1988

An expert system in school psychology for PMHP

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An Expert System in School Psychology For PMHP

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A thesis, submitted to
The Faculty of the School of Computer Science and Technology,
in partial fulfillment of the requirements for the degree of
Master of Science in Computer Science.

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August 30, 1988

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Acknowledgments

First, I would like to thank Al Biles. His steady direction and knowledge of expert systems kept me calm and on track during the many months of work on this thesis. Secondly, I would like to thank Dirk Hightower. I deeply appreciate his willingness to share his expertise in psychology and his project, PMHP, with me. It was always a pleasure to work with him, and his enthusiasm kept me going when my enthusiasm waned. Thirdly, I would like to thank Norma Harmon. Without her continual, yet gentle "nudging", the five years it took to obtain this degree may very well have stretched into ten. I appreciate her loving perseverance. Fourthly, I would like to thank my future husband, Michael Callari, for his loving support and encouragement. Finally, and most importantly, I would like to thank the Lord Jesus. Without His direction I may never have embarked on this path. And without His loving presence in my life this degree, as with all other earthly possessions, would have little meaning.

Abstract

Primary Mental Health Project (PMHP) is a program for early detection and prevention of problems with school adjustment. PMHP identifies young children that have the potential for school problems early in their school careers, and uses trained paraprofessionals as child associates to work preventively with these children.

To implement this program, several evaluation forms must be filled out for each student, to determine which children should, or should not, be referred to the program. Unfortunately, a limited number of PMHP professionals are available to evaluate students. Due to this limitation, it was the desire of the author to create an expert system that would take as input the PMHP evaluation forms and produce two forms of output: a profile on each student, giving ratings on various categories and making suggested referrals to the PMHP program when appropriate, and for students referred to PMHP, objectives or goals to be reached within some given timeframe.

CHAPTER 1

INTRODUCTION

Primary Mental Health Project (PMHP) is a program that is a joint effort of the University of Rochester, the Monroe County Board of Cooperative Educational Services, the Rochester City School District, and a citizens' support group. It is a program for early detection and prevention of problems with school adjustment. PMHP identifies young children that have the potential for school problems early in their school careers, and uses trained paraprofessionals as child associates to work preventively with these children. PMHP believes that early identification of problems with school adjustment, along with early intervention is more effective than traditional repair approaches.

PMHP began as an experimental project in one school in 1957. During the 1985-86 school year the program was used to help nearly 1000 children in 18 Rochester, N.Y., area schools. Similar programs are being used in more than 60 New York State schools and over 300 school districts around the country.

As part of PMHP, students, teachers and PMHP aides are asked to complete screening/evaluation forms on students.

These measures are then evaluated by the PMHP staff to determine which children should, or should not, be referred to the program. Unfortunately, a limited number of PMHP professionals are available to evaluate students. Due to this limitation, it was the desire of the author to create an expert system that would take as input the PMHP evaluation forms and produce two forms of output. First, the system would complete a profile on each student, giving ratings on various categories and making suggested referrals to the PMHP program. Secondly, for those students referred to the program, objectives or goals would be summarized.

Chapters two through four cover the literature review done in preparation for this thesis.

Chapter two covers the literature review of School Psychology, emphasizing the development of testing procedures, including those used in the PMHP project. Chapter three provides a literature review of expert systems. In particular, topics relating to the thesis, such as the use of personal computers, human logic processes, and knowledge acquisition are discussed. Chapter four reviews the literature on expert systems designed for School Psychology. Theories and actual systems are discussed.

Chapter five discusses the design and implementation of this thesis. The first section of the chapter is an overview of the testing instruments used to measure and evaluate a student's abilities or difficulties. The remaining sections outline the steps involved in completing this thesis. The

design issues, including knowledge acquisition, are discussed, followed by an in-depth discussion of the implementation tool, SAGE. Chapter six encompasses the findings, results, and conclusions of this thesis.

Appendix A, the glossary, defines terms used in this thesis. Appendix B summarizes additional background information pertaining to School Psychology. Appendices C and D summarize general rules and guidelines gleaned during the knowledge acquisition process. Appendix E is a group of figures.

CHAPTER 2

LITERATURE REVIEW - SCHOOL PSYCHOLOGY

This chapter summarizes material presented by the expert consultant. This background material should assist in understanding classification and goal-setting, both of which are essential to the PMHP program, and, therefore, to this project. This chapter also describes some concepts and scales from which PMHP evaluation measures were derived. The sections are organized to illustrate various aspects of classification: why it's important, how to do it, and what and whom to classify.

Secton 2.1 discusses two types of classification methods: the clinically derived system and the multivariate statistical approach. These methods are evaluated according to seven criteria: clear and operational definition, reliability, validity, utility, completeness, parsimony, and mutual exclusion of patterns. Five of the major clinical classification systems are DSM, WHO, ICD-9, The Group for Advancement of Psychiatry, and the California I-Level System. Four disorders emerge from the multivariae statistical

approach: conduct disorder, anxiety-withdrawal, immaturity, and socialized-aggressive disorder.

Section 2.2 discusses actuarial assessment methods, in which decisions are made on the basis of statistically derived probabilities. Three methods of grouping children are discussed: multiple regression analysis, hierarchical cluster analysis, and multiple discriminant analysis. Three methods of classification, discriminant function classification, multivariate classification analysis, and multidimensional actuarial classification, are also discussed.

School psychology has been moving from an evaluation-control process to one of prevention. Section 2.3 discusses Barclay's four-I model. The model gains its information from three viewpoints: self report, peer judgments, and teacher expectations. Four types of individuals were identified: "thinkers", "leaders", those having multiple problems in achievement or interpersonal relationships, and impulsive children.

Section 2.4 summarizes various personality assessment instruments, methods, and theories used by school psychologists.

2.1 CLASSIFICATION

"Accurate quantification is a particularly important requisite for the scientific study of human behavior" [Quay 79]. When children are classified, categorically or

dimensionally, further information about them should be implied by the classification. For example, classification should allow statements or predictions about relationships with peers and parents, school performance, likelihood of responding to a particular treatment, and future behavior.

There are seven criteria by which any system for the classification of behavior must be evaluated [Quay 79]. First, and most importantly, the characteristics that define a category must be clearly described and operationally defined. Without such clarity, classification procedures are predicted to fail [Quay 79]. The second requisite is reliability; the assignment of an individual to a category or to a place on a continuum must be consistent. Questions about reliability are extremely critical for any classification system, since reliability sets a ceiling on the third criterion, validity. Validity means "patterns should be discriminable from one another and should demonstrate coherent relationships with variables other than those initially used to define them" [Quay 79]. Validity lays the foundation for the fourth criterion, utility. Any classification system should provide information beyond just a description of the existing phenomena. Categories should ideally have differential relationships to etiology, treatment, and prognosis. The fifth criterion is completeness. Any system describing children's behavior should not have to consistently deal with the occurrence of pathological children that do not fit any of the existing patterns. The sixth criterion is parsimony. The

best classification system should have no more subcategories than are necessary to produce maximum reliability and validity. The seventh criterion is that patterns should be mutually exclusive.

Categories have evolved from observations by clinicians within clinical settings. Problems of reliability and validity are described elsewhere [Zubin 67], but are not elaborated here. Brief discussions of five of the major clinical classification systems follow.

The Diagnostic and Statistical Manual, Second Edition (DSM-II), published in 1968 [A P A 68], was the "official" system used for reporting diagnoses to government health agencies for categorizing the mentally ill in official reports and other administrative purposes. A newer system, DSM-III [A P A 77], supplements the DSM-II. DSM-III provides three basic categories for children's and adolescents' diagnoses: attention-deficit, conduct, and anxiety disorders. Also, there are five disorders dealing with eating, four with repetitive movements and ten specific developmental disorders. There are three disorders of late adolescence: emancipation disorder, identity disorder, and specific academic or work inhibition. There are two disorders of childhood and adolescence: oppositional disorder and academic underachievement disorder.

The World Health Organization (WHO) Multiaxial Classification system [Rutter 69,75] looks at diagnosis as involving not only classification with regard to the nature of

the disorder itself but also with regard to the intellectual level, biological factors, and associated or etiological psychosocial influences. This system recognizes eight major categories and eight subcategories of specific developmental disorders. It also recognizes categories of psychosomatic disorder, personality disorder, and a set of other clinical syndromes. The three categories of greatest interest are Hyperkinetic syndrome, Conduct Disorder, and Neurotic Disorder.

The International Classification of Diseases (ICD-9) has provisions for disorders that occur only at particular age periods [Rutter 69,75]. The ICD-9 provides five categories of disorders. There are nine subtypes of neurotic disorders, eight special symptoms or syndromes, and nine adjustment reactions. Once again, three categories of greatest interest are Disturbance of Conduct, Disturbance of Emotions Specific to Childhood and Adolescence, and Hyperkinetic syndrome of Childhood.

The most complex of all the clinical classification systems is that offered by the Group for the Advancement of Psychiatry. This system recognizes eight major categories of disorders and over 40 subcategories, including those of interest noted above. One of the categories, psychoneurotic disorders, parallels anxious-withdrawn categories in other systems, but no direct parallels exist for hyperactivity, conduct-disorder, or socialized-conduct-disorder categories. This system's complexities are not supported by results of

more objective approaches.

The California I-level system [Sullivan 57] was initially derived from a theoretical position about personality development and elaborated upon through clinical observation. It was developed in the context of a treatment program for juvenile delinquents and has not been extended to other populations of deviant behavior.

In summary, all the major clinical classification approaches provide for separate hyperkinetic, unsocialized-aggressive, socialized-aggressive, and anxiety-withdrawal disorders. The DSM-III, WHO, and ICD-9 differ in their approaches of categorizing hyperactivity. However, significant agreement occurs regarding the separateness of undersocialized and socialized-conduct disorders.

In considering the criteria, of the clinical approaches, only the WHO system has been subject to reliability studies, and the California I-level approach is the only method to inquire into validity.

A second type of classification uses a multivariate statistical approach. This approach uses statistical techniques to isolate patterns of interrelated behavior. Ackerson [Ackerson 42], and Hewitt and Jenkins [Hewitt 46] first used this approach to analyze case histories of problem children.

A study by Peterson [Peterson 61], which served as a model for much additional work, received over 400

representatively selected case folders from a child guidance clinic. Fifty-eight items descriptive of deviant behavior were compiled into a checklist. Peterson [Peterson 61] suggested these 58 items could be separated into two clusters: conduct problems and personality problems. He similarly divided the majority of school problem behaviors into two dimensions: aggression and withdrawal.

Statistical classification obviates two clinical approach weaknesses. First, empirical evidence obtained necessarily shows that the dimension or constant exists and can be measured. Second, the measures' objectiveness permits relatively easy assessment of its reliability and validity.

The statistical approach also has its critics. For example, if a dimension is not represented by its constituent behavior traits, it cannot possibly emerge. Also, a dimension will be identified only if there is an intercorrelation among a subset of behaviors. Factors that do emerge are behavioral dimensions, not types of individuals. In the field of childhood psychopathology it is likely that the quantitative view will win out, and the classification will be done in terms of dimensions rather than types [Quay 79]. A larger problem has been the method and settings of data collection.

Quay [Quay 79] reviewed the major broad-based disorders found in statistical multivariate classifications. Conduct Disorders involve aggression, both verbal and physical. These disorders are associated generally with "disturbing" behavior, poor social relationships, and the children can be seen as

having "too much" behavior or to be suffering from behavioral excesses.

On the other hand, Anxiety-Withdrawal disorders involve withdrawal rather than attack, isolation instead of active engagement, and subjectively experienced anxiety and distress in contrast to the apparent freedom from anxiety characterizing conduct disorder. The anxious and withdrawn child is less aversive to adults and peers, and is less likely to excite the environment into action; the child has "too little" behavior.

Immaturity is a third pattern. It was labeled initially schizoid and then autism, but the implication of psychosis was in error. Characteristics of Immaturity include poor attention span and lack of attentiveness, which "suggest a poorly developed behavioral repertoire and an inability to come to grips with environmental demands" [Bijou 75], or behavior deficits. This pattern is common in public schools' special education classes.

The Socialized-Aggressive Disorder has most often been labeled as socialized or subcultural delinquency. It generally only occurs in samples of juvenile delinquents or child-guidance clinic cases in metropolitan areas. In 1970 this pattern was found to occur in a sample of behaviorally disordered public school children [Brady 70].

Psychosis does not usually appear as a dimension on statistical multivariate techniques, although its existence is not in dispute. However, there is serious doubt as to the

existence of hyperactivity as a disorder independent of other patterns, especially conduct disorder. Some findings pertaining to these disorders follow.

In summary, "there is considerable evidence for the cross-cultural generality of conduct disorder and anxiety-withdrawal within culturally different groups in the U.S. and in other countries" [Gordon 72]. In the U.S., these constructs have emerged in studies of Hawaiian-American adolescents [Gordon 72], Mexican-American children [Touliatos 76] and Oglala Sioux Indian adolescents [O'Donnell 75]. They have also emerged in England [Collins 62, Herbert 74], in Sicily [Peterson 65], Greece, Iran, Finland [Quay 72], and Japan [Hayashi 76].

Assessing reliability of conduct disorder, anxiety-withdrawal, immaturity, and socialized-aggressive, is a function of the method of measurement, the setting in which the measures are obtained, the observational and reporting skill of those doing the assessment, the extent of knowledge about those being assessed, and the objectivity and consistency of the behaviors defining the patterns. The internal consistency reliabilities of conduct-disorder, anxiety-withdrawal, and socialized-aggressive are satisfactory. Immaturity fails to meet any reasonable criterion.

In 1961, Peterson found inter-rater reliabilities for parents to be 0.48 for conduct disorder, 0.52 for anxiety-withdrawal, and 0.62 for immaturity [Peterson 61].

For teachers it was 0.82 for conduct disorder, 0.68 for anxiety-withdrawal, and 0.74 for immaturity. For parent-teacher agreement it was 0.41 for conduct disorder, 0.24 for anxiety-withdrawal and 0.41 for immaturity. Inter-rater reliabilities of conduct disorder and anxiety-withdrawal were adequate when raters had adequate opportunity for observation. Immaturity was rated with a lesser degree of agreement, and there were no reports on inter-rater reliability for socialized-aggressive.

In 1975, Evans conducted studies on test-retest reliability, or stability [Evans 75]. The time interval between ratings was two weeks. The correlations between ratings for boys were 0.85 for conduct disorder, 0.75 for anxiety-withdrawal, 0.82 for immaturity, and 0.82 for socialized-aggressive. For girls the correlations were 0.91 for conduct disorder, 0.87 for anxiety-withdrawal, 0.93 for immaturity, and 0.79 for socialized-aggressive. Much less stability is evident when ratings are a year apart. Findings that emerge from studies relating patterns further define the dimensions, extend their meaning, and thus, provide evidence for their validity.

General intelligence does not seem to be related to the four dimensions to any appreciable extent. Typically, there has been insignificant relationships between the four dimensions and general intelligence [Kohlberg 63, Hudgins 73, Jurkovic 74].

In comparing delinquency and moral development,

conflicting results were produced with regard to the level of moral functioning of both delinquents and their mothers when compared to nondelinquents and their mothers. In a study by Campagna and Harter [Campagna 75], psychopathic children showed less mature moral reasoning. In a study by Hezel [Hezel 69], socialized-aggressive delinquents operated at a higher level of ego-development than did both conduct disorder and anxiety-withdrawal groups.

Many studies have been undertaken to investigate the responsiveness of groups with disorders to social reinforcement. In 1962, it was shown that boys performed significantly better after receiving food and praise as opposed to only praise [Levin 62]. Under frustration conditions, the anxiety-withdrawal and socialized-aggressive groups significantly increased, while the conduct disorder group significantly decreased.

In studying the relationship between conduct disorder and anxiety-withdrawal and two motivational factors, the need for power and the need for affiliation, the following results were found. The conduct disorder group was significantly higher in the need for power than in need for affiliation, and they significantly exceeded the anxiety-withdrawal group in the need for power. The anxiety-withdrawal group was significantly higher in need for affiliation than in need for power and was significantly higher in need for affiliation than the conduct disorder group.

Acting-out and withdrawn children show a lower self

concept than normal children [Weinstein 74]. Anxiety-withdrawn children perceived their parents as pulling them in different directions. Research has confirmed the relationship of impulsiveness to conduct disorder and to immaturity [Paulsen 77].

Some investigators feel that extreme conduct disorder is motivated by a pathological need for stimulation. On initial testing [Skrzypek 69], the conduct disorder group indicated a greater preference for the complex and the novel. The anxiety-withdrawn group preferred the less complex and more mundane. Arousal experience served to increase the anxiety of the anxiety-withdrawn and to decrease their preference for complexity.

Cavior and Howard [Cavior 73] studied the relationship between physical attractiveness and social acceptance. For white subjects, the socialized-aggressive group was judged most attractive, followed by the anxiety-withdrawn, immature, and conduct disorder. There were no significant differences among the groups of blacks.

Smyth and Ingram [Smyth 70] conducted a study that looked at the relationship between sick calls, classified as medical, emotional or malingering, and the four patterns. The anxiety-withdrawal group had significantly more emotional sick calls. The conduct disorder group accounted for 39% of the malingering sick calls.

This section, though it may seem tedious to a computer science person, contains necessary information to understand

how classification of students is accomplished currently. This background information was used in the development of the PMHP instruments.

2.2 ACTUARIAL ASSESSMENT SYSTEMS FOR THE GROUPING AND CLASSIFICATION OF SCHOOL CHILDREN

As previously shown, clinical classification methods are not always the best. This section discusses some actuarial assessment methods. These methods emphasize grouping of children rather than individual assessment.

