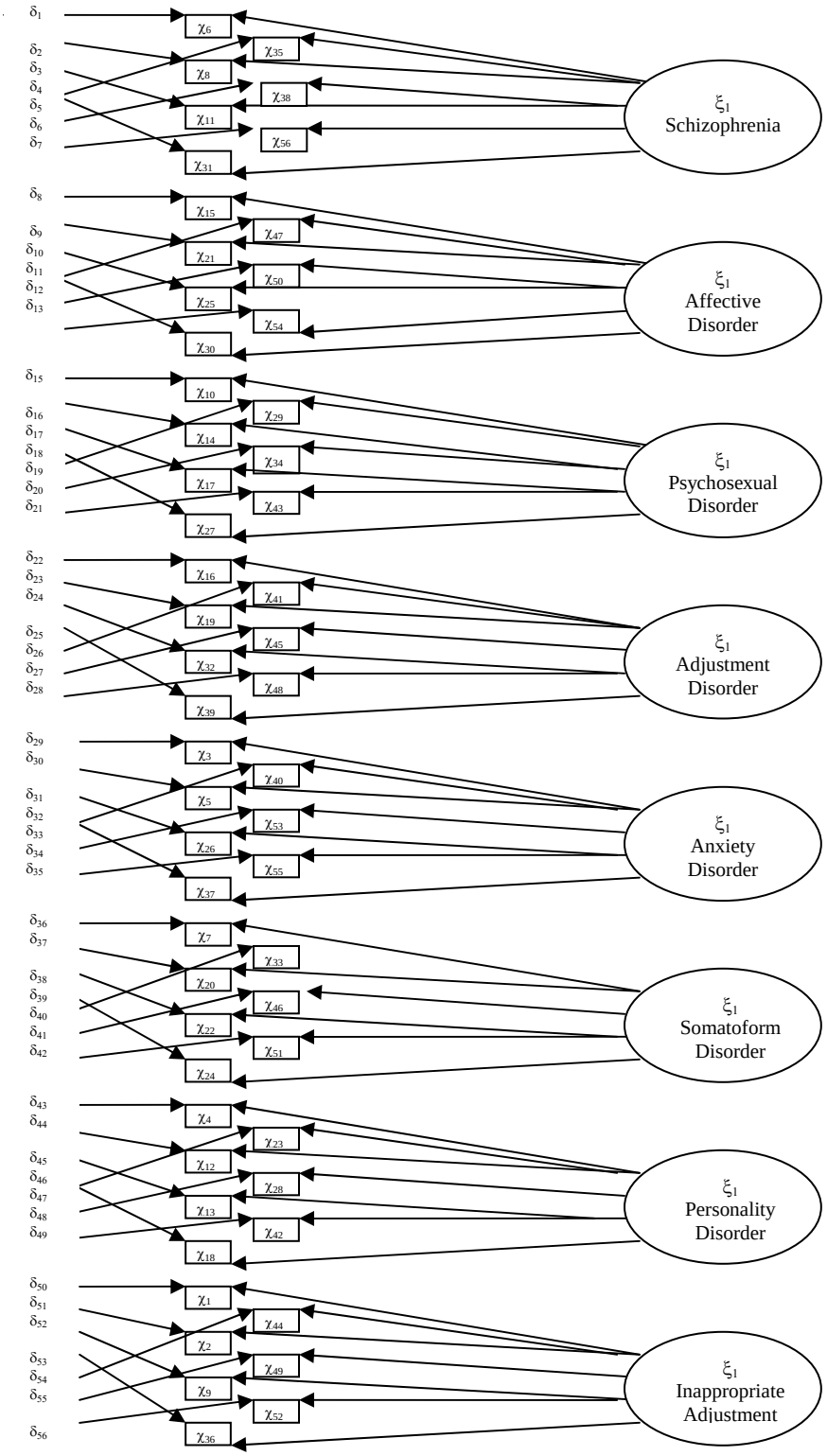
Evidence of validity includes analysis of variance of subgroups of individuals within the samples. An ANOVA of the total PIMRA score and presence of mental health diagnosis indicated that individuals with a mental health diagnosis had a higher PIMRA score ($F = 7.04$, $df = 1, 104$, $p < .01$). Individuals who were classified as being depressed on the PIMRA had higher scores on the Beck Depression Inventory ($F = 7.51$, $df = 1, 104$, $p < .01$) and the Zung ($F = 4.07$, $df = 1, 104$, $p < .05$). Additionally PIMRA scores were significantly correlated with the Beck ($r = .40$) and Zung ($r = .39$).

Research Question One: How well does the PIMRA scoring model fit the data of PIMRA scores?

In order to answer the first research question, a CFA analysis was conducted with one sample of the PIMRA data. First, a random sample of 317 (one third) of the participants who completed the PIMRA was selected using the random select procedure with SPSS version 13. Using this random sample, a confirmatory factor analysis was conducted constraining the items into the factors outlined in the scoring of the PIMRA manual (See Figure 1). In Figure 1, the χ symbol represents the indicators (the items of the PIMRA), ξ represents the latent factors (subscales of the PIMRA) and δ represents measurement error. The lines representing λ indicate a relationship with the arrow indicating the direction of the relationship. In the first confirmatory factor analysis the factor correlations and error variances were allowed to be free, constraining only the items to the factor to which they are associated. A tetrachoric correlation matrix using the

LISREL 8 (Joreskog & Sorbom, 1996) program with a maximum likelihood method of estimation was used. The asymptotic covariance matrix could not be used because of the large number of variables required a sample size equal to k(k-1)/2. With 56 k variables, 1,512 cases were required. The LISREL manual (Jöreskog & Sörböm, 1996) suggests using the maximum method if the sample size is not sufficiently large enough to estimate the asymptotic covariance matrix. The model was evaluated first by determining the identification status then by reviewing the likelihood chi-square significance test, adjusted goodness of fit index (AGFI) and the root-mean-square-error-of-approximation (RMSEA). Due to the large sample sizes, the chi-square is expected to be significant so evaluation of the model will rely mostly on the goodness of fit indices. To improve the fit the error variance output and the modification indices were consulted.