Identifying and classifying children's developmental, social and learning difficulties is one of the primary functions of preventive and remedial psychology [McDermott 82]. However, investigation shows grave concern over the grouping and classification of school children. School psychology is particularly susceptible because assessment remains a primary professional function and legal responsibility. School psychology remains both permeable and accountable to public pressure and scrutiny [McDermott 82].

In discussing grouping and classification, some terms should be known. "Group" refers to a collection of children regarded as a unit for purposes of educational placement or programming. "Grouping" refers to the formation or establishment of groups, and to the explication of the nature of the group members' characteristics or traits. "Classification" is the systematic assignment of children to groups. "Classification congruence" means that several

psychologists observe the same characteristics of a child and of his/her surroundings, and agree with one another in their classifications.

The ability of school psychologists to provide competent decisions has been vehemently challenged in the courts and in the research literature. In many cases they are unable to agree on classifications of children. Flor [Flor 78] demonstrated that not only are school psychologists unable to attain classification agreement among themselves, but that agreement is even more elusive by way of child study or interdisciplinary teams. However, there is reason to suspect that much classification disagreement follows from diagnosticians' deliberate and inadvertent noncompliance with existing standards [McDermott 82]. Psychologists' classifications have been found to be biased as a function of a client's social class, sex, race, and cultural background, as well as on the basis of prior classifications, expectations of referral sources, and information obtained from parents [McDermott 82]. It has also been noted that much of psychologists' incongruity is related to the absence of objective data about children.

In judging the appropriateness of groups there have been several federal court cases. In Mills vs. Board of Education (1972), it was stated that all children have the right to a free publicly supported education. The Louisiana district court in New Orleans mandated that, prior to all grouping of exceptional children, a written, individual plan for education

and training for each child must be submitted by schools. Some grouping may have an adverse and unacceptable impact on the lives of children and their families. Some of these groupings are characterized by their long duration, their quasi-impermeability, and their attached "stigma" [McDermott 82]. Fine [Fine 67] demonstrated that special education group status has marked effects (usually adverse) on the perceptions of regular teachers. And, Allington [Allington 75] pointed out the irreparable injury and harm associated with deviant group labels in schools. However, labels are important in classifying a child. Bowers [Bowers 73] implied that the attribution of qualities to children, as well as to the environment in which they function, is entirely necessary if we are to be afforded any real understanding of the differences in the ways by which children learn and develop in the school setting.

Actuarial Assessment is the process of making decisions on the basis of statistically derived probabilities regarding relationships among simultaneously varied and monotonic input variables and potential outcome variables [McDermott 82]. It is the process of making decisions about people on the basis of statistical probability. This necessitates multidimensional analyses of information about children and their surroundings and statistical tests of the significance of nonrandom events. Actuarial techniques may be used to forecast outcomes. The principal objectives of Actuarial techniques are the maximization of evaluative efficiency and

effect. Evaluative efficiency is the minimization of the costs of assessment in terms of time, money, and energy expended. Evaluative effect is accomplished by the maximization of diagnostic "hits" and minimization of diagnostic "misses".

Some methods of grouping children follow [McDermott 82]. For example, Multiple Regression Analysis is used to determine what are the best combinations of input variables in the prediction of specific outcomes. As an example, in a field application the WRAT was administered to 138 children. The objective was to identify potential future problems (true positives) and simultaneously avoid false negatives among those children who would actually develop a reading disability. The percentage of true positive "hits" for the actuarial method was two and one half times greater than for the clinical score comparison method. The percentage of false negative "misses" for the clinical method was twice that yielded by the actuarial process. In addition, multiple regression may be used to correct test measures and predictions for bias or unfairness. Actuarial predictions are not meant to be ends in themselves, but rather conditional. Outcome predictions are true only if circumstances do not change and no intervention occurs. But, the whole thrust of preventive education is to ensure that circumstances do change and intervention does take place.

Hierarchical Cluster Analysis, another method of grouping, takes as input a group of children and tries to

detect groupings statistically. Traditionally, schools have stated that great variations among children's needs and limited resources in public education necessitate the grouping of children to maximize the benefits of schooling and minimize the expense in the public sphere [McDermott 82]. This has meant historically grouping the uneducable together. It has been found [Esposito 73, Findley 71] that homogeneous ability grouping does not facilitate learning better than does heterogeneous grouping. Variables such as instructional method, availability of materials, and many other "child characteristics" play more crucial roles in learning than ability. Homogeneous ability grouping has often been used to stifle the needs of the disadvantaged in favor of the advantaged.

Group differentiation is usually accomplished with an approach known as Discriminant Function Analysis. This model can be intuitively approached through consideration of a geometric representation when the dimensions are assessed. Children's IQ and SQ scores are plotted on a graph. They will tend to form clusters dependent on their scores. The center of a cluster is called the centroid and the imaginary outer perimeter is called the centour. A straight line is drawn where the centours cross each other. A second line is drawn that intersects the first. This is called the discriminant function. This function is defined as the best weighted combination of variables for the purpose of predicting group membership. This type of analysis has shown that human

subjectivity often plays a large part in the interpretation of the nature of composition of discriminant functions [McDermott 82]. Edelman [Edelman 74] reported that according to national surveys of educable mentally retarded classes, a black child is twice as likely to be classified as retarded when compared to a white child.

Once groups have been established, children must be classified for placement in these groups. One method of classification is Discriminant Function Classification. The single most useful decision rule possible is drawn from discriminant functions.

Another method of classification for groups is Multivariate Classification Analysis. Some decisions when employing discriminant functions are not straight forward. Some children may fall between and not within groups. Classification analysis provides a probability statement for each child's membership in each group. In actuarial classification the characteristics of children determine group membership. So actuarial techniques provide a means of detecting misclassifications so that such children may be removed from a group as opposed to remaining in and being affected by the group.

A third method is Multidimensional Actuarial Classification. This type of technique systematically considers the status of one characteristic of a child, or the relationship between two such characteristics, and moves on in a predetermined sequence of such considerations. At each

step, critical questions are asked about a child, decision rules are applied, and decisions made. The process very much resembles the decision-making behaviors of human clinicians.

Actuarial assessment appears to take the child and his environment into consideration more than the clinical methods do. This seems to be more beneficial to the school setting.

2.3 MOVING TOWARD A TECHNOLOGY OF PREVENTION: A MODEL AND SOME TENTATIVE FINDINGS

School psychology has often been looked at negatively; it has been seen as often detecting the problem too late [Barclay 83]. School psychology's thrust has been one of crisis-coping. Often at this point intervention is difficult. Barclay sees prevention in children as the ideal [Barclay 83]. Why wait until it is too late?

The process of school psychology has been changing from one of evaluation-control to one that involves not only etiology and present functioning but also prognosis and consequent outcomes. Barclay's approach is what he calls the "four I model" [Barclay 83]. The four steps are: Identify, Integrate, Infer and Implement. In this approach, evaluation includes "relevant identification of empirical, behavioral and psychometric characteristics, the integration of such characteristics into a multi-method synthesis, the matching of specific skill deficits obtained from the assessment to alternative inferred treatments, and the implementation and evaluation of these treatments" [Barclay 83].

It is well known in medical research that a preventive approach works if a technology of assessment and evaluation exists, and this technology is given enough time to obtain results. What is not recognized is that the same thing is often true for school psychology. There is overwhelming knowledge that "the effects of intelligence, socio-economic status, and effort and motivation are strongly influenced by psychological support systems within the learning environment" [Barclay 83].

Barclay believes that computer screening of children is a practical and optimal way of implementing a prevention program. His work has focused on children in grades 3 through 6. The Barclay Classroom Assessment System (BCAS) assesses children within their classroom. The primary purpose of the BCAS is to identify children who may suffer from diminished learning by identifying those children who may suffer from academic deficits or personal-social problems. These outputs are integrated by a computer, then a printout of the characteristics of each child and a list of children who may have problems that warrant school psychology inspection or consultation is created.

The BCAS gives information about children from three viewpoints: self-report, peer judgments, and teacher expectations. Current research shows that social interactions, emotions, and attitudes that characterize each student play an important role in the student's achievement. The results from self, peers and teachers are integrated via

factor analysis and provide six factors that describe each child. The main purpose of this report is to help the school psychologist develop a prevention method.

A number of studies aim toward building self-competency and self-confidence in children. Many studies show that expectations and behaviors in the classroom relate to each other [Barclay 83].

Four different types of individuals were identified as output from the BCAS. These four groups have distinctive ways of dealing with information, decision-making and learning style. Group I was identified as the "thinkers". They are internally oriented, good achievers and responsible citizens in the classroom. Group II was identified as the "leaders". They have a great deal of support from others and are usually good students. Group III was identified as having multiple problems in achievement or interpersonal relationships. Group IV was characterized by impulsiveness, acting-out behavior and underachievement [Barclay 83].

Meta-analysis was used to analyze the treatments used on these groups. Meta-analysis is a technique for estimating the size of a given treatment through secondary data analysis. Significant positive and negative effect sizes were obtained when the data were analyzed by group and treatment [Barclay 83]. This research therefore emphasizes the importance of classifying children before engaging in a strategy of intervention.

Treatments that were used were Traditional curriculum

approach, Open Education curriculum approach, Behavioral curriculum approach, a consultation approach using teams of teachers and consultants, a group counseling approach using logical rational confrontation, a group counseling approach using an affective group experience, and a mastery curriculum and behavioral learning approach. It was shown that different students make gains or losses based on different treatments.

Some implications made in this study showed that the value of certain kinds of treatments matched certain kinds of characteristics. The quality of emotional characteristics observed in individuals with multi-trait and multi-source inputs is possibly crucial in assessing the needs of individuals.

Hunt stated that there are three major variables that must be assessed for adequate prescriptive learning interventions: learning style, conceptual level and needed degrees of structure [Hunt 71]. Children with a low level of conceptual thinking gain more from an environment high in structure. Children who are higher achievers and show more internal control tend to benefit from open curriculum approaches. Children with lesser skills and more interpersonal and social problems benefit more from the structured approach of mastery learning.

2.4 CURRENT PRACTICES IN THE ASSESSMENT OF PERSONALITY AND BEHAVIOR OF SCHOOL PSYCHOLOGISTS

Following are some paragraphs describing various

instruments and methods used by school psychologists in making personality assessments.

School psychologists disagree on the theories and practices of personality assessment. In the past, projective techniques and self-report inventories were used. Self-report inventories adopt an empirically-based approach and emphasize the measurement of discrete personality traits or characteristics [Fuller 83]. Projective techniques aim at finding the underlying structure of personality.

School psychologists were asked to list what and how many assessment instruments they used. For projective assessment of personality, the Bender Visual-Motor Gestalt Test, the sentence completion techniques, and House-Tree-Person were the three most utilized instruments. Self-report techniques were used less. This is not surprising since there have been few objective personality tests for children. The merit of these tests is that they are quantifiable and can be subjected to empirical test. However, they are time-consuming and lengthy to administer and score [Fuller 83].

The merits of behavior rating scales are their convenient use, their freedom from interpretation and sensitivity to intervention. However, the use of these scales is still at an unsophisticated, developing stage.

CHAPTER 3

LITERATURE REVIEW - EXPERT SYSTEMS

The following sections are a summary of material discussing expert systems. Some of the material pertains to expert systems on personal computers; some pertains to the rules and logic of expert systems.

Section 3.1 discusses microcomputer-based expert systems. Some of the problems pertain to hardware: lack of memory, lack of processing speed, and lack of adequate mass storage. However, one of the advantages is that experimentation can be accomplished without sizeable investments. Artificial intelligence programming languages and expert system tools are being designed to help overcome the problems of microcomputer-based expert systems.

Section 3.2 briefly discusses Preceptor, a shell system for building rule-based expert systems. It consists of two modules: the knowledge base manager and the inference module. It provides forward chaining, backward chaining, and explanatory messages.

Section 3.3 briefly discusses human logic processes.

Humans tend to pick a range of solutions and then move toward a single solution.

Section 3.4 briefly discusses approximate reasoning, or "fuzzy logic". Two alternatives are summarized: truth value restriction and compositional inference.

Section 3.5 discusses knowledge acquisition. There are five approaches: informal interviews, transcription, computer-interactive techniques, automatic induction of rules, and heuristic discovery. This section discusses how transcription was used to build an expert system for leukaemia diagnosis.

Section 3.6 investigates the suitability of PASCAL, LISP, and PROLOG as development languages. It also investigates the suitability of flowcharts, rules, intersection of sets, catalogue searching, and probability as decision techniques.

3.1 MICROCOMPUTER-BASED EXPERT SYSTEMS: WHERE WE ARE, WHERE WE ARE HEADED

The skepticism of the feasibility of expert systems on a microcomputer focuses on hardware issues: the lack of memory, the lack of processing speed, and the lack of adequate mass storage [Shafer 85].

A pattern of development on microcomputers has emerged. First, development tools are being produced with which other tools and products can be made. In the world of expert systems, tools such as LISP and Prolog are now emerging. The

second step is the emergence of custom or semi-custom applications. In expert systems this will correspond to the availability of in-house and domain-specific knowledge-based expert systems. Step three is a development of more general-purpose microcomputer software due to the realization that programs had more in common than points of differentiation. This is the phase of the expert system "shell". The fourth step is a step of further generalization involving the spreadsheet. This phase will correspond to the emergence of the general-purpose problem solver.

The microcomputer software industry has developed ways of taking better advantage of the limited memory and mass storage available. It has done so by its willingness to settle for less information being stored by the computer so more topics can be covered in less depth. In the field of expert systems, this has led to the idea of the compiled knowledge base.

One advantage of expert system tools on micros is that companies can experiment with expert systems without making sizable investments or alerting too many people prematurely that the experiment is going on. In this way, unsuccessful experiments need not be publicized, and successful experiments can remain proprietary.

Serious micro-based expert systems work has already begun. Some Artificial Intelligence programming languages available for the PC are Golden Common Lisp, MULISP/83, Arity/Prolog, Ada Prolog, Prolog V, LPA Micro-Prolog and Logicware's MProlog. Other languages that have been used to

write reasonably complete expert system development tools are Forth, Pascal, Basic and Logo.

Expert system tools are also becoming available. Some of these include Expert-Ease, which produces rules by inference from examples provided by the user. EXSYS permits the developer to specify the probability of a conclusion being correct. If a person using an EXSYS-based expert system responds so that multiple answers are feasible, EXSYS will continue to ask questions until it either resolves the ambiguity or concludes that it is unable to do so. ES/P Advisor permits the developer to make available to the user at each stage of interaction with the system all of the information he needs to answer questions. The resulting knowledge base is compiled into optimized Prolog. ExperOPS5 programs consist of a series of "if-then" rules and knowledge descriptions. "Guru" is built around Micro Data Base Systems' Knowledge Man database management system. "Insight" is a production rule generation program. Autologic uses examples to produce rules. A common thread that runs through all of the products listed is their inherent limitation on the number of rules which can comprise the knowledge base, which can present difficulties if the project is large.

Besides medicine, the fields most likely to implement expert systems seem to be banking, insurance and the legal profession. However, due to marketability, the sales of expert system "shell" programs is predicted to be confined to developers rather than end users.

Though microcomputers are not currently being used extensively for expert systems, many of the problems are being addressed and solved. And many tools and languages are being developed for microcomputers.

3.2 PRECEPTOR: A SHELL FOR MEDICAL EXPERT SYSTEMS AND ITS APPLICATION IN A STUDY OF PROGNOSTIC INDICIES IN STROKE

Preceptor is a shell system for building rule-based expert systems to support clinical decision-making [McSherry 85]. It was developed by the Queen's University Department of Medical Computing and Statistics. Its knowledge base was designed to reflect the structure and complexity of medical decision-making.

Preceptor comprises two separate modules: the knowledge base manager and the inference module. The knowledge base maintains five conclusion categories: diagnosis, recommended tests, recommended treatments, prognostic assessments and general conclusions. Patient data is classified as symptoms, clinical findings, results, and historical features. It also contains files of backward chaining rules, forward chaining rules, and explanatory messages. The knowledge base is designed to grow dynamically.

Once the user has created the required indicant and conclusion category files, he can create the backward chaining rules. To create such a rule the user specifies the number of

premises in the rule. Then for each premise, the user specifies the type and number of the proposition involved and whether it is required to be true, false, unknown or undecidable. Finally, the user specifies the type and number of the rule's conclusion.

The strategy used in the inference module is goal-directed. Forward propagation of deductions also occurs if the knowledge base contains any forward chaining rules. The inference module conducts dialogue with the user, drawing conclusions based on rules contained in the knowledge base.

Preceptor allows knowledge acquisition to occur on the computer. The expert can verify, edit or delete an existing set of rules for his specialist. A major advantage of this approach is that the domain expert can interact directly and independently with the computer.

Preceptor seems to be a step forward in expert system shell development, although it, like other shells, is mainly directed at the medical world.

3.3 EMULATION OF HUMAN TREATMENT OF UNCERTAINTY IN ARTIFICIAL INTELLIGENCE SYSTEMS

In studying how expert systems handle uncertainty we must first look at how the human mind handles uncertainty [Bacon 86]. Human estimating techniques tend to follow several principles. Humans pick a range before they pick an estimate. To pick a range, we list everything we know,

especially those values we know lie outside our range. Then we make an estimate by building a "most likely" scenario. Humans treat uncertainty more in a range of possibility than in a range of probability. We home in toward a value by using the weighting of the contributions from many possibly conflicting sources, rather than by the straight computation of the estimate. We are more comfortable working with the whole distribution of data rather than the point by point analysis. Our certainty increases with abstraction. In other words, the more general a statement becomes, the more certain we are that that statement is true. We tend to define something by stating what it is not.