Figure 1 The Structure of the PIMRA Scoring Model



Research Question Two: Is there an alternate model that provides a better fit to the data of PIMRA scores?

To answer research question two, using the same random sample selected above two exploratory factor analyses using principal components analysis and then maximum likelihood method of estimation with a varimax rotation were conducted to determine whether an alternate factor pattern emerged. The Scree plot was examined to determine the number of factors by examining the bend in the line. The exploratory analysis was evaluated by examining the item loadings and theoretical interpretability of the items loading within the factors. Factors were evaluated against theoretical criteria listed in the DSM as indicative of a specific mental illness. Items with loadings less than .3 were maintained as contributing to a factor if they theoretically fit within the factor. Although items that load .35 and greater are stronger contributors, the goal was to retain as many items as possible. Items with multiple loadings were placed in the factor with the highest loading. One item, number 52 “evidences no sexual hang-ups” loaded on the psychosexual disorder factor -.190. It was deleted from the data and the EFA model was retested. The deletion of the item from the model significantly altered the fit of many other items resulting in a model that did not fit the theoretical criteria of mental illness diagnoses. Therefore, this item was reentered into the model. The proposed six-factor model was then estimated using a confirmatory factor analysis was using a different sample of 317 cases. The same method of identifying and evaluating the first confirmatory factor analysis was used in this second confirmatory factor analysis.

A multiple group analysis was conducted to further evaluate factorial invariance. The remaining group of 636 individuals was divided into half. Each half was run through Prelis to obtain a separate covariance matrix with the data structured according to the six factor EFA model. Then the model was to be tested with a series of constraints on the factor correlations, error variances and factor loadings to examine the differences in factor structure across the two groups. Due to the fact an adequate model for the PIMRA scoring structure could not be identified in the original CFA as described in the results section, this comparison was not conducted. Instead only the six factor EFA model was tested with as sequence of constrained models to determine factorial invariance.

First, the EFA model was tested by freeing the factor correlations and error variances and maintaining the factor pattern as the least constrained model. That is, the factor correlations and error variances were allowed to be different between the two groups of data but the factor pattern was invariant between groups. Second, the EFA model was tested by constraining the factor pattern and factor correlations while freeing the error variance, allowing them to be different for both groups as the moderately constrained model. Finally, the most constrained model tested the hypothesis that all the parameters, factor pattern, factor correlations and error variances were identical for both groups of data. The models were evaluated by reviewing the change in chi-square and fit statistics.

Research Question Three: How well do the two models (PIMRA and alternate) fit to subgroups of individuals based on level of mental retardation?

To answer research question three, the same sample of 636 individuals was divided into three groups based on level of mental retardation (mild, moderate and severe/profound). First the data for each group was run through Prelis to obtain the tetrachoric covariance matrix with the data structured according to the six factor EFA model. This model was tested across the three groups using the same procedure as with the two group analysis. First, constraints assumed all the parameters are the same for all three groups. Second, the models were tested by constraining the factor correlations to be the same for all three groups while relaxing the factor loadings and error variances. Finally, the models were tested by relaxing the factor correlations, factor loadings and error variances allowing them all to be different across groups. The model was evaluated by reviewing the change in chi-square and goodness-of-fit statistics across the three analyses.

Research Question Four: What are the consequences of using the PIMRA instrument to identify mental health diagnosis?

To answer research question four, to evaluate the accuracy of the scoring mechanism of both the PIMRA model and the six factor EFA model, a series of logistic regression analyses were conducted. The logistic regressions were run using the entire database of 953 individuals and selecting those who had a “true” psychiatric diagnosis and deleting those individuals who did no have a “true” diagnosis. This resulted in a database of 788 individuals. The first series of logistic regression used the presence of a

"true" diagnosis as the independent variable and the PIMRA score for the diagnostic category as the dependent variable. The second series of logistic regressions used the presence of a "true" diagnosis as the independent variable and the modified six factor EFA model score for the diagnostic category as the dependent variable. The "true" diagnosis consisted of the diagnosis recorded in the medical records prior to the administration of the PIMRA. The PIMRA has seven diagnostic categories. The eighth subscale of the PIMRA consists of a general inappropriate adjustment did not correspond to any "true" diagnosis and was therefore eliminated from this analysis. The score for each diagnostic category of the PIMRA and six factor EFA model was calculated by adding the total score of the items within each diagnostic category or factor. Each diagnosis was entered separately into the regression equation resulting in 13 logistic regression equations. The two sets of logistic regressions were evaluated by examining the regression coefficients, Wald statistics, chi-square statistical significances, variance accounted for as indicated by the Snell R^2 and Nagelkerke R^2, the odds ratios, and the percent of correctly identified diagnoses.

CHAPTER IV

RESULTS

This chapter describes the results of the analyses conducted to answer the four research questions.

Research Question One: How well does the PIMRA scoring model fit the data of PIMRA scores?

A confirmatory factor analysis for the PIMRA eight factor scoring model was tested using the LISREL 8 statistical program. The first analysis allowed the factor correlations and error variance to be free while constraining the 56 items to the eight factors (seven items for each factor) as described in the PIMRA scoring structure. The resulting values of this first analysis were $\chi^2 = 93.29$, df = 1456, p = 1.0, AGFI = .99, and RMSEA 0.0. Table 5 shows the eight factors and their respective items, along with the lambda coefficients for the items for this first analysis. The model matrix was non-positive definite and a ridge adjustment of 10.0 was applied. This indicates that at least one of the eigenvalues in the matrix is not positive due a) linear dependency of items and/or factors, b) no error variance or c) negative error variance (Wothke, 1993). Use of the ridge adjustment can lead to bias of the estimations, error and fit indices. Evidence of linear dependency, no error variance and negative error variance were analyzed because the data are dichotomous.

Table 5 Confirmatory Factor Analysis Model for the PIMRA

Factor (PIMRA Model) Item No. and Wording		λ
Inappropriate Adjustment		
1	Person displays verbal and facial affect that is appropriate to the situation (e. g., smiles or laughs at jokes and evidences appropriate concern when someone tells them of a misfortune)	.62
2	Adjusts easily to new situations	.63
9	Person generally conforms well to rules and social situations	.78
36	Considered pleasant to be around (reverse scored)	.62
44	Refrains from discussion of physical ailments except when appropriate	.78
49	Outgoing person who interacts frequently & appropriately with others	.25
52	Person does not evidence sexual hang-ups	-.10
Anxiety		
3	Self-consciousness and a proclivity toward being easily embarrassed	.21
5	Anxiety, fearful or tense	.78
26	Cannot relax	.49
37	Easily frustrated by failure	.50
40	Constant fear and/or worry	.06
53	Shy, timid and bashful	.78
55	Difficulty concentrating because thoughts wonder	.49
Personality Disorder		
4	Appearance of being cold and unemotional and lacks a sense of humor	.28
12	Indifferent to praise or criticism or to the feelings of others	.64
13	Dependent, helpless, constantly seeking reassurance or is vain and demanding	.59
18	Excessive dependence evident by subordination of one's own needs to those of persons on whom he/she depends	.54
23	Has "odd speech" (without loosening of associations or incoherence) that is digressive, vague, over-elaborate, circumstantial, metaphorical	.36
28	Shows a preoccupation with evidencing behavior of the opposite sex	.66
42	Self-dramatizes and exaggerates expression of emotions	.51
Schizophrenia		
6	Blunted, flat, inappropriate affect associated with a general lack of appropriate emotionality in the voice (e. g., remarking that a close friend had recently died with no change in voice inflection or facial expression)	.44

Factor (PIMRA Model) Item No. and Wording		λ
		.24
8	Speech that is incoherent due to inability to put words together in a coherent sequence	
11	Auditory hallucinations	.46
31	Recent (last few months) marked deterioration in work performance, physical appearance and socials relations	.33
35	Bizarre delusions	.66
38	Withdrawal from social contacts	.62
56	Marked peculiar behavior such as collecting garbage, talking to oneself or hoarding physical objects such as clothes	.41
Psychosexual Disorder		
10	Has sexually assaulted or attempted to sexually assault another person	.69
14	Evidences sexual excitation over inanimate objects (fetish)	.58
17	Typically wears clothing of the opposite sex	.96
27	Sense of discomfort about one's own anatomical sex	.91
29	Preoccupation with suspicions that others are trying to take advantage of him/her	.68
34	Frequently stated desire to be someone of the opposite sex	.41
43	Exposes him/herself in public	.15
Somatoform Disorder		
7	The person believes that they are more frequently ill than others	.69
20	Complains of frequent and excessive pain (e. g., head, stomach backaches)	.49
22	Physical illness or the pretext of such an illness is frequently used to avoid unpleasant tasks such as work	.63
24	Fear of debilitating disease such as cancer despite medical reassurance that such a problem is not present	.34
33	Preoccupation with a physical defect out of proportion with reality	.76
46	Discusses present or past physical complaints to gain attention or favor	.81
51	Frequent complaints of dizziness, chest pains or shortness of breath despite evidence of no physical problem	.59
Affective Disorder		
15	Mood swings and moodiness	.28
21	Decreased energy; mental and/or physical fatigue	.33
25	Unusual weight loss in the last four months	.68
30	Statements or appearance of sadness, loneliness, unhappiness, hopelessness and/or pessimism	.52

Factor (PIMRA Model) Item No. and Wording		λ
47	Death wishes and/or hypersensitivity that results in crying easily	.55
50	Social withdrawal evidenced by the person being less outgoing and evidencing less group participation	.44
54	Initial insomnia and restless sleep	.34
Adjustment Disorder		
16	Person is noncompliant and refuses to conform to rules	.60
19	Cannot cope with stress	.58
32	Hostile and aggressive toward others	.56
39	Very nervous and jittery	.44
41	Person is unable to handle routine responsibilities that are reasonable given their cognitive ability	.61
45	Person vandalizes or steals the property of others	.39
48	The person is antisocial or is considered “obnoxious” in their social interactions with others	.64

Factor and item correlations were examined due to the application of the ridge option indicating potential problems with linear dependency between factors or no/negative error variance between the items. A review of several output items was conducted to determine what type of modifications to the PIMRA scoring structure could be undertaken to provide a better fit. Factor correlations ranged from -.07 (somatoform disorder and inappropriate adjustment) to 1.10 (adjustment disorder and affective disorder). Since, it is not statistically possible to achieve real results of correlational analyses that exceed 1.0, data derived from this CFA is suspect. Specifically, factor correlations were problematic for personality disorder and anxiety disorder (.95), affective disorder and anxiety disorder (.90), affective disorder and personality disorder (1.07), affective disorder and schizophrenia (.99), affective disorder and psychosexual disorder (.95), and adjustment disorder and schizophrenia (1.09) indicating linear