Understanding human logic processes is crucial in understanding how expert system logic works, since expert systems are an extension of the human expert.

3.4 ALTERNATIVE LOGICS FOR APPROXIMATE REASONING IN EXPERT SYSTEMS: A COMPARATIVE STUDY

Human expert knowledge is incorporated into expert systems by means of rules expressed in the form "If X is A then Y is (should be) B". For example, "If weather is rainy then window-position should be closed". In light of fuzzy expert knowledge, adjustments must be made to our "crisp", non-fuzzy rules. For example, a well-functioning system should advise us to have the window nearly closed if we informed it that the weather was drizzly.

Approximate reasoning can be accomplished with two alternative approaches: truth value restriction and compositional inference. Most of the actual expert systems surveyed use compositional inference.

In truth value restriction, "the degree to which the actual given value A' of a variable X agrees with the antecedent value A in a production rule 'If X is A then Y is B' is represented as a fuzzy subset of a truth space" [Whalen 85]. This fuzzy subset of a truth space is what is referred to as the truth value restriction. It is used in a fuzzy relation between the variables X and Y.

Classical logic includes the following methods of reasoning from implications like "If X is A then Y is B". Modus Ponens involves reasoning from data about X to a conclusion about Y. Modus Tollens involves reasoning from data about Y to a conclusion about X. Hypothetical Syllogism involves an implication relating X to Y combined with an implication relating Y to Z, yielding an implication relating X to Z.

Modal logics are concerned with the varieties of human knowledge. Examples of modal logics are alethic logic which classifies propositions as necessary, possible, contingent, and impossible. Epistemic logic classifies hypotheses as verified, undecided and falsified. Deontic logic classifies actions as required, permitted, indifferent, and forbidden. Existential logic classifies properties as universal, existent, and void.

Many structures of fuzzy logic have been proposed. They differ somewhat in their definitions of AND and OR, in the way evidence combines with an implication relation to yield a deduction, and in the way multiple deductions about the same variable are combined and reconciled. The most significant difference between the logics is the definition of the implication operator which constructs the implication relation from the antecedent and consequent propositions. There are five classes of construction. Class 1 implication operators use only maximization, minimization, and complementation. Class 2 operators use complementation and a bounded sum operation. Class 3 operators use a discontinuous jump operation. Class 4 operators use complementation, addition and multiplication. Class 5 operators use complementation and bounded division.

In building expert systems, approximate reasoning is needed to mimic the human logic processes. Some methods have been summarized here.

3.5 KNOWLEDGE ACQUISITION FOR EXPERT SYSTEMS: EXPERIENCE IN LEUKAEMIA DIAGNOSIS

Some expert system designers consider knowledge acquisition as the major obstacle to success in building expert systems. "The aim of knowledge acquisition is to specify a body of knowledge which is as complete, consistent, and correct as possible" [Fox 85]. Existing techniques for

knowledge acquisition need improvement. They need to assess the accuracy of knowledge and correctly apply this knowledge to logical relationships. Since it is not currently possible for designers to guarantee consistency, completeness and correctness, it is important to publish quantitative evaluations of knowledge acquisition techniques.

Leukaemia Diagnosis requires expertise which is not widely available. Leukaemias are classified by clinical aggressiveness of the disease, haematological class of the leukaemia and cell surface immunology. At the present time, there is no more definitive way of making diagnoses than by the judgment of M.F. Greaves (MG). It was the aim of this paper to emulate his expertise in detail.

There are five approaches to knowledge acquisition:

1. informal interviews and case conferences,
2. protocol analysis or transcription,
3. computer-interactive techniques,
4. automatic induction of rules, and
5. heuristic discovery.

Informal methods of knowledge acquisition are time-consuming and unreliable. Interactive techniques are restricted to structures which have been foreseen by the system designer. Automatic techniques are immature and suffer from implicit assumptions built into the induction algorithm. For these reasons, the transcription method was used for knowledge acquisition.

Tape recordings were made of MG diagnosing cases of leukaemia from written laboratory records. Records for 63 patients were selected. The recordings included clarifying questions from J. Fox and C.D. Myers, and MG's answers to these questions.

The knowledge base was built in stages. First, statements from the transcripts which contained substantial information were selected. Second, these statements were simplified to represent the basic relationship being described, and to remove redundant information. Finally, this simplified list was placed into a table of IF-THEN rules.

The EMYCIN expert system package was used. MYCIN introduced "the representation of knowledge as IF-THEN production rules, probabilistic parameters attached to the rules, application of the rules during reasoning by means of 'backwards chaining', and rudimentary capabilities of the system to explain its behavior and conclusions" [Fox 85].

The first step of system development was to get a rough view of the leukaemia diagnosis task. A consultation with EMYCIN has a form which is determined by a hierarchical structure called a context tree. A structure consisting of two major entities, person and sample, was used in this paper. "Sample" refers to a sample of blood, bone marrow or cerebrospinal fluid. Each diagnosis decision for each sample consisted of two subdecisions establishing cell lineage and cell type.

The knowledge base development consisted of six stages.

1. "A system of 21 rules was assembled quickly from the knowledge table before any organisation issues were encountered.

2. Thirteen rules were added, twelve directly from the knowledge table and the thirteenth after discussion of a particular point with Dr. Greaves. Three rules were also modified.

3. Fifteen rules were added, and two modified.

4. At this point a prospective series of 100 patients was introduced as a test set and the performance of the 49 rule system was assessed on both the transcript set and the new test set. As a result ten rules were added, one discarded and one modified.

5. At this stage approximately 35% of the original knowledge table was still unused, though the main factors were thought to have been covered. The fifth version was largely developed from this unused, more detailed information. Nine new rules were added and one modified.

6. The final system was primarily developed in response to testing on the new series of 100 patients. One new parameter and fifteen new rules had been added, four old rules deleted and five others modified" [Fox 85].

The system performance was assessed by comparing the diagnoses with MG's recorded judgments for each case. The criteria used to assess each diagnosis are as follows:

Correct - answer agrees exactly with MG's answer.

Incorrect - a decision is made that contradicts MG's diagnosis.

Correct + Other - a list of options including 'incorrect' diagnoses is produced.

Underdiagnosed - no decision is made, though MG gave a positive diagnostic decision.

Overdiagnosed - a positive diagnosis is made although MG found insufficient evidence for a

diagnosis.

Some features of the data follow.

1. "The increase in size of the knowledge base does not appear to have had any significant affect on the diagnostic accuracy of the developing expert system. There appears to be merely a trading of false negative errors (underdiagnosis) for false positive errors (overdiagnosis and incorrects)" [Fox 85].

2. Diagnostic accuracy of the first system with only 21 rules was 68%.

3. "As the system grew, there was an increase in agreement with MG for those cases given a firm diagnosis, but no increase of agreement for those cases which MG decided were undiagnosable" [Fox 85].

The disagreements could be attributed to several factors.

1. "Protocol analysis is a poor technique which leads to a distorted or incomplete representation of a human expert's knowledge.

2. The transcript set is not representative of the range of leukaemias.

3. All available knowledge has not been extracted from the protocols.

4. The expert is inconsistent due to momentary error or other cause.

5. Incorrect estimates or inappropriate use of probabilities.

6. Mistakes in formulating the rules" [Fox 85].

7. The transcripts gave no guidance about the higher level structure of the task.

8. Defining the cell type and cell lineage were implicit rather than explicit in the transcripts.

9. The conditions deciding when patients were considered "undiagnosable" were not spelled out.

10. Acquiring knowledge about rare cases is not easily done.

11. There is less confidence in knowledge that may be implicit.

12. "Common sense" knowledge, general problem solving strategies, and "deep" knowledge of the biological foundation of the domain are examples of knowledge the expert may not think to mention.

13. An expert's judgment may vary.

Protocols are a useful basis for starting to build a knowledge base, even though they may be limited because protocols may not reflect some kinds of knowledge.

As can be seen in this section, knowledge acquisition is a very time-consuming, yet important, task in expert system building. The expert system can only be as correct as the knowledge acquired to build it with.

3.6 EXPERT SYSTEMS IN THE SELECTION OF PROCESS EQUIPMENT

This paper examines "the development of consultation programs for the selection of process valves, as a prototype of equipment selection, under three different programming environments, i.e., PASCAL, LISP and PROLOG" [Norman, unlisted]. The development of Expert Systems in the Selection of Process Equipment (ESSPE) was investigated by examining the development of Expert Systems for Valve Selection (ESVS). The fundamental task was to provide consultative advice for the user in the course of selecting a suitable valve type or design. The goals were:

1. to investigate the suitability of PASCAL, LISP and PROLOG as development languages,

2. to investigate the suitability of various decision techniques, and

3. to implement such a system on a small machine.

The selection process was as follows:

1. select suitable material of construction, and

2. select suitable valve-type.

Of the languages chosen for investigation, PASCAL was chosen as a representative of algebraic languages. LISP is widely used as an Artificial Intelligence (AI) programming language. PROLOG is a descriptive language widely used as an AI programming language. A descriptive language is one in which decisions are made based on predicate logic.

The decision techniques used were flowcharts, rules, intersection of sets, catalogue searching, and probability. Flowcharts are commonly-used decision-making techniques for conventional languages. Rule-based decision has been used to develop expert systems. SETS are data structures in PASCAL, and can be represented by lists in LISP and PROLOG. Catalogue searching is how equipment is selected manually. Probabilistic decision-making is a widely-used technique in expert system construction.

In PASCAL, flowcharts and decision by rules are represented by the 'IF' statement. A SET is a data structure in PASCAL, and intersection is performed by the '*' operator. Catalogue searching is performed with the data structures RECORD and ARRAY. Probabilistic calculations are performed

with real number computation. The key point in using PASCAL is to store as much of the system knowledge as possible in a knowledge base.

In LISP, a flowchart is represented by a list expression. Rules are simply appended to the rulebase. A set may be defined by LIST. Catalogue searching can be accomplished with the Property List. Probabilities are represented as likelihoods. "The major advantage of using LISP is that the decision rules may be represented as data which can carry out actions as a function or program" [Norman, unlisted].

In PROLOG, flowcharts and rules are easily defined. Intersection of sets is inefficient. A catalogue is constructed by using facts. Probabilities are represented as likelihoods. PROLOG can be viewed as a Rule-based Database System.

Material-Temperature selection was done by flowcharts. Material-Corrosion selection was accomplished with simple information retrieval. Probabilistic decision is the most appropriate for valve-type selection.

Languages and tools must be chosen for each application of an expert system. No one language or tool is best for every application. Each has its own strengths and weaknesses, and must be judged separately for each application.

CHAPTER 4

LITERATURE REVIEW - EXPERT SYSTEMS FOR SCHOOL PSYCHOLOGY

The following sections are a summary of material discussing expert systems already developed and/or in use by educators. Some of these expert systems directly relate to the topic of school psychology. And some of the expert systems were very similar to this thesis in intent, method, and purpose.

Section 4.1 discusses some applications of artificial intelligence in education. Educational applications have included intelligent tutoring and expert consulting programs. Some systems already designed are the Diagnostic of Reading Difficulties Expert System, BUGGY, CLASS.LD2, Mandate Consultant, and Behavior Consultant.

Section 4.2 briefly discusses the use of expert systems in special education. Both the potential problems and the beneficial effects are discussed. CLASS.LD, DEBUGGY, and Colbourn and McLeod's prototype are briefly discussed as examples.

Section 4.3 discusses expert system usage in rural

settings. In rural settings there is a lack of support services, and experts are needed who are readily available. Two systems in use are DEBUGGY and a model by Colbourn and McLeod. DEBUGGY is used in planning specific remediation, and the model by Colbourn and McLeod is used for the development and implementation of instructional plans.

Section 4.4 discusses the use of expert systems in moving from data to objectives in the Individual Education Program Process. Two systems discussed are the Math Test Interpreter and Behavior Consultant.

Section 4.5 briefly discusses CAPS, an automated evaluation system. It measures a patient's community adjustment in order to measure the effectiveness of mental health treatment.

Section 4.6 briefly describes what is ideally contained in an expert system. It then goes on to briefly discuss SCHOLAR and SOPHIE, two intelligent computer-assisted instruction systems used in education.

Section 4.7 discusses CLASS.2. This expert system was designed to perform classification duties, since humans are inconsistent, and often inaccurate. There is often little relationship between data and human decisions.

Section 4.8 discusses computerized diagnostic testing. Current testing does not use the tools or experience available. Some early ideas are presented by Uhl, Anderson, Willing, and Paulu. Some current systems include BUGGY, Diagnose, a system developed in the Netherlands, and a system

used to administer Graduate Record Examinations.

Section 4.9 discusses applications of artificial intelligence in education. It discusses several limitations of current expert systems and what requirements should be met in an expert system. An expert system should contain a problem-solving module, a student model, and a means for teaching. Some current systems are SCHOLAR, SOPHIE, BIP, WUMPUS, WHY, GUIDON, EXAMINER, ACE, QUADRATIC TUTOR, and CHECK. LOGO, a system that creates an environment of discovery learning, is discussed.

Section 4.10 discusses a prototype for computer-guided diagnosis of learning disabilities. The current roles of the computer in the classroom are discussed. The aim of the thesis is defined, followed by a summary of the design. Topics such as the fundamental stages of diagnosis, the global database, the production rules, the control structure, and the user interface are discussed. The implementation phase covers topics concerning the computer system and computer language used, means of identifying the need for further analysis, and each level of diagnosis. The measures of reliability and validity are based on human diagnoses.

4.1 ARTIFICIAL INTELLIGENCE: APPLICATIONS IN EDUCATION

Artificial Intelligence has dealt with some of the most difficult problems in computer science [Thorkildsen 86]. Expert systems are computer programs which replicate the

expertise humans use to solve problems. A knowledge engineer organizes the human expertise into a knowledge base. The knowledge base is built on factual and heuristic knowledge. Factual knowledge consists of information that can be documented. Heuristic knowledge consists of rules of thumb or probabilistic experiences of humans.

Over the last 15 years, educational applications of expert systems have included intelligent tutoring and expert consulting programs. Intelligent tutoring allows the student to interact with the computerized tutor rather than just respond to the tutor's directives. Expert problem-solving computer programs assist the user in making more efficient decisions.

A Diagnosis of Reading Difficulties Expert System by Colburn and McLeod suggests to the user (teacher or specialist) the type of data needed on a particular student. Once the data is entered into the computer, the computer makes an appraisal of the student's performance. The expert system collects information in several areas: basic educational skills, psychoeducational skills, and non-educational factors. The program generates a report of the diagnostic findings. If complete data is unavailable, the expert system continues with at least a tentative diagnosis of a particular problem.

BUGGY helps elementary school teachers learn to diagnose error patterns or "bugs" in student arithmetic problems via a computer game.

CLASS.LD2 provides a second opinion regarding the

accuracy of judgments about student eligibility for special education in the area of learning disabilities. The program contains approximately 170 factual and heuristic rules.

Mandate Consultant reviews implementation of the Individual Education Program (IEP) process for special education students. It provides school officials and parents a second opinion regarding appropriateness of the procedures used to develop a program for a handicapped student.

Behavior Consultant applies expert system technology to student behavior problems in the classroom. The program reviews information from the user regarding the student's behavior problems and suggests strategies to address the problem.

Although much work has begun addressing expert system use in education, much work remains for these systems to be used extensively.

4.2 EXPERT SYSTEMS AND SPECIAL EDUCATION

An expert system usually involves a dialogue between the expert and the computer. This parallels the conversation a person might have with an expert consultant.

Generally, the procedures used by expert systems have been developed after examining examples of problem solving by an expert. These examples are studied to identify underlying rules used by the expert in the problem solving, or to verify rules supplied by the expert.

There are several reasons why artificial intelligence has not been applied to public education [Hofmeister 84]. First, the technical and personnel resources necessary for the development of artificial intelligence products have been rare and expensive until recently. Second, the long-term efforts necessary for artificial intelligence product development did not fit the funding patterns for educational research. The existence of scaled-down systems now appears to place expert system development within the reach of public education.

In special education, potential problems for expert systems might include: 1) the development of an instructional prescription based on assessment information, 2) the classification of a child into one of the special education categories based on assessment information, or 3) the selection of an appropriate behavior management strategy based on classroom observations. Expert systems can have at least three beneficial effects in the field of special education. First, an expert system, teamed with a powerful small computer, can make low-cost computer consultant services available to classroom teachers. Second, is the training value of the "intelligent knowledge base" generated by the development of the expert system. This training can reduce the threats presented to special education students by beginning instructors and diagnosticians. A third benefit is that the expert system development could accelerate the clarification and expansion of knowledge in special education.

CLASS.LD provides a second opinion on the accuracy of the

classification "learning disabled". The system operates on a high-powered microcomputer. With DEBUGGY, the user is trained to identify error patterns in students' attempts at arithmetic problems. Colbourn and McLeod's prototype performance suggests that using an expert system for special education diagnosis is clearly feasible.

Since expert systems' use has been shown to be feasible in special education, it would be beneficial to take this study further and investigate their use in specific applications.

4.3 THE POTENTIAL OF COMPUTER-BASED EXPERT SYSTEMS FOR SPECIAL EDUCATORS IN RURAL SETTINGS

The expert system could serve as consultant to the educator in addressing issues such as identification, diagnosis, and remediation of problems presented by special education students [Parry 84].

There is a lack of support services in rural districts because of too much geography and too little money. A group of educational experts is needed who are readily available to teachers and administrators at each school of a rural district. Knowledge-based expert systems can provide teachers and administrators with readily available advice concerning a specific content area. They also have the potential to capture practical experimental knowledge for teachers and administrators.