dependence for these factors. A review of the item correlation matrix found that eight pairs of items were perfectly correlated (numbered items noted in Table 5 - 12 and 5, 11 and 9, 10 and 13, 7 and 23, 15 and 26, 21 and 27, 47 and 31, and 32 and 38). Each item of the pairs of items are associated with a different factor and, at least theoretically, do not appear to be associated with each other. Additional review of the R^2 for each of the variables indicated the amount of variance contributed by 11 items were .01 or less (numbered items noted in Table 5 – 3, 4, 8, 15, 25, 43, 44, 52, 53, 54, and 56). Given the serious difficulties and the amount of reconfiguration to the PIMRA scoring structure required to obtain an acceptable fit, modification to the structure, although explored, was not conducted. Modifications such as combining items and assigning them to a factor to which they were not associated with as described in the PIMRA manual violated the PIMRA scoring structure model. At this point the PIMRA model was declared as not an acceptable fit and the additional CFA analyses only involved the alternate scoring structure identified in the EFA.

Research Question Two: Is there an alternate model that provides a better fit to the data of PIMRA scores?

A Principal Components Analysis (PCA) and Maximum Likelihood Estimation (MLE) factor analysis of the data was conducted. These analyses initially revealed 18 components with eigenvalues over 1 explaining 61.3% of the variance. An examination of the Scree plot suggested a final solution of six components with the final eigenvalues of 6.778, 3.850, 2.299, 2.133, 1.938, and 1.903. The varimax rotation converged in 20 iterations. The six-component-solution explained 33.8% of the variance. Examination of

the item factor loadings indicated they were interpretable according to mental illness diagnostic characteristics. Table 6 displays the six factor solution, the items within each factor and the factor loadings of the items. One item, number 52 “evidences no sexual hang-ups, displayed a very low factor loading -.19 on the psychosexual factor. The six-factor PCA was reevaluated after removing this item. The resulting six-factor model was not theoretically interpretable based on symptomology of mental illness and was thereby rejected. Therefore, the following analyses used the original six factor model as displayed in Table 6. While one would like to have a model that explained more variance, it was decided to continue with the additional analyses anyway.

Table 6 Factors, Items, and Item Loadings for the Exploratory Factor Analysis of the PIMRA

Factor/Item		SOM	ADJ	ANX	SCH	AFF	SEX
46	Shares complaints to gain favor	.678					
7	Believe more often ill	.668					
20	Complains of frequent pain	.613					
22	Illness used to avoid tasks	.574					
40	Constant worry	.514					
51	Complains of phys prob w/o evidence	.504					
42	Exaggerates emotions	.442					
21	Decreased energy	.435					
30	Sad, lonely, hopeless	.418					
24	Irrational fear of debilitating disease	.416					
47	Death wishes	.385					
13	Dependent, helpless	.373					
18	Subordinate own needs to others	.359					
31	Deterioration in work performance	.349					
33	Preoccupation with physical defect	.331					
44	Refrain fr inapprop share phys ills (RS)	.306					
9	Conforms to rules (RS)		.649				
49	Outgoing and appropriate (RS)		.591				
36	Pleasant to be around (RS)		.540				
1	Appropriate affect (RS)		.497				
2	Adjusts easily (RS)		.488				

Factor/Item		SOM	ADJ	ANX	SCH	AFF	SEX
16	Refuses to conform		.476				
48	Obnoxious in social situations		.391				
41	Unable to handle routine		.372				
45	Vandalizes or steals		.346				
12	Indifferent to praise or criticism		.274				
37	Easily frustrated by failure			.586			
5	Anxious, fearful, tense			.570			
19	Cannot cope with stress			.526			
15	Mood swings			.507			
39	Very nervous			.495			
26	Cannot relax			.440			
28	Suspicious of other			.421			
3	Self-conscious, easily embarrassed			.418			
32	Hostile toward others			.408			
35	Bizarre delusions				.641		
56	Collects garbage, hoards objects				.618		
11	Auditory hallucinations				.616		
23	Odd speech				.518		
55	Difficulty concentrating				.480		
54	Insomnia				.371		
8	Incoherent speech				.346		
53	Shy, bashful					.644	
50	Social withdrawal					.523	
38	Withdrawal from social contacts					.446	
6	Inappropriate affect					.354	
25	Unusual weight loss					.352	
4	Cold, unemotional					.342	
29	Preoccupied w/ behavior of opposite sex						.633
17	Cross dresses						.558
27	Discomfort with anatomical sex						.497
14	Sexual fetish						.491
10	Sexually assaultive						.447
34	Desire to be of opposite sex						.428
43	Exposes self in public						.339
52	No sexual hang-ups (RS)						-.190

SOM = somatoform disorder, ADJ = adjustment disorder, ANX = anxiety disorder, SCH = schizophrenia, AFF = affective disorder, SEX = psychosexual disorder RS= reverse scored

A confirmatory factor analysis of the six-factor alternate model was also conducted using the LISREL 8 statistical program with a tetrachoric covariance matrix and maximum likelihood method of estimation. This first analysis allowed the factor correlations and error variance to be free while constraining the 56 items to the six components identified in the EFA. The model matrix was non-positive definite and a ridge option with a ridge constant of 1.0 was applied. The resulting values were χ^2 = 2052.34, df = 1469, p =.0, AGFI = .80, and RMSEA .035. Lambdas ranged from .42 to .71 for adjustment disorder, .17 to .73 for anxiety disorder, .17 to .83 for affective disorder, .49 to .70 for schizophrenia, .20 to .91 for psychosexual disorder, and .29 to .77 for somatoform disorder. Again, due to possible problems with application of the ridge adjustment, evidence of linear dependency, no error variance and negative error variance was sought. The factor correlations ranged from .07 (somatoform disorder and affective disorder) to .62 (somatoform disorder and anxiety disorder). The R^2 values ranged from .020 to .35. No evidence of linear dependency or negative or no error variance.