DEBUGGY: Recognizing that nearly 80% of all student errors are systematic in nature, the DEBUGGY system identifies the student's misconceptions by collecting evidence of error patterns from test problems worked by the student. By combining the rule-based logic of DEBUGGY and student data, the computer outputs the subskills the student still needs to master and the rules the student has internalized resulting in the incorrect answer. Diagnosis at this level is useful for the teacher in planning specific remediation to address the student's need.

Colbourn and McLeod: Once the specific nature of the child's problem is identified, teachers can turn their attention to development and implementation of a successful instructional plan. Since delays in the diagnostic process have been reduced, if not eliminated, hopefully services for the student can begin sooner.

These are only two expert systems that are useful in rural areas. The rural community seems an ideal location for expert systems, due to the community's lack of human expert resources.

4.4 EXPERT SYSTEMS IN THE INDIVIDUAL EDUCATION PROGRAM PROCESS

The purpose of an Individual Education Program, IEP, is primarily to guide the delivery of instructional services to a handicapped child. The process of developing an appropriate

instructional plan begins with collecting test and observational data. There are problems in moving from data to objectives. A great deal of data describing student performance is collected, but much of it is technically inadequate and irrelevant [Thurlow 79]. To be instructionally relevant, an individual's performance must be assessed in absolute terms. Many instructional planners have difficulty moving from data collection to writing instructional objectives. Often more detailed and time-consuming criterion-referenced test data is required to write suitable objectives. Many times, unskilled planners don't even know when to ask for more information. Social skills must also be considered.

Artificial intelligence may be a possible solution. Two prototype expert systems have been developed to test the feasibility of applying expert systems to translating test and observational data into prescriptive objectives.

"The Math Test Interpreter, MTI, is designed to combine student information, results from the Key Math diagnostic Arithmetic Test and additional program generated criterion-referenced test data to produce a prescription for program planning in the area of mathematics" [Lubke 85].

The knowledge base of MTI contains several components: 1) a set of rules to guide the consultation, 2) a master set of objectives from which review and instructional objectives are selected, and 3) a set of criterion-referenced test items designed to obtain missing student information.

Behavior Consultant, BC, applies expert systems to student behavior problems in the classroom. The overall structure includes: 1) an initial videodisc component designed to teach effective skills for observing student behavior, 2) an expert system component designed to evaluate data from the user regarding student behavior problems and suggest strategies for addressing the problems, and 3) a second videodisc component designed to teach effective implementation of the behavior strategies recommended by the expert system.

Both prototypes engage the user in a dialogue. Both were written in a computer language that organizes human knowledge into a series of rules. Both contain factual and heuristic rules. Both use back chaining. They seek values for the expressions within rules in three ways: 1) already known (in global memory), 2) seeking rules which conclude with a value for the expression, and 3) asking the user.

Possible system outcomes are inadequate information or objectives. MTI presents two types of objectives: review and instructional. Review objectives cover those isolated skills a student appears to be lacking. Instructional objectives correspond with the level of the test items that fall at or above the student's ceiling level. BC provides terminal objectives as well as an explanation of step-by-step procedures for achieving those objectives.

M.1 was used to create both MTI and BC. Several M.1 features are particularly attractive to educators. TRACE

allows the user to monitor the computer logic as it attempts to provide advice. WHY allows the user to question the program about "why" it asked a question. SHOW allows the user to query the program at any point in the consultation regarding its intermediate conclusions.

Evaluations conducted with prototypes of MTI and BC indicate that these systems can perform as well as humans in specific areas. Some of the problems faced by special educators are similar to the problems faced in other disciplines where expert systems have been successful. The development of the rules of a knowledge base clarifies existing knowledge and identifies areas where knowledge is needed.

This study shows how expert systems can be used to develop raw data into instructional plans and objectives. Expert systems can be helpful in handling time-consuming analysis of data, and making decisions when a human expert is not available.

4.5 CAPS: AN AUTOMATED EVALUATION SYSTEM

One of the most direct ways to measure the effectiveness of mental health treatment may be to compare the patient's community adjustment prior to treatment with his community adjustment after treatment [Evenson 74]. Information about a patient's community adjustment obtained from appropriate relatives was as reliable as that obtained from staff members

and more reliable than that obtained from the patient himself. Ten areas of community adjustment are measured by 60 items on a questionnaire. The data is keypunched into a central computer and a CAPS (Community Adjustment Profile System) report is printed out at the admitting hospital. The data from the time of admission and 90 days after the patient has left the hospital are compared. The CAPS profile shows graphically whether a patient's outcome is better or worse than the statewide average.

The CAPS system shows once again how computer automation can speed up processes that would take humans much longer.

4.6 EXPERT SYSTEMS: THEIR POTENTIAL ROLES WITHIN EDUCATION

"Artificial Intelligence - the study of how to make computers do things at which, at the moment, people are better" [Rich 83]. Ideally an expert system should contain a language processor to carry out communication with the user; a workspace for recording intermediate results; a database of facts concerning the particular case in question; a knowledge base containing problem-solving rules or heuristics; a control structure which handles the problem-solving process; a consistency enforcer which adjusts previous conclusions when new data is acquired; and a justifier that can explain the system's behavior and conclusions [Colbourn 84].

The knowledge base should contain all the knowledge employed by a human expert.

The control structure is often specified as two components, the interpreter and the scheduler. The scheduler determines which of the potential actions should be executed next and the interpreter is responsible for performing the selected action.

Most Intelligent Computer-Assisted Instruction systems store information in the form of pre-written frames. SCHOLAR [Carbonell 70] was organized around an associated database which contained simple facts. It is an early example of a mixed-initiative system; both student and system can initiate a dialogue. SOPHIE provides the student with a learning environment in which to acquire problem-solving skills by trying out ideas.

This section shows us that expert systems can be helpful in education. Intelligent computer-assisted instruction systems already exist in the education field.

4.7 CLASS 2: AN EXPERT SYSTEM FOR STUDENT CLASSIFICATION

Multidisciplinary teams do not follow a systematic approach in making decisions [Ferrara 85]. Placement teams have not been accurate. Teams spend about 30% of their time discussing questionable data. Individuals discussing this data use language which is unfamiliar to noneducators. It was reported that there was little relationship between the psychometric data presented to placement teams and the eligibility decisions those teams made [Ysseldyke 82]. Some

reasons follow:

1. There seems to be no systematic approach to eligibility determination,

2. and frequently placement decisions are made prior to the actual team meeting by a few supposedly "knowledgeable" individuals. Teachers and other professionals rarely argue with these individuals.

3. An aggressive individual might convince team members to ignore selected portions, or in some cases, all psychometric data.

"Artificial Intelligence - the art of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior - understanding, language, learning, reasoning, solving problems and so on" [Barr 81].

The CLASS.2 system consists of six components:

1. CLASS.LD2 (for Learning Disabilities),
2. CLASS.SL2 (for Speech and Language),
3. CLASS.MR2 (for Mental Retardation),
4. CLASS.BD2 (for Behavior Disorders),
5. CLASS.PI2 (for Physical Impairment), and
6. CLASS.SI2 (for Sensory Impairment).

Each component may be used independently, or the components may be used as a coordinated package.

A consultation with CLASS.LD can be ended in three ways. The "quick-out" identifies a condition which totally precludes the possibility of a child being classified as learning disabled. The "voluntary-end" establishes that the information provided by the user is too limited to determine a

valid classification. The "advice shown" is when the system collects enough information to provide reasonably reliable advice.

CLASS was authored with M.1, implying that TRACE, WHY and SHOW are available.

Classification and placement by human experts appears to be inconsistant. Because of this apparent difficulty, expert systems have begun to be used for classification purposes. They seem to lend consistency, if not always accuracy.

4.8 COMPUTERIZED DIAGNOSTIC TESTING

Current diagnostic testing in education seems weak in its theoretical foundations. It makes use of few statistical tools and little of the wealth of experience available from other professions. The question seems to be how diagnostic testing, modern psychometric theory and computer technology can be most effectively combined.

The common idea behind most educational diagnosis has been "the use of tests to provide information about specific problems in the performance of a task by an individual student" [McArthur 84]. Existing diagnostic tests are concerned with the following key elements:

1. examination of a student's consistent performance problems,
2. construction of a summary test score profile of the student's strengths and weaknesses, and

3. identification of the specific misunderstandings that must have led the student to perform poorly.

Some early ideas on diagnostic educational tests are described. Uhl stressed examination of a student's methods of work and interrogation of the student during the problem solving phase [Uhl 17]. Anderson discussed diagnostic testing in reference to seven types of errors in long division [Anderson 18]. Willing proposed error types as the basis for diagnosis [Willing 20]. Paulus' concepts urged teachers to observe their students for important signs of individual difficulty and immediate specific remediation [Paulu 24].

Several attempts have been made in recent years to use computer technology to exploit the information contained in incorrect answers. Brown and Burton have developed "BUGGY" in which "it is necessary to analyze each skill under study, to formulate a 'procedural network' of subskills, and to list correct and incorrect ways to apply each subskill" [McArthur 84].

In computerized diagnosis in medicine, the problem-solving process occurs in three parts: "obtaining information, evaluating decision alternatives and either making a suitable diagnosis or obtaining additional information in the instance that diagnosis is not yet indicated. The typical configuration of a computer-based medical diagnostic system involves a disease-symptom database, a combination of statistical and heuristic algorithms for developing decisions and, through the input of the medical

professional, a contact with the target case" [McArthur 84]. The program reaches a point at which it can state a diagnosis, a level of confidence in the diagnosis, some alternative diagnoses, and recommendations for treatment in both expected and adverse circumstances.

Some current efforts in computerized diagnosis in education follow. Diagnose is a multi-part computer-based program for reporting criterion-referenced test results [Furlong 78]. Its purpose is to provide a nontechnical description of a student's test performance. It shows how questions are answered incorrectly and offers objectives for further study. It also provides class profile summaries for the teacher. This program was put into use at Southern Illinois University, but certain assumptions about teachers were erroneous and the system disappeared for lack of demand. An elaborate diagnostic system to provide feedback about consistent patterns of error on multiple-choice tests was developed in the Netherlands [Gobits 74]. The developers aimed to build structural and syntactical rules that the computer could follow to extract significant patterns of wrong answers. This system was never put into use. Currently a microcomputer-based diagnostic testing program for administering sample tests for the Graduate Record Examination is in its final stages. It provides the student with scaled scores and plans for remedial study, and retests selectively when needed.

Current research is exploring algorithms that assess the

relative merits of competing hypotheses about the nature of a student's misunderstanding. The answer-until-correct method [Horst 33] seems well-suited for computer-managed testing. The student is shown the next item only when he answers the previous item correctly. Adaptive testing [Weiss 83] is also showing considerable promise. The computer moves through banks of questions, moving to easier questions when the student answers too many questions incorrectly, and to more difficult questions when the student answers questions correctly.

None of the present efforts takes advantage of artificial intelligence's ability to engage in interactive appraisal of a student's strengths and weaknesses. The success of computer diagnosis in the field of medicine has not been matched in computerized educational testing, though some of the early strides in utilizing computerized educational testing certainly show a promising future.

4.9 APPLICATIONS OF ARTIFICIAL INTELLIGENCE WITHIN EDUCATION

Computers are used within education to teach programming skills, in instructional and diagnostic roles, as an educational resource, and to maintain databases of student information.

Computer Assisted Instruction (CAI) systems have several limitations:

1. "an inability to conduct conversations with the student in the student's natural language;

2. an inability to understand the subject being taught, thus being unable to accept unanticipated responses;

3. an inability to decide what should be taught next;

4. an inability to anticipate, diagnose, and understand the student's mistakes and misconceptions;

5. an inability to improve or modify current teaching strategies or learn new ones" [Jones 85].

"Providing teachers with assistance in the diagnosis and assessment of learning difficulties is a major application of computers in education" [Jones 85].

In early CAI programs, which were little more than drill-and-practice units, the teachers provided the course material, the criteria for evaluation, and the possible routes through the material.

Recent CAI systems provide a reactive learning environment, one in which the student actively engages with the program. This type of system must be capable of analyzing many types of student responses. Generally this requires the inclusion of a domain expert. This type of system usually contains a model with both the student's knowledge and misconceptions. It also has a component that contains appropriate teaching strategies.

The domain expert, or expert system, "embodies knowledge of a particular application area combined with inference mechanisms that enable the program to employ this knowledge in problem-solving situations" [Jones 85]. The problem-solving

module must contain the domain-specific knowledge. The module uses this knowledge to generate questions and evaluate student's responses.

A second component of an intelligent CAI system is the student model. This model represents the student's understanding of the material. In BUGGY, by Brown and Burton, a perturbation construct was used to represent student's misconceptions as variants of the correct procedural skills.

A third important component to an ICAI is a means for teaching. It should be able to choose what, when, and how to teach. Some recent work by O'Shea [O'Shea 79,82] involved self-improving ICAI systems.

Some examples of ICAI systems are SCHOLAR, SOPHIE, BIP, WUMPUS, WHY, GUIDON, EXAMINER, ACE, QUADRATIC TUTOR and EXCHECK. SCHOLAR is an example of a mixed-initiative system, in which both the student and system may initiate the dialogue. SOPHIE is a computer-based expert that helps students develop, test, and debug hypotheses. WHY teaches the student about physical processes. WEST used differential modeling, which compares what the student is doing to what the expert expects.

Current ICAI systems lack the flexibility and adaptability of a human teacher.

LOGO was developed to create an environment of discovery learning for the student. Discovery learning is defined as the student discovering information or laws for himself. LOGO was developed under two fundamental heuristics.

1. "Start from previous knowledge; a person is not able to make sense of a new experience and assimmilate it unless it can be related to previous experience.

2. The learner should use the new ideas to 'make them his own': concepts are learned and remembered if they are important to the learner" [Jones 85].

LOGO allows the child to be the programmer, by providing tools and sufficient guidance for the child to create programs and simulations to study a variety of subjects.

An important aspect of teaching is to be able to anticipate and diagnose a student's misconceptions. The underlying cause of errors must be determined. The nature of the child's difficulties must be determined. Initial assessment should be done by a teacher in the regular school environment. However, most teachers do not have the expertise to do in-depth diagnoses; local experts are called upon to "augment the initial assessment with more sophisticated evaluation procedures, leading to advice, guidance, and prescriptive programming" [Jones 85]. Often in reality, though, initial assessments are not done and specialists are unavailable.

The computer can supply educational diagnoses within the regular classroom. It could guide the teacher through the initial diagnosing phase to the prescription phase. The system could provide a summary of its diagnostic findings with appropriate remedial activities and instructional techniques. Interaction between the child and system could also be added to the system.

An initial step was taken in developing McLeod Educational Diagnostic Model to assist in the assessment of reading problems. First, relevant information must be collected about the child's physical, mental, emotional, social, and academic history of development. The expert system also examines psycho-educational correlates, including intellectual, visual, auditory, and language skill deficiencies. In addition, the expert system must determine which skills and abilities the child has mastered. This information is necessary for the development of appropriate remedial programs.

In building a diagnostic model, one must determine:

1. "what data are normally collected,
2. the usual sources of such data, and
3. how this information is applied" [Jones 85].

The system's performance was evaluated by comparing diagnoses with those of human experts. The results were encouraging.

BUGGY is a program that determines a student's arithmetic misconceptions by attempting "to determine what internalized set of incorrect instructions give results equal to the student's answer" [Jones 85].

BUGGY's domain expert contains 110 primitive bugs and 20 common compound bugs. An initial set of bugs are combined to generate additional hypotheses for bugs. Each proposed bug is classified as to how well it explains the student's answer.

This section seems to show that several systems are under development or in use within the field of education. With the positive strides that have been made, it seems obvious that expert systems should become an integral part of the school environment.

4.10 COMPUTER-GUIDED DIAGNOSIS OF LEARNING DISABILITIES: A PROTOTYPE

4.10.1 Introduction

The computer has many roles in the classroom: record keeping, fun and games, teaching computer literacy, and teaching programming concepts or languages. Another important role is the diagnosis of learning difficulties.

Many of today's conventional classroom programs allow the pupil little or no control over the content of the lesson or a means for obtaining advice or guidance. They are, however, useful in identifying a child's weak subjects and skills.

Research in Artificial Intelligence has shown that individualized computer instruction is possible. Allowing the student interaction with a simulation of the situation in question gives him/her the ability to explore new subjects. This is generative Computer Assisted Instruction, where the lessons are generated. SOPHIE [Brown 75] uses this method. Barr, Beard & Atkinson [Barr 76] designed a system that emphasized problem-solving. The student attempts to solve the

problem with guidance from the computer. The computer programs must be flexible to be useful.

At the University of Edinburgh [Howe, not listed] a program has been developed to teach children words using a phonic approach. The program uses a pressure sensitive screen and teaches the child to associate letters with pictures of known objects. Then the child must begin to associate these letters with unknown objects. When errors are made, the correct choice is shown and the child's incorrect choice is explained.

CARIS (Computer Animated Reading Instruction System), a system for teaching reading using animation, has been developed at the University of New Hampshire. The child chooses a noun and a verb from the screen. The words disappear and are replaced by a figure on the screen (noun) acting out the verb. This phase teaches the child sentence formation. The second phase is the spelling phase. The child must now spell out the words to be animated.

Development of quality software for educational purposes is being done. "Collaboration of educators and computer scientists has resulted in the expertise to develop a computer system capable of guiding an educator through the various stages of diagnosing learning disabilities" [Colbourn 82].