Although the likelihood chi-square is statistically significant, this may be due to the large sample size. Although, the RMSEA indicates a good fit below .05, the AGFI is low, not quite reaching .90. Therefore, a modification of the six factor EFA model was pursued by reviewing the modification index and the R^2 values. Ten of the 56 items were removed from the model (numbers in Table - 5 3, 8, 12, 25, 31, 43, 44, 45, 52, and 53) having an R^2 that accounted for less than 10% of the variance. A second confirmatory factor analysis was conducted. The resulting values from this analysis were χ^2 = 1190.73, df = 1011, p =.00007, AGFI = .85, and RMSEA .024. Lambdas ranged from .46 to .70

for adjustment disorder, .49 to .72 for anxiety disorder, .60 to .84 for affective disorder, .60 to .88 for schizophrenia, .48 to .91 for psychosexual disorder, and .46 to .78 for somatoform disorder (See Table 7). The RMSEA indicates a good fit below .05, but although the AGFI is somewhat increased, it still does not meet the .9 criterion. Additional modifications did not significantly improve the fit.

The six-factor-model is substantially improved over the PIMRA model. The RMSEA indicates a good fit even though the AGFI is somewhat low. Because a CFA model should not be accepted or rejected on statistical grounds alone (Reise, Widaman, & Pugh, 1993) this model was used for additional testing of factorial invariance. This model is a simple structure representation of the PIMRA and these fit indices suggest adequate fit of a simple structure.

Table 7 Factors, Items and Lambdas of the Modified EFA Model

Factor	Item		λ
Adjustment Disorder	1	Verbal and facial affect that is appropriate to the situation	.61
	2	Adjusts easily to new situations	.57
	9	Conforms well to rules and social situations	.67
	16	Noncompliant and refuses to conform to rules	.55
	36	Considered pleasant to be around (reverse scored)	.70
	41	Unable to handle routine responsibilities	.46
	48	Antisocial or “obnoxious” in social interactions	.52
	49	Outgoing, interacts appropriately with others	.54
Anxiety Disorder	5	Anxiety, fearful, tense	.72
	15	Mood swings, moodiness	.49
	19	Cannot cope with stress	.49
	26	Cannot relax	.65
	28	Preoccupations with suspicions that others are taking advantage of them	.58
	32	Hostile and aggressive toward others	.57
	37	Easily frustrated by failure	.58

Factor	Item		λ
	39	Very nervous, jittery	.50
Affective	4	Appearance of being cold and unemotional	.68
Disorder	6	Blunted, flat, inappropriate affect	.60
	38	Withdrawal from social contacts	.84
	50	Social withdrawal	.76
Schizophrenia	11	Auditory hallucinations	.60
	23	Odd speech	.55
	35	Bizarre delusions	.53
	54	Initial insomnia	.88
	55	Difficulty concentrating because thoughts wander	.71
	56	Peculiar behavior such as collecting garbage, hoarding	.64
Psychosexual	10	Sexually assaultive	.48
Disorder	14	Sexual fetish	.69
	17	Cross dresses	.70
	27	Discomfort with own anatomical sex	.81
	29	Evidences behavior of the opposite sex	.91
	34	Desire to be someone of the opposite sex	.58
	7	Believes more frequently ill than others	.68
Somatoform	13	Dependent, helpless	.72
Disorder	18	Dependence by subordination of own needs to those of others	.66
	20	Frequent complaints of excessive pain	.66
	21	Decreased energy, fatigue	.76
	22	Physical illness used to avoid unpleasant tasks	.67
	24	Fear of debilitating disease despite reassurance such a problem does not exist	.78
	30	Statements or appearance of sadness or loneliness	.62
	33	Preoccupation with physical defect	.46
	40	Constant fear, worry	.58
	42	Exaggerates emotions	.62
	46	Discusses physical complaints to gain favor	.74
	47	Death wishes	.50
	51	Frequent complaints of dizziness, chest pains or shortness of breath	.49

To test the factorial invariance of the modified six factor EFA model, a series of differently constrained analyses were conducted across two different random samples. First, the modified six-factor EFA model was tested by freeing the factor correlations and error variances and maintaining the factor pattern as the least constrained model. Second, the modified six factor EFA model was tested by constraining the factor pattern and factor correlations while freeing the error variance, allowing them to be different for both groups as the moderately constrained model. Finally, the most constrained model tested the hypothesis that all the parameters, factor pattern, factor correlations and error variances were identical for both groups of data. The change in the likelihood chi-square statistic, degrees of freedom and RMSEA were used to evaluate the fit. The values resulting from this analysis are displayed in Table 8. The chi-square is statistically significant (again likely due to sample size) and the RMSEA of .065 for the least constrained analysis indicates that the factorial invariance of the modified EFA model is not supported based on the most conservative value of .05. The moderately and most constrained analyses were also conducted, but they were unnecessary given that the least constrained model was not supported. The changes in chi-square and corresponding degrees of freedom were statistically significant for both progressions of constraints. This provides evidence that the modified EFA model may not be factorially invariant.

To further investigate the fit of this model across the two groups the factor correlation matices for the two groups were examined. If these matrices are similar, this would provide additional evidence of factorial invariance. Dissimilar matrices are indicative are a lack of factorial invariance. A review of these matrices found continued

estimation problems. Whereas the factor correlations for one group ranged from .12 (somatoform disorder and adjustment disorder) to .53 (affective disorder and anxiety disorder) the factor correlations for the second group were problematic. Seven of these factor correlations were above 1.0, an illogical value. Therefore, this model cannot be supported.