Expert systems for educational diagnosis are not currently available to educators. Expert systems have been developed in other areas. Some of the fields include chemistry, clinical psychiatric diagnosis, medical diagnosis

for blood and meningitis infections, internal medicine, glaucoma, digitalis therapy, cancer treatment and pulmonary function. CADUCEUS, currently being developed at the University of Pittsburgh, is intended to diagnose within several fields of medicine.

4.10.2 An Expert System For Educational Diagnosis

The purpose of this thesis was "to provide the teacher with expert advice on how to proceed from an initial suspicion that the child is experiencing problems through to developing a prescriptive treatment program" [Colbourn 82].

The first step is to address the following questions.

1. Who will be carrying out the diagnosis?
2. Where will the diagnosis be carried out?
3. What is the diagnostician's level of expertise?
4. What assistance and resources are available to the diagnostician?

Diagnosis generally begins in the regular classroom. For some cases, the teacher may feel that additional advice is needed. The resource room teacher can be consulted without removing the child from the classroom. The child may need to be removed from the classroom occasionally. In some cases specialists, such as doctors and psychologists, should be consulted. Children with severe problems may need to be removed from the classroom and placed in a Learning Assistance center.

Figure 4-1 shows the various levels at which assessment can be made. Efficiency of time and money is essential.

Unfortunately the guidelines specified by the SEECC model (Standards for Educators of Exceptional Children in Canada) are not always followed. Often initial screening is not done. Often there is a lengthy wait before the specialist is available. The main reason assessment is not done in the regular classroom is a lack of expertise. Also procedures change, therefore making a classroom teacher "out-of-date" quickly.

"The main purpose of a computer-based diagnostic system is to assist teachers in the assessment of learning difficulties" [Colbourn 82]. The system can accomplish the initial screening through to a prescription. Then the system can suggest the next step. This could be further testing, consultation with a specialist or referral to an outside agency. The teacher performs the task. The system then proposes the next step, and so on. The system eventually provides a summary of its diagnostic finding and a prescription. The system's job is to guide the diagnostician. It should be able to handle incomplete and incorrect data. It can provide helpful information and history about the student. The system is meant to be an aid to the teacher, but the teacher has the final control.

One of the first tests to utilize a computer for scoring and interpretation, was the Minnesota Multiphasic Personality Inventories (MMPI). Others are the Sixteen PF Questionnaire,

the Clinical Analysis Questionnaire, the Briggs Social History, the Deck Depression Inventory, the California Psychological Inventory and the Eysenck Personality Inventory. The most popular assessment test is the Revised Wechsler Intelligence Scale for Children (WISC-R). Rakiecki, Quackenbush and Hynd [Rakiecki, not listed] developed a program to produce scaled scores, intelligence quotients and percentiles out of WISC-R raw scores. It also gives a profile of the student's strengths and weaknesses.

In the later stages of assessment, standardized testing is not often used. The computer can also be used at this stage to produce "appropriate criterion-referenced test materials". Effective heuristic methods for producing appropriate tests for arithmetic skills already exist. A program has already been developed to aid in diagnosing reading problems [Knights 76,77,78].

The prescription section of the program should provide appropriate activities and instructional techniques. The database of activities should be kept up-to-date at all times. By doing this, unsuccessful activities are eliminated.

4.10.3 The Design

The aim of this thesis was to demonstrate the feasibility of an expert consulting system.

Commonsense guidelines and recommended procedures for educational diagnosis are already in existence. All diagnoses

should be logical and systematic, resulting in recommendations and suggestions of remedial activities for the child's ability level. All contributing factors should be examined. Most diagnosticians begin by collecting data concerning the child's developmental and educational history. It is important to collect only pertinent information and to do this as efficiently as possible. Generally standardized tests are used for diagnosis. Diagnostic decisions should not be made based on a single source. Comparisons should be made to the child's peers. Determination of both relative strengths and relative weaknesses are important.

The McLeod Educational Diagnostic Model was chosen as a frame of reference for this thesis since it most reflects the diagnostic procedures in Saskatchewan. This model contains four stages: Retrospective, Definitive, Analytic and Prescriptive. Each stage contains levels: basic educational skills, psycho-educational skills and non-educational factors. Great flexibility is attained in this model since the type of information to be collected is specified but not which tests must be administered to obtain this information.

"Diagnosis begins with a suspicion that the child is experiencing learning difficulties and progresses through to an appropriate prescrition" [Colbourn 82]. The fundamental stages of diagnosis are as follows:

1. Retrospective - relevant data about the child's previous developmental history is reviewed.

2. Definitive - the existence, or non-existence, of a learning disability is established.

3. Analytic - surface symptoms are subjected to progressively finer scrutiny.

4. Prescriptive - corrective or remedial action is initiated.

The model specifies three levels of information:

1. basic educational skills in areas such as reading, spelling and arithmetic,

2. psycho-educational correlates which include those intellectual, visual, auditory and language skill deficiencies which might be related to learning disabilities, and

3. non-educational factors which are primarily in the medical, social and developmental areas.

In the initial stages of design of the expert system it is important to determine when each type of information should be collected. The present study concentrates on information which has been shown to be "educationally or clinically significant" [Colbourn 82].

The Definitive stage involves the first direct diagnostic contact with the child. The child's abilities and achievement in reading, spelling and arithmetic are assessed. Also a language screening test is administered. Further assessment may be recommended for medical, emotional or behavioral problems.

The Analytic stage further analyzes the child's skills to pinpoint problems. At this stage the diagnostician must establish which skills are already mastered.

The Prescriptive stage was eliminated in this project

since it was not essential to the project. The diagnostician can use the output from the computer-guided diagnosis to prescribe remedial or corrective instruction. Also, few experts agree on appropriate remedial materials. And it is a major task to decide which remedial activities and instructional techniques are most appropriate for each child.

This system has been intended for regular classroom teachers or resource room teachers. No previous experience with computers is required. But the user must be familiar with standard diagnostic procedures. Users should be familiar with the following topics:

1. aims of psycho-educational diagnosis,
2. complementary relationship between diagnosis and prescriptive instruction,
3. approaches to principles of diagnosis,
4. concepts and terminology of testing and diagnosis,
5. current issues in research and legislation,
6. SEECC model,
7. McLeod Educational Diagnostic Model, and
8. administration, scoring and interpretation of standardized tests.

This project has been limited to aiding teachers in diagnosing reading difficulties of children ages eight through ten inclusive.

Most expert systems are production systems consisting of a global database, a set of production rules and a control structure. In this system the global database is the child's

file. For each administered test, the global database contains the aggregate test score, subtest scores, date of administration and any other information about the test.

Production rules represent the expert's knowledge. All the rules are of the form:

situation or condition ----> action

An example of a possible rule is:

Condition:	Action:
Test: Wide Range Achievement Test	administer a test, such as the Test
Subtest: Spelling	of Written Spelling
Type of Score: Spelling Quotient	to assess the child's spelling skills.
Score: less than 90	

The control structure is a computer program that determines which appropriate production rule will be applied. The control structure is responsible for coordinating the entire diagnostic process.

The control structure of this project examines each production rule within each component in turn to determine whether it's applicable. The control structure selects the "best" rule and executes it, which always involves updating the global database. As a result, a rule previously inapplicable may now become applicable and vice versa. This cycle of examination, selection and execution continues until no rule is applicable. The control structure then chooses

which component to enter next. In this way "the control structure determines the system's progress through the various stages and levels of the diagnostic model, as well as controlling the execution of the system's production rules within each component" [Colbourn 82].

The control structure examines production rules in the following way. When the precondition of the rule is executed, a priority is associated with the rule. When each rule has been examined, the one with the highest priority is chosen. The action is then executed. The precondition does not change the global database, but the execution of the action always changes the global database. In some cases no rule within a particular component may be applicable. When the system completes its assessment a diagnostic report is created.

The control structure also acts as the interface between the user and the computer programs. Few users are experienced in computer operations and interfaces must be developed with this in mind. This project's interface is very simple. All data entered is presumed to be correct. No checking is done.

The development of the production rules for this project was a major undertaking. For each component the following was assessed:

1. what data is normally collected,
2. the usual sources, e.g. questionnaires, tests, previous assessments, and
3. how this information is applied, e.g. what facts, suspicions, hunches are concluded when this new knowledge is assimilated.

The following sources were consulted:

1. previous Edexc 450 diagnoses (primary source),
2. local psycho-educational experts, and
3. research literature.

A preliminary draft of the production rules was prepared after studying approximately 50 files. Often manuals for the diagnostic tests offer appropriate guidelines for decision-making. When this is not true, estimation is accomplished by experience and cumulative fine tuning.

No commitment was made to particular data structures for the global database due to widely varying structures dependent upon the programming language chosen.

4.10.4 The Implementation

The first step in implementation is the selection of the computer system and the computer language. This project was programmed in LISP on the DEC 2060. LISP was chosen since it is an interactive language and lends itself well to production rule systems. Also, since LISP does not differentiate between program and data it is very useful in incorporating a user interface. All data structures are property lists. For example:

CHILD

FIRST-NAME Bill

BIRTH-DATE (21 2 1962)

AGE (13 2 26)

SEX M

The control structure was implemented and tested separately. Then all of the production rules were transcribed into LISP. Initially each component was tested separately; then the whole system was tested. At this point the developers discovered that their expert system did not produce answers similar to those of the human expert. Adjustments were made to the program whenever the program failed to produce the same results as the human diagnostician.

The system is currently available in a developmental format. After necessary initialization, interactive communication begins. The system presents one question at a time to the user. The user may respond with 'DK' (don't know), an affirmative answer or a negative answer. When the user must enter data in a specific format, the system prompts the user for the appropriate data. Each time the user administers a test, the system asks for:

1. the abbreviated test name,
2. the date of administration,
3. the type of test score, and
4. the child's score.

Most of the information of interest is presented in the

diagnostic report. The global database contains all the entered data as well as resultant computations. The diagnostic report is the summary of the system's findings throughout the diagnosis. Flags are set for areas that need further analysis. The potential flags follow:

1. FA-INTELLECT--intellectual ability
2. FA-BEHAV-EMOT--behaviour or emotional problems
3. FA-HEARING--hearing
4. FA-VISION--eyesight
5. FA-VIS-PERCEPTION--visual perception including the ability to discriminate visual symbols
6. FA-AUD-PERCEPTION--auditory perception including the ability to differentiate between similar sounds
7. FA-MOTOR-GROSS--gross motor skills
8. FA-MOTOR-FINE--fine motor skills
9. FA-SPELLING--spelling skills
10. FA-ARITHMETIC--arithmetic skills
11. FA-LANGUAGE--ability to communicate through oral and written language
12. FA-WRITING--handwriting skills
13. FA-COMPREHENSION--reading comprehension
14. FA-DECODING--ability to decode unfamiliar words
15. FA-LETTERS--knowledge of letter names and sounds
16. FA-SOUND-BLENDING--ability to blend sounds together

The remedial activities prescribed are based on descriptors. Descriptors are classified as strengths, weaknesses, average abilities, relative strengths, relative weaknesses, or relative average abilities. A skill is

considered a strength when "compared to the child's chronological peers, the child's ability is better than average" [Colbourn 82]. A skill is considered a relative strength when it "involves a comparison to the child's other abilities" [Colbourn 82].

Descriptors can be added to the system to not only encompass reading, but also arithmetic and spelling. To incorporate arithmetic into the system, descriptors for operations (ADDITION, SUBTRACTION, MULTIPLICATION, DIVISION) and applications (TIME, MONEY, MEASUREMENT) would need to be added. To analyze each aspect of arithmetic, appropriate descriptors must be developed. These descriptors must encompass all possible difficulties or erroneous algorithms. For example, descriptors should be developed to represent the following problems:

1. basic subtraction facts without zero,
2. basic subtraction facts with zero,
3. subtraction of ones and tens with no regrouping required,
4. three-digit minuend minus two-digit subtrahend, no regrouping, and
5. two-digit minuend minus two-digit subtrahend, regrouping required.

Descriptors can also be added to diagnose areas of spelling. The system can assess a child's unsuccessful spelling of phonetically-regular words by including descriptors for the following skills:

1. 's' spelling of the s and z sounds,
2. 'gh' and 'ph' spelling of the f sounds,
3. 'wh' spelling of the g and j sounds,
4. consonant sounds spelled with double letters, and
5. silent consonants.

The system can also assess a child's use of morphemes to make structural changes when spelling by developing descriptors for the following skills:

1. 's' and 'es' plurals,
2. changing 'y' to 'i' before 'es', and
3. suffixes and prefixes, and associated spelling rules.

In the implementation of this project the system's descriptors are determined by the production rules. To determine where the child's performance rates, below average, average or better, the system used the average range for the administered test. This was assumed to be the test mean, plus or minus one standard deviation.

4.10.4.1 Retrospective Level 1 -

Purpose: to collect relevant information regarding the child's past and present academic achievements.

Information Sources: Referral form
School Report
previous assessments

This stage is the one in which essential introductory information is obtained. The child's academic development is determined by the reasons for referral. "A major purpose of the Retrospective Stage is to obtain an indication of the child's academic skills. This is done through teacher ratings and previous assessments" [Colbourn 82]. The teacher gives a comparison of the child to his/her chronological peers in the School Report. The system also asks for pertinent information from any previous testing. Appropriate flags are set for further assessment, if the child's ability falls below average for any skill.

4.10.4.2 Retrospective Level 2 -

Purpose: to collect information regarding psycho-educational correlates affecting the child's academic achievement.

Information Sources: School Report

The user must enter ratings computed from the School Report for the following:

1. gross motor skills,
2. fine motor skills,
3. spoken language,
4. written language, and
5. behaviour.

The user must also enter the parents' attitudes. This

includes "their acceptance of the child's difficulties and their willingness to cooperate with the school" [Colbourn 82]. Appropriate flags are set for areas needing further assessment.

4.10.4.3 Retrospective Level 3 -

Purpose: to collect information concerning the child's developmental history, including medical, behavioural, emotional and language development.

Information Sources: Parent Questionnaire

The Parent Questionnaire generates information concerning the following:

1. parents' perception of the problem,
2. educational circumstances such as absence from school, changes of schools or teachers,
3. visual and auditory acuity,
4. developmental history,
5. emotional factors,
6. language development, particularly during the preschool years,
7. prenatal and perinatal factors,
8. neurologically-related factors such as visual-motor coordination and spatial orientation, and
9. familial factors.

Since it would be extremely time-consuming to collect data on all aspects of a child's development, only that information

considered significant is collected. The article did not say who determined what information was significant. Appropriate flags are set for areas receiving adverse responses and needing further assessment.

4.10.4.4 Definitive Level 1 -

Purpose: assessment of both the child's intellectual abilities and his/her achievement in basic skills.

Information Sources: Individual intelligence tests
Individual general achievement tests

First, the system decides if the child's intellectual ability needs assessment by determining whether the child has obtained an average or better than average score on the test chosen by the expert system within the past two years. If so, further assessment is not necessary. Subtests are given if necessary, and abilities are determined to represent a strength, a weakness, a major strength or a major weakness. Relative strengths and relative weaknesses can be determined when the child's abilities have been classified relative to his/her chronological peers. Subtest scores allow assessment of the following:

1. the auditory-vocal channel,
2. the visual-motor channel,
3. the receptive process,

4. the associative process,
5. the expressive process,
6. the representational level, and
7. the automatic level.

(See the Glossary, Appendix A, for definitions of these terms). Appropriate flags are set for areas needing further assessment.

4.10.4.5 Definitive Level 2 -

Purpose: further assessment of reading, spelling and arithmetic skills, as well as general assessment of the child's communication skills (e.g. language and writing).

Information Sources: Standard tests in each of the aforementioned areas

The scope of this system's expertise is restricted to reading. If arithmetic, spelling or language need further assessment, the system recommends two tests, but offers no additional guidance. For reading, the child's comprehension can be rated as a relative strength or relative weakness by comparing his/her comprehension with other reading achievement scores.

4.10.4.6 Definitive Level 3 -

Purpose: to assess the child's behaviour, emotional status, social and medical problems.

Information Sources: This generally involves consultation with specialists.

In this component, the child's behavioural, emotional and social problems are assessed. Consultation or referral to specialists may be necessary. In this system, medical problems are restricted to eyesight and hearing.

4.10.4.7 Analytic Level 1 -

Purpose: further assessment of basic educational skills such as reading, spelling and arithmetic.

Information Sources: Standardized tests supplemented by informal assessment.

At this point, assessment has been limited to reading problems. Further assessment is done if the child's decoding skills are average or below average.

In this component, for each paragraph the child reads, the number of word substitutions, additions, omissions, refusals and reversals are entered. Then, the number of mispronunciation errors, substitutions at the beginning, in the middle or at the end of words, is entered. Finally, the system decides whether the child is relying on context clues. The system detects adequate knowledge, weaknesses, and

relative weaknesses.

4.10.4.8 Analytic Level 2 -

Purpose: to assess auditory and visual perceptual skills, motor skills, as well as further assessment of language skills.

Information Sources: Both standardized tests and informal assessment techniques.

Tests are recommended for areas of weakness. For example, if the FA-AUD-PERCEPTION flag is set, the system recommends the administration of a test of auditory discrimination. If the FA-VIS-PERCEPTION flag is set, the system recommends the administration of a test of visual perception.

4.10.5 The Evaluation

The criteria on which computer-guided diagnoses are judged must be based on human diagnoses. An expert system must produce reliable and valid diagnoses. Computers are inherently consistent and reliable. Validity was judged by comparison to previous diagnoses, similar in nature to those used during the design and implementation stages.

Twenty-four files were selected for the comparison. Necessary information from various tests, and school and parent reports was summarized. These reports were encoded in

terms of the expert system's descriptors and descriptor classification scheme.