Table 8 Fit Statistics, Changes in and Degrees of Freedom and p values of the Three Models of Measurement Invariance for Two Random Groups

Model	χ^2	*df*	*p*	RMSEA	χ^2 Change	*df* Change	*p* of Change
Least Constrained	6013.95	2014	.00	.065			
Moderately Constrained	6178.00	2029	.00	.066	164.05	15	0
Most Constrained	11686.70	2055	.01	.099	5508.70	26	0

Research Question Three: How well do the two models (PIMRA and alternate) fit to subgroups of individuals based on level of mental retardation?

To continue the test of factorial invariance of the modified six-factor EFA model, a series of differently constrained analyses were conducted across three additional samples based on level of mental retardation (mild, moderate and severe/profound). The constraining pattern was identical to the two group analyses. The model was not identified with a ridge adjustment of 10 applied. A review of the factor and item correlations revealed substantial problems with three factor correlations ranging from .93 (affective disorder and adjustment disorder) to 1.06 (somatoform disorder and adjustment disorder). Deleting the adjustment disorder factor from the model did not improve the model, it continued to have severe statistical problems. These results indicate that

factorial invariance most likely does not apply across groups of individuals based on level of mental retardation. Given the substantive differences between individuals with mild mental retardation and severe/profound mental retardation this result is not surprising.

Research Question Four: What are the consequences of using the PIMRA instrument to identify mental health diagnosis?

A logistic regression analysis was performed using SPSS version 13 (2004). The dependent variable in this analysis was whether a diagnosis was made (1) or not made (0). The single predictor variable was the PIMRA score. A separate analysis, using 788 individuals was conducted for each PIMRA subscale score. The eighth PIMRA category, inappropriate adjustment, is not a diagnostic category associated with any "true" diagnoses and was therefore eliminated from this analysis. It could not be used as an "other" category due to the types of other diagnoses in the database such as dementia, conduct disorder, impulsive control disorder and the characteristics associated with these disorders would not be expected to correlate with inappropriate adjustment items.

Using the scores obtained from the PIMRA model, the schizophrenia, affective and psychosexual disorder predictors were significant predictors of the "true" diagnosis indicating that these scores distinguished between individuals who had a "true" diagnosis and those who did not. For schizophrenia ($\chi^2 = 28.987$, df = 1, $p < .001$), the variance accounted for is low with Cox and Snell R^2 equal to .036 and Nagelkerke R^2 equal to .049. Predicted success for the schizophrenia diagnosis was 26%. The overall success rate was 62.8%. The odds ratio indicate that for each one point increase in the PIMRA

schizophrenia score an individual was 1.277 times more likely to have a “true” schizophrenia diagnosis. For affective disorder ($\chi^2 = 4.797$, df = 1, p = .028), the variance accounted for is low with Cox and Snell R^2 equal to .006 and Nagelkerke R^2 equal to .010. Predicted success for the affective disorder was 0%. The overall success rate was 81%. The odds ratio indicate that for each one point increase in the PIMRA affective score an individual was 1.145 times more likely to have a “true” affective disorder diagnosis. For psychosexual disorder ($\chi^2 = 4.053$, df = 1, p = .024), the variance accounted for is low with Cox and Snell R^2 equal to .005 and Nagelkerke R^2 equal to .035. Predicted success for the psychosexual disorder was also 0%. The overall success rate was 98.5%. The odds ratio indicate that for each one point increase in the PIMRA psychosexual score an individual was 1.636 times more likely to have a “true” psychosexual disorder.

The other four PIMRA diagnoses were not significant in predicting “true” diagnoses. Again, scores on each of the PIMRA diagnostic categories were better at predicting lack of diagnosis than presence of a “true” diagnosis. Table 9 displays the regression coefficients, standard errors, Wald statistics, degrees of freedom, statistical significances and odd ratios for each of the seven predictors.

Table 9 Logistic Regression Coefficients, Standard Errors, Wald Statistics, Degrees of Freedom, Chi-Square Significance, and Odds Ratios for PIMRA Scoring Model

Predictors	B	S. E.	Wald	df	Sign	Odds Ratio
Schizophrenia	.245	.046	28.076	1	.000	1.277
Affective Disorder	.135	.061	4.841	1	.028	1.145
Psychosexual Disorder	.492	.218	5.092	1	.024	1.636
Adjustment Disorder	.070	.102	.474	1	.491	1.073
Anxiety Disorder	-.005	.120	.002	1	.969	.995
Somatoform Disorder	.635	.473	1.807	1	.179	1.880
Personality Disorder	.105	.076	1.951	1	.163	1.111

Using the configuration of items based on the modified six-factor EFA model, another set of regression analyses was conducted using the same procedure substituting the six factor scores for the PIMRA subscale scores. The schizophrenia, affective disorder and psychosexual disorder predictors were significant predictors of the "true" diagnosis indicating that these scores distinguished between individuals who had a "true" diagnosis and those who did not. For schizophrenia ($\chi^2 = 18.331$, df = 1, $p < .001$), the variance accounted for is low with Cox and Snell R^2 equal to .023 and Nagelkerke R^2 equal to .031. Predicted success for the schizophrenia diagnosis was 13.3%. The overall success rate was 62.7%. The odds ratio indicate that for each one point increase in the modified six-factor EFA model schizophrenia score an individual was 1.213 times more likely to have a "true" schizophrenia diagnosis. For affective disorder ($\chi^2 = 8.672$, df = 1, $p = .003$), the variance accounted for is low with Cox and Snell R^2 equal to .011 and Nagelkerke R^2 equal to .018. Predicted success for the affective disorder was 0%. The overall success rate was 81%. The odds ratio indicate that for each one point increase in the modified six-factor EFA model affective score an individual was .796 times more

likely to have a "true" affective disorder diagnosis. For psychosexual disorder (χ^2 = 5.254, df = 1, p = .022), the variance accounted for is low with Cox and Snell R^2 equal to .007 and Nagelkerke R^2 equal to .046. Predicted success for the psychosexual disorder was also 0%. The overall success rate was 98.5%. The odds ratio indicate that for each one point increase in the modified six-factor EFA model psychosexual score an individual was 1.827 times more likely to have a "true" psychosexual disorder diagnosis.

The other three diagnoses were not significant in predicting "true" diagnoses using the modified six factor EFA model. Again, scores on each of the six diagnostic categories were better at predicting lack of diagnosis than presence of a "true" diagnosis. Table 10 displays the regression coefficients, standard errors, Wald statistics, degrees of freedom, statistical significances and odd ratios for each of the six predictors.

Table 10 Logistic Regression Coefficients, Standard Errors, Wald Statistics, Degrees of Freedom, Chi-Square Significance, and Odds Ratios for the Modified EFA Scoring Model

Predictors	B	S. E.	Wald	df	Sign	Odds Ratio
Schizophrenia	.193	.045	18.067	1	.000	1.213
Affective Disorder	-.229	.080	8.089	1	.004	.796
Psychosexual Disorder	.603	.232	6.749	1	.009	1.827
Adjustment Disorder	-.020	.089	.049	1	.824	.980
Anxiety Disorder	-.002	.097	0.0	1	.984	.998
Somatoform Disorder	.238	.254	.880	1	.348	1.269

Results of both sets of logistic regressions suggest that regardless of which model is used, the PIMRA eight-factor or the modified six-factor EFA model, the instrument is more likely to be able to predict lack of diagnosis than actual "true" diagnosis. These results indicate that we could assume that someone does not have a specific diagnosis and we would be just as accurate as the instrument. Use of the modified six-factor model is only slightly more accurate than the PIMRA scoring model. While the percentage accurately diagnosed is comparable, the modified six-factor model accounts for a marginal amount more of the variance of scores. It is also more parsimonious in providing comparable diagnostic rates with ten fewer items.

CHAPTER V

SUMMARY AND DISCUSSION

There is a great need for an instrument to assist in identifying mental illness in individuals with mental retardation. While the incidence of such individuals is low, the seriousness of the diagnostic issues surrounding them is great. An accurate diagnosis is necessary to get appropriate treatment and measure response to the treatment. Even more troublesome is the use of medications that cause serious, life long side effects in absence of adequate diagnosis.

This study investigated the use of the Psychopathology Inventory for Mentally Retarded Adults (PIMRA) as an assist to diagnosis individuals with mental retardation suspected to have a co-morbid mental illness. Whereas initial investigations revealed the possible adequacy of the instrument, substantially more investigations are warranted. The initial confirmatory factor analysis provided evidence that the scoring structure of the PIMRA is not supported. The analysis showed substantial problems such that the model could not be solved without a major reconfiguration of the items and factor structure. An alternate model using exploratory factor analysis identified a six-factor model that was used in a second confirmatory factor analysis. This model was modified to delete ten items with very low variance. This modified six-factor EFA initially appeared to approach a good fit with a RMSEA of .024 and AGFI of .85.

Two series of confirmatory factor analyses to test the factorial invariance across groups were conducted with the modified six-factor EFA model. The first series tested

two random groups using three differently constrained models. First, the modified six-factor EFA model was tested by freeing the factor correlations and error variances and maintaining the factor pattern as the least constrained model. Second, the modified six-factor EFA model was tested by constraining the factor pattern and factor correlations while freeing the error variance. Finally, the most constrained model tested the hypothesis that all the parameters, factor pattern, factor correlations and error variances were identical for both groups of data. The changes in the chi-square statistic between the three models were statistically significant and the RMSEA of .065 for the least constrained analysis indicates that the factorial invariance of the modified six-factor EFA model may not be supported. A review of the factor correlation matrices for the two random groups revealed dissimilar factor correlation patterns. Seven factor correlations for one group were illogical, above 1.0, providing evidence that the six-factor model may not be supported either. Another series of confirmatory factor analyses was conducted with three groups based on level of mental retardation using the same procedure as described for the two group analysis. The model for three group analysis could not be identified with problems with factor correlations. Deleting the factor producing the highest intercorrelations did not improve the fit of the model. This provides evidence that the modified six-factor EFA model is not factorially invariant across subgroups of individuals based on level of mental retardation.

Finally, both the PIMRA and modified six-factor EFA models were used in a series of logistic regressions in attempt to predict the type of mental illness diagnosis. Both models provided some significant predictive power to three diagnoses;

schizophrenia, affective disorder, and psychosexual disorder. The results of the logistic regressions indicate that both models more accurately predict the lack of diagnosis than presence of a diagnosis for these three diagnostic categories. Predictive power for the other diagnostic categories was not significant. The modified six-factor EFA model is only slightly better than the PIMRA model in the amount of variance accounted for and in parsimony of administering and using only 46 items rather than the 56 items on the PIMRA.

Limitations

One limitation to this study is proceeding with the confirmatory factor analyses given the low amount of variance explained by the six-factor EFA. The diagnostic categories of the PIMRA need to be defined more succinctly so the items converge better in order to measure the diagnostic categories. One would want to explain more than approximately one-third of the variance prior to undertaking the more substantive analyses such as a confirmatory factor analysis. This severely limits any of the findings that follow the EFA. Obviously something else other than consideration of psychiatric symptoms accounts for a large amount of the variance of PIMRA scores. One possibility impacting the scores on the PIMRA is the concept of diagnostic overshadowing. Diagnostic overshadowing involves the attribution of maladaptive behaviors as characteristics of mental retardation rather than considering the possibility of mental illness retardation (Borthwick-Duffy & Eyman, 1990; Borthwick-Duffy, 1994; Silka & Hauser, 1997). The informants that completed the PIMRA on the behalf of the

individuals with mental retardation may be employing that concept when reporting on the behavior of the individual.