It was important to determine if any information was included in the expert system's report, but not the human's, and vice versa. What is to be determined is whether the original diagnostic reports contain findings which the expert system's reports do not contain, but should.

Encoding was undertaken by two independent education students. Problems were encountered in encoding when diagnostic findings were not stated precisely. Too often diagnostic findings made simple statements and did not contain further clarification. Agreement between the two encoders was approximately 50%.

Total Number of Descriptors Noted as Relative Strengths:

Noted by Encoder 1 (not noted by Encoder 2):	13
Noted by Encoder 1 and 2:	16
Noted by Encoder 2 (not noted by Encoder 1):	7

Total Number of Descriptors Noted as Relative Weaknesses:

Noted by Encoder 1 (not noted by Encoder 2):	44
Noted by Encoder 1 and 2:	49
Noted by Encoder 2 (not noted by Encoder 1):	46

This lack of agreement makes it difficult to judge the expert system's performance. Following is a comparison of the system's classification with each encoder.

Total Number of Descriptors Noted as Relative Strengths:

Noted by Encoder 1 (not noted by the expert system):	9
Noted by Encoder 1 and the expert system:	20
Noted by the expert system (not noted by Encoder 1):	37
Noted by Encoder 2 (not noted by the expert system):	5
Noted by Encoder 2 and the expert system:	18
Noted by the expert system (not noted by Encoder 2):	39

Total Number of Descriptors Noted as Relative Weaknesses:

Noted by Encoder 1 (not noted by the expert system):	48
Noted by Encoder 1 and the expert system:	45
Noted by the expert system: (not noted by Encoder 1):	106
Noted by Encoder 2 (not noted by the expert system):	56
Noted by Encoder 2 and the expert system:	39
Noted by the expert system (not noted by Encoder 2):	114

In some cases, the expert system's report contains information not included in the original reports. The system can make conclusions based on calculations that would be time-consuming for a human. The computer has the ability to be fast and accurate in its calculations. This type of information was generally lacking in human diagnostic reports. Diagnostic reports often did not distinguish between strengths

and relative strengths, or weaknesses and relative weaknesses.

Another reason for disagreement between the expert system and the encodings was that the expert system had only the information given to it available for decisions. The human diagnostician had the results of a variety of previous tests available. Also the expert system reports all diagnostic findings, but a human diagnostician might report only the most relevant findings for short term remediation.

From the reports gained, the system's output appears to be consistently good. In contrast, reports prepared by human diagnosticians vary greatly in style, format, reliability, relevance and accuracy.

4.10.6 The Conclusions

"The intent of this thesis was to examine the feasibility of computer-guided educatonal diagnosis. Feasibility has been demonstrated by designing and implementing an expert system to assist in the diagnosis of reading difficulties. From the results discussed, it is apparent that the current system provides sufficient advice to guide the diagnostician from the first level of the Retrospective stage through to the second level of the Analytic stage. Moreover, the resultant diagnostic report contains accurate information upon which to base a prescription. Although the ultimate system has not been developed, the system discussed here is operational and provides the fundamental working basis upon which to build

future systems" [Colbourn 82].

The system is designed to allow modifications and extensions. The rules are self-contained, therefore they can be modified, added, or deleted without making another rule "wrong". Not only can each rule be viewed as a separate unit, but each component of the model can be viewed as a separate unit. One reason for choosing a production system format for the expert system is that the three system components can be modified relatively independently.

In creating the rules, it was decided to base them upon previous diagnoses, instead of a single expert's opinion. This process is time-consuming but has many advantages. The resultant rules are more accurate. Many expert's opinions can be incorporated. In order to use diagnoses for the basis of the rules, the diagnosticians are forced to make their decisions explicit. Therefore, as a side-effect, precise guidelines can be created for less experienced diagnosticians. The system can also point out deviations from accepted diagnostic practice. Unfounded diagnostic decisions can be determined by examining previous diagnoses. Due to the modular nature of the system, the future incorporation of additional experts' opinions is possible.

Before the system is suitable for general use, a more elaborate interface is needed. Additional production rules are needed before the system can be used beyond its age and subject restrictions. To expand within the area of reading, the examination of more cases is needed.

This section was very helpful in preparing for the thesis described in the next chapter. Not only did it provide helpful information so as not to "reinvent the wheel", but it also lent positive reinforcement for the success of the succeeding thesis.

CHAPTER 5

AN EXPERT SYSTEM FOR PMHP

5.1 EVALUATION PROCEDURES [HIGHTOWER 86]

5.1.1 AML-R

The AML-R Behavior Rating Scale (AML-R) is a quick, teacher-completed, 12-item, screening instrument. The scales include Acting Out, Moody, and Learning. This form is completed by all first grade teachers for all pupils. Mental health professionals, senior child associates, or child associates create and distribute class packets and collect them one week later. AML-Rs are scored at the schools and summaries are created for each class. A copy of the AML-R is kept at the school, while the original and class summaries are returned to PMHP. Screening results are shared with teachers.

The AML-R is designed to identify young children experiencing early school adjustment problems. The items comprising the AML-R are divided into three scales. The A-Scale, Acting-Out, measures the frequency of a child's

aggressive, disruptive, and acting out behaviors. The M-Scale, Moody, is an index of a child's moody, shy, and withdrawn behaviors. The L-Scale, Learning, evaluates a child's difficulties in learning. The total AML-R scale provides an overall evaluation of a child's school adjustment problems.

The AML-R items are rated on a five point scale. The five points are:

Never:

behavior has never been observed

Seldom:

behavior was observed once or twice in the past month

Moderately often:

behavior was seen more often than once a month but less often than once a week

Often:

behavior was seen more often than once a week but less often than daily

Most or all of the time:

behavior occurs with great frequency averaging once a day or more

See figure 5-1 for an example. The A-Scale score is calculated by summing items 1, 4, 7, and 10. The M-Scale

score is calculated by summing items 2, 5, 8, and 11. The L-Scale score is calculated by summing items 3, 6, 9, and 12. The Total score is calculated by summing all 12 items. These four scores are recorded as raw scores. The AML-R norm tables are then used to determine each child's percentile.

These raw and percentile scores allow the PMHP team to rapidly identify children who may be at risk for the measured aspects of school adjustment problems. During assignment conferences teachers are asked to discuss their perceptions of children that fall below the 30th percentile with a special emphasis on those falling below the 15th percentile.

The Total percentile can aid the PMHP team in determining how "problem-ridden" a teacher may feel his/her entire class is. Teachers with low percentiles either have many troubled children in their class or are very sensitive about the problems occurring. Teachers with high percentiles either have well-adjusted students or are hesitant to identify children with problems.

5.1.2 Child Rating Scale (CRS)

An efficient and effective way to acquire information about people is to ask them. The CRS allows children to report their own behavior, impressions, thoughts, and attitudes. Schools provide important social and behavioral settings for children and also provide important situations in which they must react. Therefore a child's perceptions of

his/her reactions within a classroom provide insights to that child's needs. Once these needs are identified, intervention can be initiated.

The CRS is a 36-item, student-completed instrument that can be group or individually administered as a screening instrument. It is completed by all second and third grade students, and all first through sixth grade students who have been referred to PMHP.

Group administration requires two PMHP team members. One member reads the directions and items aloud, while the second member monitors the classroom. The teacher may stay in the classroom or leave. The next school day the students' responses are given to the teacher to review for one week.

CRS individual administration of students enrolled in PMHP are typically given after three sessions by the PMHP team. The child associate gives the CRS to each first through sixth grader unless it was previously completed, as a part of screening procedures. The child associate records information for the first graders. Second graders and above are typically able to record their own responses.

An example CRS can be found in figure 5-2. Items are rated with a three point scale: usually no, sometimes, usually yes. Children's responses are grouped into four subscales. Rule Compliance/Acting Out assesses a child's perceptions of his/her conduct with regard to following typically established school and classroom rules. Anxiety/Withdrawal measures a child's perceptions of his/her

reactions to distress. Social Skills assesses a child's perceptions of his/her interpersonal functioning and confidence in dealing with peers. Self/School Confidence measures a child's perceptions of school related activity.

Rule Compliance is measured by summing items 1, 5, 9, 13, 17, 21, and 25. Anxiety/Withdrawal is measured by summing items 2, 6, 10, 14, 18, 22, and 26. Social Skills is measured by summing items 3, 7, 11, 15, 19, 23, and 27. Self/School Confidence is measured by summing items 4, 8, 12, and 20. The remaining items are experimental. Rekeying of items is performed by subtractions; see figure 5-3. In order to compare a given child with the normative sample, a profile can be used. See figure 5-4. Each vertical line represents a subscale. Horizontal lines represent the percentile of the normative representation. If a subscale has more than one item missing, then that subscale is not used. If only one scale item is missing, the child should be asked for clarification, otherwise, the most common item value is chosen.

5.1.3 Background Information Form (BIF)

The BIF is a one-page form that provides important demographic information. It is completed by all teachers for all children being referred to PMHP. A BIF is completed and returned to PMHP one week before conferencing. An example form is given in figure 5-5.

5.1.4 Teacher-Child Rating Scale (T-CRS)

Teachers are sensitive and accurate observers of their students' behaviors. Four to six weeks after school starts, they can usually identify students who are having or are likely to have problems, students who are functioning adequately, and students who exhibit social, behavioral, academic, and learning strengths.

The T-CRS is a third generation rating scale. The first scale was the Teacher Referral Form (TRF). It was created in the late 1960's and allowed teachers to check from a list of 47 behavior problems. In the early 1970's, the Classroom Adjustment Rating Scale (CARS) with 41 behaviorally-oriented items describing school adjustment problems rated on five point scales and the Health Resources Inventory (HRI), a 54-item form designed to measure school-related competencies in elementary children evolved. The T-CRS combined items from the CARS and HRI, and was created to reduce the teacher's work (100 items to 38 items) while maintaining the essence of the CARS and HRI.

The T-CRS is a two-part measure with seven scales describing a child's school adjustment. Part I assesses problem behaviors and part II assesses behavioral strengths. It is completed by all teachers of children referred to PMHP before the intervention begins. A second T-CRS is completed at the time of PMHP termination. An example form can be seen in figure 5-6.

Part I has 18 behaviorally-oriented items from the CARS and part II has 20 items assessing a child's strengths from the HRI. Part I is rated on a five point severity of problem rating scale, and three subscales are derived. Acting-Out assesses a child's problems of aggressiveness, disruptiveness, and impulsiveness. Shy-Anxious measures shy, withdrawn, dependent behaviors. Learning Skills assesses problems in skills needed to succeed in the school environment.

Part II is rated on a different, descriptive five point scale; four subscales are determined. Frustration Tolerance/Behavioral Limits assesses a child's skills in tolerating and adapting to limits imposed by the school environment or the child's own limitations. Assertive Social Skills measures a child's social status in interpersonal functioning and confidence in dealing with peers. Task-Orientation/Educational Performance assesses the child's functional effectiveness within the educational setting. Peer Social Skills measures the child's popularity or likeability among peers.

The Acting-Out scale is calculated by summing items 1, 4, 7, 10, 13, and 16 in Part I. The Shy-Anxious scale is calculated by summing items 3, 5, 8, 11, 14, and 17 in Part I. The Learning scale is calculated by summing items 3, 6, 9, 12, 15, and 18 in Part I. The Frustration Tolerance/Behavioral Limits scale is calculated by summing items 1, 5, 9, 13, and 17 in Part II. The Assertive Social Skills scale is calculated by summing items

2, 6, 10, 14, and 18 in Part II. The Task-Orientation/Educational Performance scale is calculated by summing items 3, 7, 11, 15, and 19 in Part II. The Peer Social Skills scale is calculated by summing items 4, 8, 12, 16, and 20 in Part II. If three or more items are missing or any subscale has two or more items missing, the teacher should be approached for more information. If only one item for a scale is missing, the teacher may be approached or the most frequently used items' value for that subscale may be used. Once raw scores are calculated, they can be compared with the standardization sample by using the T-CRS Profile. See figure 5-7.

5.1.5 Associate-Child Rating Scale (A-CRS)

This scale includes behavior ratings of children in the PMHP playroom and specific PMHP goals. It is completed by the PMHP child associates, immediately following the fourth contact by a child associate, and one week prior to the progress and termination conferences.

The A-CRS is a third generation child associate rating form. It is derived in part from the Aide Status Evaluation Form (ASEF) and Aide Child Evaluation Scale (ACES). The ASEF items were identical to the CARS teacher ratings of problem behaviors. It was later replaced by the ACES. Some items of the ACES were modifications of the ASEF, some were derived from the HRI, and some were suggestions from child associates.

Problems and strengths were assessed by the ACES for behaviors inside and outside of the playroom. After two years of pilot work, which included input from child associates, senior child associates, and mental health professionals, and extensive statistical analysis, the A-CRS was created. See figure 5-8.

The A-CRS consists of two parts. Part I is comprised of 20 items. Approximately half assess strengths and half assess problems. All items are rated on a five point scale depending on how well they describe the child. Four scales were derived that assess the following areas:

1. Initiative/Participation,
2. Behavioral Limits,
3. Shy-Anxious Behaviors, and
4. Self-Confidence.

Scale 1 is scored by summing items 1, 5, 9, 13, and 17. Scale 2 is scored by summing items 2, 6, 10, 14, and 18. Scale 3 is scored by summing items 3, 7, 11, 15, and 19. Scale 4 is scored by summing items 4, 8, 12, 16, and 20. After the scales' scores are calculated, these scores are entered on the A-CRS profile, figure 5-9. This serves as a quick norm table to determine percentiles, and as a visual aid of a child's strengths compared to other PMHP referred children. This form does not compare children to the typical school population.

Part II requires the associate to choose two goals from the Associate Goal List that are in agreement with the teacher and PMHP team. If the teacher and PMHP team cannot agree on

goals, the teacher's goals are listed first.

The relative vertical position of the scales' scores can help in choosing priorities and goals. One example cited is: Scale 1 = 70, Scale 2 = 70, Scale 3 = 50, Scale 4 = 70. This suggests the child may need help with overcoming his/her shyness and/or anxiety. This does not mean that the other areas should be overlooked since these scores are compared to other PMHP referred children, not the normal population. The profile may also be used to compare a child to himself/herself. When several assessments are plotted, for example initial, progress, and final, the child's relative gains and/or losses can be visually seen.

5.1.6 Child Associate Logs

These logs record identifying information for each child being seen and are an on-going cumulative record of individual and group contacts. They are completed by the child associate upon assignment of the children and throughout their contact with the children. Logs are distributed to the child associates by the senior child associate to be completed for each child assigned. The logs are collected monthly and should be updated daily. See figure 5-10.

The Associate Logs provide the central PMHP staff with the only available systematic record of child contacts. At the end of the year a comprehensive "Utilization Report" is created, summarizing the number of children seen, average

number of sessions, frequency of contact, etc., on a school by school, district by district basis. This document is used extensively during the school year to help determine how much help is provided to the children through the project. It also helps in determining ways in which PMHP resources are distributed.

5.1.7 Professional Termination Report (PTR)

This form is a one-page summary of each child's PMHP experience, progress, and program recommendations. It is completed by the supervising mental health professional responsible for that child. The mental health professional should complete the PTR during or immediately after the termination conference and/or consultation with school staff involved with the child. The original is given to the PMHP staff and a copy is retained at the school in the child's PMHP records. See figure 5-11.

5.1.8 Associate's Goal List

Section II of the A-CRS asks the child associates to specify two major intervention goals for a child. Some typical goals are listed in figure 5-12.

5.2 THE DESIGN OF THE EXPERT SYSTEM

In the spring of 1987, the concept of computerized aid

for the PMHP program was presented at a nation-wide PMHP conference. There was a mixture of professionals representing various occupations in attendance, who had a variety of reactions to the concept. The occupations of the conference attendees ranged from PMHP child associates to psychologists, teachers, principals, and social workers. Most reacted positively to the concept; enthusiasm about computerized record-keeping, the ease of input, maintenance, and access were typical reactions. Not only could the schools maintain full records on all their students throughout their school years, but the University of Rochester (U. of R.) could also maintain full access to nation-wide records on students for research purposes. This program would also standardize testing procedures and recommendations for remediations.

There were also some concerns. Some feared computers, which will need to be overcome. Others would need an adjustment time for using the program, as it would bring change into policies and methods of utilizing PMHP. Another concern was for maintaining students' records security.

Following is a goal list for the design of this thesis:

1. assistance to PMHP in gathering data on students,
2. easy means of update to students' records,
3. localized storage of students' records,
4. initial assistance in evaluation to schools when the human expert is not available,
5. easier means of scoring tests for teachers and child associates, and

6. more security of students' records.

In meeting these goals, the plan was as follows.

1. Data would be entered on terminals at the local school and stored on a disk. These cumulative files would then be brought to the U. of R. for storage. Here the files could be used for future references in making predictions about behavior tendencies. The findings from these files could also be used to create more rules and generalizations about students for the expert system.

2. Since the data would be kept on files at the U. of R. and the local schools, updates could be made easily, as long as care was taken to coordinate updates at both sites.

3. Storage would be at the U. of R. and the local schools. This allows for redundancy, an inherent back-up, and the security for the schools of maintaining their own records. This seemed to be an important factor to many people.

4. The program will take in test information and make recommendations based on the knowledge of a school psychologist. In this way, the schools can begin determining remediation needs before the psychologist is available.

5. By using the computer as a data entry means, the teachers and child associates need not fill out and maintain many physical sheets of paper. Also, since the computer performs all the calculations for scoring the tests, the teachers and child associates need not.

6. Due to the fact that the data will be stored in only two places on disks, security is needed in only those two places. Also, the data files can not be easily read as a physical sheet of paper might be. Only those people with the proper access to the computer will have the ability to read the files.