Another limitation is that the PIMRA and modified six-factor EFA model only attempted to identify a small number of mental illness diagnoses, seven and six, respectively of those presented by the individuals in this database. The second most common diagnosis among these individuals, psychosis, is not represented in either of the models.

A third limitation is the reliance on the accuracy of the "true" diagnosis provided by a psychiatric professional. Cross training between the professionals in the fields of mental retardation and mental health is negligible so that the professionals who provide the mental health diagnosis and subsequent treatment known little about individuals with mental retardation (Beasley & DuPree, 2003; Chaplin, 2004). The reliability of these diagnoses is unknown.

A final limitation is the reliability of the PIMRA scores. Cronbach Alpha reliability estimates from previous studies (see Table 2) provide evidence that the reliability of PIMRA scores are quite variable. These estimates indicate that the reliability of subscale scores may have impacted these results by producing scores that may not be reliable. Lack of demonstrated reliability of at least .80 would have affected the PIMRA and six-factor model results.

Implications

The findings of this study indicate that the PIMRA, as it currently structured, provides little evidence to support its' use as a diagnostic tool for individuals with mental

retardation. The modified six-factor EFA model initially showed promise by approaching the standards of goodness-of-fit, but did not hold up to testing of factorial invariance in multi-sample analyses. Neither scoring structure, the PIMRA model nor the six-factor model provides a valid and reliable diagnostic process for individuals with mental retardation.

The six-factor EFA model displayed significant estimation problems when comparing individuals of different levels of mental retardation. Given the substantive differences between these two groups this finding is not surprising. These are two distinct groups of individuals with different characteristics (Beirne-Smith, Patton, & Kim, 2006) that may impact the applicability of and diagnostic characteristics of mental illness. Most individuals with mental retardation are diagnosed with mild mental retardation, they tend to be verbal and experience situations more typical of individuals without mental retardation. Individuals with severe and profound levels of mental retardation are often nonverbal and have difficulty communicating basic wants and needs. These individuals are not likely to experience the full range of life experiences, living in restricted environments or in natural environments with restricted opportunities. It is possible that these two groups of individuals manifest behaviors symptomatic of mental illness in different ways. It is also possible that mental illness is more difficult to diagnosis in individuals with more severe forms of mental retardation. Moss (2002) found some items on the PASS-DD instrument were difficult for individuals with severe mental retardation to demonstrate. How might a non-verbal individual demonstrate that he/she is having auditory hallucinations?

Recommendations

Since neither of these models can be supported by this investigation, one recommendation is to abandon the PIMRA and exert future research efforts in the creation of a new instrument. The newest version of the DSM should be consulted in the creation of a bank of items that may distinguish between individuals with mental retardation who possess mental health issues and those who not. These items should be tested in samples representative of the national population of individuals of mental retardation across levels of retardation (mild, moderate, severe and profound), gender, ethnic backgrounds and all possible residential locations. The items should be tested for adequate reliability such as Cronbach Alpha and test-retest requiring a minimum of .80 in order to provide a stable measure of mental health status. Validity should include a body of evidence to support its' continued use such as exploratory and confirmatory factor analyses, discriminant analysis, and predictive regression analyses. Given that no other valid and reliable measure currently exists for this population criterion validity estimates with other measures of mental health status for individuals without mental retardation should be explored, but may not produce significant results.

A second recommendation is to extend current research to discern whether mental health behavioral symptomology is manifested in the same manner for individuals with differing levels of mental retardation. Additional confirmatory analyses of the PIMRA scoring model and modified-six factor model using only individuals with mild mental retardation should be conducted. One possibility is that the PIMRA instrument as a whole is better suited for individuals with mild mental retardation. It is also possible that some

subscales are easier to diagnosis in individuals with mild mental retardation who have better communication skills. An individual with severe/profound mental retardation may have more difficulty expressing the internal processes of some mental health problems, such as auditory hallucinations, that may not be clearly observed by care-givers. This should also be explored.

A final recommendation is to increase the number of service providers who are knowledgeable in both the mental health and mental retardation fields. It is clear that the current status quo with experts specializing only in one area is detrimental to individuals with mental retardation experiencing mental health difficulties. Realizing that individuals with mental retardation experience mental health problems is only the first step in providing adequate care. Our lack of knowledge is cause of great concern about their treatment as medication and placement in psychiatric hospitals continues to be a controversial issue. In the Thomas S. population, 19.5% of the individuals were diagnosed as psychosis NOS (not otherwise specified). As the second most common diagnosis, this indicates that psychiatric professionals could not provide a specific diagnosis to lead to appropriate treatment in a substantial number of individuals. Medications were prescribed to 93% of the individuals with psychosis NOS including anticonvulsants, antidepressants, antipsychotics, and sedatives. The variety of medications is another indication that the psychiatric professionals were unclear of a consistent course of treatment. It is imperative that we learn more about the display of maladaptive behaviors associated with mental illness among individuals with mental illness and educate the professionals who have the responsibility of providing diagnoses

and outlining treatment. An adequate instrument to measure mental health status could then also be used to evaluate the individuals' response to treatment. In addition, the fact that 18% of the Thomas S. individuals did not have a psychiatric diagnosis, but were still placed in a psychiatric hospital indicates that we must also educate the mental retardation professionals about mental illness characteristics. Until we can provide the mental health and mental retardation fields with individuals with expertise in both arenas, the plight of individuals with co-morbid mental retardation and mental health diagnoses will continue to be dim.

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