It was decided to have two general sections in this program. The first is one in which the tests are scored and profiles created. The second is one in which initial recommendations are made. Future expansion will include storage of data to external files and any additional expansion desired for the two initial sections. There is also a possibility of incorporating old records in current judgments and recommendations made.

The design phase included a great deal of time with the expert in the knowledge acquisition process. In this phase, it was also decided to use a software tool to assist in the generation of the program.

5.3 KNOWLEDGE ACQUISITION

Knowledge acquisition is the process of gathering the facts and rules necessary to build an expert system. It is a process that occurs between one or more experts and a knowledge engineer. The expert is the person who has knowledge of and expertise in the field or topic that will be emulated by the expert system. The knowledge engineer is the person responsible for taking the expert's knowledge and programming the computer with this knowledge, so that when faced with a problem or question, the computer will give a similar answer as the expert would have given.

Often times this process is a difficult one for several reasons. Getting any person to write down in words how they make decisions is a very difficult task. The human brain goes through many more steps in reaching a decision than people realize. The person making the decision does not even realize all the steps involved. Also, the expert often feels threatened by the prospect of being replaced by a computer and is therefore unwilling to cooperate in the knowledge acquisition process. It is not always convenient for the expert and knowledge engineer to spend time together. They may have conflicting schedules or live great distances apart. Often the expert is unavailable.

The knowledge acquisition process for this project went very smoothly. The psychology expert was not intimidated. In fact, he was very anxious to have the program written. He is

often unavailable to schools to aid in sorting through evaluations and making recommendations at the initial level. He therefore wanted assistance in this process and foresees this project as becoming that assistance. The psychology expert and knowledge engineer lived in close proximity to each other; allowing for easy acquisition. Meetings were easily scheduled with few time conflicts.

5.4 IMPLEMENTATION

The rules for this project were compiled from discussions with a school psychologist. These discussions are summarized in Appendix C and Appendix D. The rules were then generated with the software tool, SAGE. One of the reasons SAGE was chosen was because it is implemented on an IBM-compatible personal computer. The decision to use an IBM-compatible personal computer was made since the program will be used in the public schools and these schools have access to personal computers. Also, IBM-compatible software has become a standard in the field, which ensures future support.

5.4.1 The Role Of A Tool

A software tool can be very helpful in implementing an expert system. It can supply the logic needed to create the rules. Also, several programs exist that implement several types of logic. By using already existing implementations, the correctness of the program can be assured.

Tools also ease the burden of user interface generation. Many tools have user interfaces already built in. The programmer needs only to supply the proper vocabulary.

SAGE was the software tool chosen for this project.

5.4.2 SAGE Characteristics

SAGE is a software package used for constructing and running consultative expert systems. It handles fuzzy logic, bayesian logic, normal arithmetic expressions, and forward and backward chaining. It has a flexible user interface format, and allows "don't know" as a response to a question. Non-numeric consultations are possible.

SAGE consists of two components: the Compiler and the Executive. The Compiler translates the source from the knowledge base into a compact, optimised, internal representaion. It is an off-line process, run during the development phase. The Executive is an on-line consultation process. It animates the knowledge base and provides the user interface.

SAGE allows building and testing of individual components. During a consultation, different components can be activated depending on the user's responses. Questions can be grouped to provide a smooth flow in the questioning process. And a built-in consistency check allows questions to be re-asked as required. Rules can be disabled by preconditions.

SAGE offers a flexible user interface. Results can be presented in histograms; explanatory text is available throughout a consultation. Reasoning structure can be traced and explained. User-defined procedures and functions are allowed. The compiler offers syntactic and semantic checks; the executive offers help on commands.

5.4.3 SAGE Language

The basic elements of the SAGE language are text, names, arithmetic constants, strings, comments, and separators. The model structure consists of the external environment, the reasoning structure, and the consultation structure. The following definitions are taken from the SAGE manual, written by Systems Designers [Pembroke House 85]..

The external environment identifies the model and its requirements to the SAGE software system and the user. It consists of MODEL/REGION, VERSION, OPTIONS, FIRSTAREA, PROCEDURE/FUNCTION, CONSTANTS, SCALE, NOISE, and EXTERNAL. They are defined as follows.

1. MODEL/REGION

   Keywords used to identify the current compilation unit. When the entire model is contained in one compilation unit, MODEL is used. Otherwise, REGION is used.

2. VERSION

   Introduces a string of versioning information, authorship dates, etc.

3. OPTIONS

   Introduces a string of directives to the SAGE software system, governing overall aspects of the system operations.

4. FIRSTAREA

   Names the consultation AREA at which a consultation is to begin.

5. PROCEDURE/FUNCTION

   Declares names for use in the model to access user-written procedures and functions.

6. CONSTANTS

   Enables the user to give names to numeric values of particular significance.

7. SCALE

   Specifies ranges of values with descriptive text attached to each range.

8. NOISE

   Introduces a list of names chosen by the user to increase text readability.

9. EXTERNAL

   Declares a name as defined in another compilation unit, specifies its type, and enables it to be used (referred to) in the current unit.

The Reasoning structure is a collection of statements, over which reasoning is to take place, and a collection of rules, specifying the reasoning connections among the statements. It consists of ASSERTION, OBJECT, RULE, EXPRESSIONS, QUESTION, and QUESTION GROUPS. They are defined as follows.

1. ASSERTION

   Introduces the statement of an hypothesis or conclusion which is part of the reasoning structure.

2. OBJECT

   Introduces the definition of an item which can have a real number associated with it and which is part of the reasoning structure.

3. RULE

   Describes the means of establishing the value or the likelihood attached to an object or an assertion.

4. EXPRESSIONS

   Is composed of terms, which may be assertion names, object names, constants, and the results of function calls, connected by operators.

5. QUESTION

   Specifies the form of question to be presented, the type of answer allowed from the user, and the effects on the model of each possible answer.

6. QUESTION GROUPS

   Make the session more coherent and the model easier to use. The question group is introduced so that any list of questions may be associated together.

The Consultation structure describes features of the SAGE language intended to assist the model developer in designing the structure of a consultation session. It consists of AREA and ACTION. They are defined as follows.

1. AREA

   Is the basic consultation unit.

2. ACTION

   Groups together a number of imperative commands which are executed in the sequence given.

The SAGE Executive commands consist of the following types: BASIC, REPORT, SEQUENCE, FORMAT, and TEST.

The BASIC commands are as follows.

1. MODEL

   Makes a named file the current model, closing off any earlier model file in use.

2. BEGIN

   Initializes the model, prints introductory text and starts a consultation session.

3. HELP

   Provides reference text for the user.

4. FACTORS

   Displays the reasoning supporting the current goal, or a named object or assertion.

5. WHY

   Displays the reason for asking the current question, in terms of its support for the current goal.

6. SET

   Volunteers information for a named question or assertion.

7. RESUME

   Returns to the system and its current investigation, from the last unanswered output, after using SAGE executive commands.

8. LOG

   Opens an output text file with the name supplied and date/time identification.

9. CLOSELOG

   Closes any current log file.

10. QUIT

    Closes down the Sage executive in an orderly way.

The REPORT commands are as follows.

1. SUMMARISE

   Summarises assertions' and objects' conclusions drawn.

2. HISTOGRAM

   Displays graphically the likelihoods or values of the assertion or object named after the PLOT keyword for varying values of the assertion, object or option question following the VARYING keyword.

3. LIST

   Displays detailed information on the named items.

The SEQUENCE commands are as follows.

1. CONSIDER

   Specifies a list of new items (goals, assertions, or objects) to be investigated.

2. FORGET

   Removes specified items from the current active investigation list.

3. DO

   Causes input to the executive to be taken from a named file of commands.

4. EVALUATE

   Executes the model in its entirety, using default values where questions have not been previously answered, for example, after volunteering some alternative answers.

5. INVESTIGATE and REINSTATE

   Executes the model in its entirety.

The FORMAT commands are as follows.

1. SCREEN

   Controls the number of lines of display to be produced at a time.

2. LINE

   Sets the length of a logical output line.

3. BREAKIN

   Sets the special character used to escape from an investigation session and uses the executive commands.

The TEST commands are as follows.

1. TRACE

   Enables the display of system actions as the model is traversed during a session.

2. SAVE

   Stores the current model state in an output text file.

3. RESTORE

   Allows a save file to be reloaded into the current model.

4. OVERFLOW

   Changes the default action when arithmetic within the SAGE model causes overflows beyond the specified ranges of objects.

5.4.4 Advantages

The SAGE shell has both positive and negative aspects. Both will be examined to assess its relative strengths.

On the positive side, SAGE does a great deal for a very small amount of money. It is a very powerful tool, yet small enough to work on a personal computer. It handles many types of logic. It is quite fast when running the user interaction interface. The user typically has to wait no longer than the amount of time it takes to print out the next question prompt.

SAGE gives the expert system designer the option of

wording questions intended for the user in a non-standard form. Several shells ask questions in the form "How certain are you that...?" This particular project will have several different types of users ranging from children to trained professionals, therefore, the user interface must be very flexible and SAGE offers this. Since questions can be grouped, the dialogue is smoother and subject-oriented.

A positive aspect of SAGE is that missing items are not easily allowed. The user must give an answer to each question or the program will reprompt for an answer. Missing answers are allowed in the form of "I don't know", but this project did not document this fact, since it was desireable for all items to be answered.

The ability to program and test in components simplifies the design and the testing phases.

5.4.5 Restrictions

Some of the negative aspects of SAGE include non-standard scaling. Much time was spent trying to determine how to set up a standard scale. In the calculations for the rules it was necessary to assign integer values to answers and then simply add them up. An example scale might be:

ANSWER	VALUE
usually yes	1
sometimes	2
usually no	3

The calculations were continually outputting real numbers such as 4.6, 12.5, etc. Finally, it was discovered that the value assigned to each answer was not the integer value listed, but the number halfway between the value assigned to the answer chosen and the value assigned to the answer directly before the answer chosen. For example, if the SAGE code defines a scale as above, the actual value assigned to "usually yes" is 1, "sometimes" is 1.5, and "usually no" is 2.5

Looping was not possible in SAGE. To allow scoring an entire classroom on the same scale, looping would have been very beneficial. The only looping possible was a restart function. When this function was called, all data collected to that point was lost. Therefore, each child had to be scored in a separate run of the program. Assemble time was quite long, and dependent upon the number of rules. Questions could not be itemized with letters or decimal numbers. The only numbering scheme allowed was integers. For example, the following type of listing was possible:

1. Kindergarten
2. First Grade
3. Second Grade

However, the following type of listing was not possible:

K. Kindergarten
1. First Grade
2. Second Grade

Though advertised as possible, writing to external files was not easily managed.

5.4.6 Conclusions

Due to the many significant features lacking, SAGE was not considered a help. All the rules created by SAGE could easily have been created in a high-level language. Scaling had to essentially be "fudged". There was no way to do looping or numbering, which was necessary. And it was too slow. Therefore, this project will be rewritten in "C".

5.4.7 Sample Code

Following are some samples of the code generated with SAGE for this project.

1. Scales

```
SCALE crs-scale: "possible answers for the CRS"
  FROM
    "usually no"          1
    "sometimes"           3
  UP TO
    "usually yes"
```

2. Area and flow of control

```
AREA crs: "the assessment of the CRS"
  ACTION main-eval3: "main evaluation"
    CONSIDER rule1,exp1,rule2,exp2,rule3,exp3

  ACTION crs-eval2: "anxiety/withdrawal
                     evaluation"
    ADVISE "!NThe anxiety/withdrawal score is ",
           anxietywithdrawal
    PROVIDED do-crs
```

3. Objects and Questions

```
OBJECT crs-1: "crs question 1"
  (1,3)
  QUESTION crs1:
  "!3NWe want to know what boys and girls like"
  "!Nyou think about in school and how you act"
  "!Nin school.  This is not a test so there are"
  "!Nno right or wrong answers.  Please decide"
  "!Nhow much each sentence below describes you"
  "!Nby choosing the number."
        "!3N1. I behave in school:"
  OBTAIN crs-1 USING crs-scale
  PROVIDED do-crs
```

4. Questions that should be grouped together

```
QUESTIONGROUP crsg1:""
  crs1,crs2,crs3,crs4
```

5. Assertions

```
ASSERTION anxietywithdrawal: "anxiety/withdrawal"
  DEFAULT 0
```

6. Rules

```
RULE rule-1:""
  rule1 IS crs-1 + (4 - crs-5) + crs-9 +
           (4 - crs-13)
```

7. Profiles were determined in the following way

```
ASSERTION anx-prof: "anxiety profile"
  DEFAULT clear

ASSERTION anx-high: "anxiety high"
  DEFAULT clear

ACTION crs-main-eval04: "crs evaluation"
  ADVISE "!2NCRS-anxiety withdrawal  ",
         anxietywithdrawal," lower 15%"
  PROVIDED
(anxietywithdrawal >= 17) OR
(anxietywithdrawal = 16 AND (sex = m OR
    (sex = f AND loc = sub))) OR
(anxietywithdrawal = 15 AND loc = sub AND
    sex = m) AND
    do-crs AND do-prof

ACTION crs-main-eval05: "crs evaluation"
  ADVISE "!2NCRS-anxiety withdrawal  ",
         anxietywithdrawal," lower 30%"
```

```
  PROVIDED
(((anxietywithdrawal = 14 OR
   anxietywithdrawal = 15)
    AND loc = urban AND sex = m) OR
((anxietywithdrawal = 16 OR
  anxietywithdrawal = 17)
    AND loc = urban AND sex = f) OR
((anxietywithdrawal = 13 OR
  anxietywithdrawal = 14)
    AND loc = sub AND sex = m) OR
(anxietywithdrawal = 15 AND sex = f AND
    loc = sub)) AND
    do-crs AND do-prof

ACTION crs-main-eval06: "crs evaluation"
  ADVISE "!2NCRS-anxiety withdrawal  ",
         anxietywithdrawal," upper 85%"
  PROVIDED
(anxietywithdrawal <= 9 OR
((anxietywithdrawal = 10 OR
  anxietywithdrawal = 11)
    AND sex = f AND loc = urban))
    AND do-crs AND do-prof
```

8. Recommendations

```
ACTION bif-eval01: "bif recommendation"
  ADVISE "!2NThis child's acting out problem may
         "!Nbe due to a divorce in the family."
         "!NCrisis intervention may need to be
         "!Nconsidered and/or alternatives to"
         "!Nimpulsive acting out behaviors should
         "!Nbe considered"
  PROVIDED (bif-24 AND (a-prof OR rule-prof)) AND
           do-rec AND do-bif AND do-aml
           AND do-crs
```

CHAPTER 6

AN EXPERT SYSTEM FOR PMHP - RESULTS

6.1 TEST RUN

A test run was performed at a local Rochester school, with four child associates and the expert present. There was a mixture of feelings about the computerized evaluations of PMHP measures. One person initially in the room said she would not work with computers, and left the room. The others were nervous at first, but after overcoming these feelings became very involved and were very excited about the expert system. They ran the program, using actual children in PMHP, to test how accurate the program was. They pointed out some mistakes in the program. They also discussed features they felt would be helpful and suggested these features be added to the program. They were very enthusiastic and anxious to have the program available for use within their classrooms and playrooms.

There has been no field trial with test data as yet, since it has been agreed upon to wait until the version

written in "C" is finished. This version will encompass more of the desired features, and therefore be a more accurate field trial.

6.2 CONCLUSIONS AND FINDINGS

6.2.1 Attitudes Encountered

In general, the program was a success. It was well accepted by teachers, child associates, and school psychologists. The child associates were very anxious to start using the expert system within their school program. Teachers have not yet been approached with the program. As stated earlier, the concept has been discussed with teachers, and has received mixed reactions. The expert consultant is very enthused about the use of this program in the public schools, and would like to see it put into practice as soon as possible.

6.2.2 SAGE

Overall, SAGE was a disappointment. As previously stated, many needed facilities were lacking. It took a great deal of time, and "trial and error" to determine that facilities were not present. Features that were available were not clearly documented, and needed much time, and "trial and error" to determine how to utilize them. The documentation was not always clear, and many topics were very

scantly discussed.

SAGE served as a positive learning experience in choosing a software tool. It made clear what items should be considered more carefully when choosing a software tool. Some of these include, assemble speed, execution speed, capability of reading from and writing to external files, capability of looping, capability of error correction, and interfaces with database facilities.

6.2.3 Expert Consultant

The expert consultant was extremely helpful and very knowledgeable. His enthusiasm and availability were instrumental in completing this project, and were greatly appreciated. It would be beneficial in the future to add the opinions of additional experts to the program. This additional information would broaden the possibilities and branches for decision making. It would give alternate routes of logic for any particular decision.

Bringing several experts together would also allow for discussion. These discussions would allow for the assimilation and combination of the experts' various ideas. When their ideas were in agreement, the theories would be strengthened. And the level of certainty for these rules would be high. When the experts disagreed, different weightings could be given to different theories depending upon evidence gathered, and the resulting theories would be more

well-balanced. The experts could even learn new techniques, methods, and concepts from each other.

6.2.4 What The Program Does Not Do

Two very important characteristics of the program that need to be altered are speed and writing to external files. The system is too slow to be acceptable as an end-product. The users would undoubtedly become impatient waiting for the profiles and recommendations. They would probably return to the manual method out of frustration and possibly fear. Some may fear that the computer is destroying data or files during its apparent silent period while it is computing profiles and recommendations. Since some of the users are reluctant to use computers, the slowness of the system may only reinforce their fears, and convince them that the manual method is faster, safer, and therefore better.

Without the capability of storing data on and retrieving data from external files, the program is virtually useless for long range needs. First, the need for storing data to files involves space. Over the course of one year, the number of records that need to be stored would exceed the capacity of the personal computers running the PMHP expert system. Over the course of several years, the need can definitely be seen for storage to external files.

Also, storage to external files will allow PMHP access to real data. Over a period of time, this data could assist PMHP

in formulating new measurements, rules, programs, and goals. It could reinforce some rules as being correct, and show the error in other rules, allowing them to be corrected or discarded.

The program also does not allow looping or backtracking of questions. Both of these features are desired. Backtracking will allow correcting of erroneous input. And looping allows data pertaining to several students to be input at one time for any given scale. Since the scales can be given at different times of the school year, this capability is essential for efficient usage of the program.

6.3 FUTURE PLANS

6.3.1 Speculations

I feel this program will be of great use to PMHP once it has been changed to accomplish the tasks which have been determined necessary and are not currently in operation. This program will be rewritten in the language "C". "C" will be easier to work with than SAGE, accomplishing many of the tasks missing in the SAGE version discussed previously. "C" will also run faster than the SAGE version.

The version rewritten in "C" is intended to be used by the U. of R. and a pilot school. If successful in the pilot school, this program will likely be used in additional schools. The intent is for the program to be used to assist in screening, especially during the first phases, or the

"weeding out" period, when experts are not easily accessible. It will be a tool for the schools and PMHP, never taking the place of the human expert who can be much more subjective, taking more data into consideration. However, it is good to keep in mind that the program will be totally objective, not allowing any biases. The full extent of its use is unknown at this time.

6.3.2 Next Thesis

Currently the program is not easily used. The teachers, children or associates must answer all questions pertaining to one student instead of being able to complete one measure for several students at one time. The problem is flexibility. Both methods should be allowed for total flexibility. The correction of errors should be allowed at the moment they are made. The user should not have to redo an entire measure to correct one mistake. They could make two mistakes in the process of correcting the first.

A subsequent thesis might be one that involves more than those currently involved in the project, i.e., schools, teachers, child associates, and students. I would like to involve parents also. The program could be a whole family experience and health care aid, allowing early detection of potential problems while the child is still at home. This program could be made available to children still at home, when parents feel a problem may be eminent.

6.3.3 Discussion

Ethically speaking, I think PMHP is doing well. They obtain information about students from many sources: parents, teachers, and the students themselves. This information is then processed through the same measures and scales for each student. The use of standardized measures makes the profile process objective. However the measures themselves are completed by people and therefore subjective. The recommendation process is handled totally by people and therefore, subjective. When decisions are made that affect a child's future or may label the child, and these decisions are made subjectively, a question of ethics does arise. I believe this project will help to alleviate some of the subjectivity involved in PMHP, and therefore alleviate some of the ethical questions.

Using a computer adds some questions of ethics though. Many people still believe computers are unreliable and should not be used for anything as critical as analyzing childrens' behavior. It is my feeling, after working with computers for several years, that computers are quite capable of at least handling the calculations involved in the profile process. This would alleviate much of the paper work resting on the teachers and associates. It would also eliminate any arithmetic errors made. The recommendation process would still be considered subjective, but only as subjective as the experts supplying the information for the decision rules.

Even this process could greatly assist the experts. I don't believe there is anything ethically wrong with this project, especially since the program will NOT replace the human expert.

It is my intent that this program could be used to help students in a process that is sometimes traumatic for many reasons that often are not even realized by the student undergoing the trauma. Leaving home, adjusting to school, adjusting to new people can all be traumatic to a child. It was always my hope to work with children as a career. My original goal was to be a school teacher. As that goal never materialized, it has been very rewarding for me to work on this project. For it is my hope that the program will eventually be used across the country in conjunction with PMHP to better assist children that are having difficulty adjusting to school, and life in general. Too often problems at home, such as divorce, abuse, etc., are overlooked in the schools. This is due many times to a lack of time and personnel. I feel PMHP is a very worthy project that tries to fill the void that schools and teachers are not always able to handle alone. Hopefully, this program will eventually be an integral part of all schools, to help with early detection of problems before they become significant and difficult to handle. I would hope that PMHP could eventually expand to help bring families to discuss problems at home and help not only the student, but the parents as well.

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APPENDIX A

APPENDIX A - GLOSSARY

1. Assignment Screening Conferences: where placement decisions are made by the PMHP team; mental health professional, teacher, senior child associate, child associate, and principal

2. Associative Process: visual association, auditory association

3. Auditory Channel: auditory reception, auditory association, verbal expression, grammatical closure, auditory sequential memory, auditory closure, sound blending

4. Automatic Level: grammatical closure, visual closure, auditory sequential memory, visual sequential memory

5. Child Associate: paraprofessional who sees children

6. Cognitive Behavior Modification: a set of skills where a child learns thinking processes that assist in managing his/her behavior (e.g., self-talk)

7. Expressive Process: verbal expression, manual expression

8. Group Contingencies: when a whole group is rewarded or punished

9. Mental Health Professional: school psychologist, school social worker, school counselor

10. Peer Reinforcement: peers provide "goodies" that increase the rate of behavior

11. PMHP Termination: child has met goals and is no longer in need of PMHP services

12. Principal Axis Method: a type of factor analysis

13. Profile: graphic representation of scales' percentiles

14. Programmed Instruction: shaping responses by successive approximations with high successful response rates, typically involves chaining and rehearsal of skills

15. Receptive Process: visual reception, auditory reception

16. Rekeying: coding items so they measure a construct in the same direction, e.g., "I behave in class", "I bother other kids". Since one measures a desirable trait and the other is less desirable, one would have to be rekeyed.

17. Representational Level: visual reception, auditory reception, visual association, auditory association, verbal expression, manual expression

18. Response Cost: the method of removing a token for the occurrence of a desired behavior. If there is one token remaining after a set period of time, a reward is earned.

19. Self-regulation: a set of skills including self-observation, goal setting, self monitoring, and self-evaluation. The direction of one's behavior by oneself

20. Senior Child Associate: paraprofessional who was a child associate, but who now coordinates instrument distribution, teacher conferences, etc.

21. Termination Conference: summary conference when goals are reached or at the end of the year

22. Time-out: removing a child from active participation to one where he/she does not receive or participate in or with inappropriate situations or behaviors

23. Token Economies: a behavioral treatment where tokens are given for desired behaviors, which can then be turned in for a "real" thing

24. Visual Channel: visual reception, visual association, manual expression, visual closure, visual sequential memory

APPENDIX B

APPENDIX B - LITERATURE REVIEW - SCHOOL PSYCHOLOGY

This appendix is a summary of a collection of articles. These articles were presented by the expert consultant. Though none of the articles directly pertain to the PMHP program or the development of the program, they were helpful in understanding the concepts of school psychology and classification.

B.1 A DIMENSIONAL APPROACH TO BEHAVIOR DISORDER: THE REVISED BEHAVIOR PROBLEM CHECKLIST

There are two major conceptualizations of behavior disorder [Quay 83]. The traditional model states that a disorder is either present or absent and that all, or nearly all, the symptoms must be present before a person can be assessed as having the disorder. The quantitative model views a disorder as a group of symptoms and the measure of the severity of the disorder depends on the number of symptoms present.

School psychologists are forced to make placement

decisions on an all-or-none basis of educational handicaps. These decisions are usually based on behavior rating scales. These ratings are quick and inexpensive to obtain, and allow parents and teachers to organize their observations of a child.

There are a number of rating scales present in the schools. Some of these are the Conners Scale, the Devereaux Elementary School Behavior Rating Scale, the Child Behavior Checklist, and the Behavior Problem Checklist. The original BPC contained 55 items. The BPC has since been expanded to 150 items. Four samples were used for the factor analyses. Sample 1 contained 276 cases in two private psychiatric residential facilities. The ratings were provided by staff. Sample 2 contained 198 cases, both outpatients and inpatients who were rated by their parents upon admission. Sample 3 contained 114 children attending a private school for children with learning disabilities. Sample 4 contained 172 ratings of children in a community-sponsored school for children with developmental disabilities. Each sample was factored separately using the principal axis method. The results of the procedure were four major and two minor scales. The four major scales were: Conduct Disorder with 22 items, Socialized Aggression with 17 items, Attention Problems-Immaturity with 16 items, and Anxiety-Withdrawal with 11 items. The two minor scales were: Psychotic Behavior with 6 items and Motor Excess with 5 items. Scoring is on a three point scale. The internal consistency of the RBPC was high. The inter-rater

reliablity ranged from 0.52 to 0.85. Validity in males was 85.5%, while in females it was 91%.

B.2 A SYNDROMIC TYPOLOGY FOR ANALYZING SCHOOL CHILDREN'S DISTURBED SOCIAL BEHAVIOR

Recent proposals for classification of child behavior disorders believe that a multiaxial or multidimensional approach gives a more accurate view of the types and intensities of maladjustments in children. Rutter, Shaffer and Shepherd [Rutter 75] feel that children differ from each other more in the degree with which they manifest certain behaviors and temperaments than by their extent of possessing inherent qualities or immutable characteristics.

Achenbach and Edelbrock [Achenbach 78] have specified necessary criteria for empirically derived typologies. 1) All indicators of disturbance must be observable and verifiable. 2) Allow for evaluations of children that follow from a continuous series of observations over time. 3) Observations should be made within a more natural setting. 4) The distribution and variation of observed maladjustment indicators should be analyzed through factor analytic study to identify principal dimensions of syndromes of child maladjustments.

In the development of an empirical typology the instrument used was the Bristol Social Adjustment Guides (BSAG). The BSAG has five core syndromes. Unforthcomingness

indicates a child's shy, unassertive, or socially ineffective behavior. Withdrawal indicates a child's socially detached or avoidance behavior. Depression depicts failure to seek out or respond to environmental stimulation. Inconsequence is impulse-ridden reactions associated with lack of forethought, distractibility, and inattentiveness. Hostility is a variety of passive-resistant and active-aggressive behaviors intended to test or sever relationships with adults or authorities. The associated groupings include nonsyndromic underreaction which is an "assortment of maladaptive indicators expressing generally passive or inhibited reactions, too heterogeneous to be viewed as an integral core syndrome, but nevertheless confirmatory of specific maladjustment as suggested by significant elevations on unforthcomingness, withdrawal or depression" [McDermott 83]. Nonsyndromic overreaction is characterized by "generally acting-out or aggressive behaviors used to confirm specific syndromic maladjustment as manifest through inconsequency, hostility, or peer maladaptiveness" [McDermott 83]. The neurological grouping is composed of behaviors associated with hyperactivity or possibly neurogenic impairment. The individual core syndromes and associated groupings combine to produce two adjustment scales: underreaction and overreaction.

B.3 THE STRESS RESPONSE SCALE: AN INSTRUMENT FOR USE IN ASSESSING EMOTIONAL ADJUSTMENT REACTIONS

The Stress Response Scale (SRS) was developed for use in the assessment of children's emotional adjustment reactions [Chandler 83]. It was designed for use in screening procedures and differential diagnosis among various groups of children seen for psychological services.

The model predicts four patterns of behavior: impulsive, dependent, passive-aggressive, and repressed. The syndromes that established these patterns include impulsive (acting out), often described as demanding, selfish, and defiant. Passive-Aggressive children are often seen as underachievers, procrastinators, having poor attitudes toward school, daydreamers, and having declining school grades. Impulsive (overactive) children are easily excited, mischievious, playful, and talkative. Repressed children are sensitive, easily hurt, worrying, nervous, jumpy, easily upset, and lacking in self-confidence. Dependent children seldom assert their wills, lack self-confidence, and are unable to take criticism.

Two studies were undertaken to establish normative data for the SRS. Study 1 was to determine the effects of sex and age on the scores of the SRS. There was a significant main effect found for each, but not an interaction effect. Males scored higher than females on the SRS. Children at either end of the age extremes, i.e., youngest and oldest, scored highest on the SRS. Study 2 was designed to compare clinic-referred children to the normative population. The results from this study were not very conclusive.

Rating scales are seen as having considerable potential for assessment. They are used a lot in studies, but seldom in practice yet. They are useful in making discriminations that have direct implications for intervention.

B.4 TEMPERAMENT: A REVIEW OF RESEARCH WITH IMPLICATIONS FOR THE SCHOOL PSYCHOLOGIST

There has recently been an increase in interest in the developmental, clinical, and educational correlates of temperament. This increase seems to be attributed to two general trends in current psychological thought. First, there is a strong impulse in psychology to focus on biological determinants of behavior. Second, some parents claim that their children have been different from birth. They would like researchers to look for sources of individual differences other than experience.

Allport defines temperament as "the characteristic phenomena of an individual's emotional stimulation, his customary strength and speed of response, and the quality of his prevailing mood, and all peculiarities of fluctuation and intensity in mood; these phenomena being regarded as dependent upon constitutional make-up, and therefore largely hereditary in nature" [Martin 83]. Thomas, Chess and colleagues [Thomas 63,77] define temperament as a behavioral style. They have researched nine temperamental variables which they feel qualify as stylistic variables: intensity, threshold,

activity, rhythmicity, adaptability, approach/withdrawal, distractibility, persistence, and mood. Rothbart and Derryberry define temperament as individual differences in reactivity and self-regulation.

Temperament seems to be felt a relatively stable trait, of genetic or congenital origin, that is a description of qualities of emotion and characteristics of central nervous system arousal as they are reflected in behavior. It is important to remember that the measured behavior is a complex interaction of genetic and environmental influences.

Two major approaches to the measurement of temperament have been used. The first involves a different instrument for different age groups. The four instruments used are the Infant Temperament Questionnaire, the Toddler Temperament Questionnaire, the Behavioral Style Questionnaire for children three through seven, and the Middle Childhood Questionnaire. These instruments have several factors that limit their use in practice, however. Their internal consistency is lower than 0.80, interpretation of individual scales is somewhat questionable, the geographic and socioeconomic characteristics of the norm sample are restricted, the validity of the scales is uncertain, and there are no manuals on two of the instruments. However, the instruments were prepared in accordance with appropriate psychometric guidelines and are generally adequate research instruments.

The second approach is the Temperament Assessment Battery (TAB). The battery consists of three forms: one for parents,

one for teachers, and one for clinicians. They are designed to measure temperament in children ages three through seven. One advantage of the TAB is that it allows for multi-source assessment. A second advantage is that the TAB was designed as a clinical as well as a research scale. The main weakness of the TAB is that its inter-rater reliability across forms is low.

In measuring the relationship between temperament and cognitive ability, Lamb, Garn and Keating [Lamb 81] obtained temperament and Bayley Mental Scale scores of over 33,000 eight-month old children. The temperamental variable of sociability was measured. A low positive correlation was measured between sociability and mental scale performance. Burk [Burk 80] studied children in a nursery school for gifted children. Gifted children were rated higher than the norm sample for approach/withdrawal, adaptability, mood, and persistence. Gordon and Thomas [Gordon 67] studied the relationship between temperament and teachers' appraisal of intelligence. Children were placed into four groups based on teacher ratings. "Plungers" were children who jumped without hesitation into new situations. "Goalongers" were children who did not plunge in, but positively adapted to new situations. "Sideliners" were children who were removed from activities and only slowly joined in. "Nonparticipators" were children who remained removed from activities. Teachers consistently rated "plungers" higher in intelligence than "sideliners" even though they may not actually have been more

intelligent.

In measuring the relationship between temperament and academic achievement, Thomas and Chess [Thomas 77] compared reading and arithmetic scores with temperament ratings. Low adaptability and low approach/withdrawal ratings were significant predictors of low achievement.

Thomas and Chess [Thomas 77] compared temperament and psychopathology. They found that "difficult children" also manifested behavioral disturbances. "Difficult child" temperamentals consisted of low biological rhythmicity, poor adaptability, low approach tendency, negative mood, and high emotional intensity.

Temperament should be looked at more since it can aid in answering questions about children more precisely.

B.5 ASSESSING THE BEHAVIORAL EXPECTATIONS AND DEMANDS OF LESS RESTRICTIVE SETTINGS

Two scales have been developed to assess teacher tolerance levels, expectations, and standards for children's social behavior associated with handicapping conditions [Rankin 83]. The SBS Inventory of Teacher Social Behavior Standards and Expectations contains 107 items and allows a teacher to indicate how critical they consider certain behaviors in their classroom. The SBS Checklist of Correlates of Child Handicapping conditions contains 24 items and allows teachers to check items that would cause them to resist

placement of a child manifesting that condition.

The SBS Inventory contains 107 items. Section I contains 56 items that describe adaptive, appropriate child behavior. Section II contains 51 items that describe maladaptive, inappropriate child behavior(s) that impair classroom adjustment and interfere with peer social relationships. Section III assesses a teacher's technical assistance needs to accomodate a child who is deficient in Section I items or outside the acceptable range of Section II items.

The SBS Checklist assesses teacher tolerance levels regarding conditions/characterstics often associated with handicapping conditions that are neither social nor behavioral.

Mischel concluded that behavior tends to be a function of the specific situations in which it occurs. "The knowledge base on teacher expectations indicates that teachers: a) form differential performance expectations for children in their classes, b) behaviorally express them during teaching interactions, and c) ultimately maximize the achievement of high expectation students and minimize it for low expectation students". [Brophy 81, Brophy 74, Good 78, Silberman 69]. When a teacher's behavioral standards and expectations are ecologically incongruent with the behavioral capabilities of individual students, the possibility exists for adjustment problems and impaired schooling effectiveness in both behavioral and academic domains.

B.6 FACTOR STRUCTURE OF TEACHER RATING SCALES FOR CHILDREN

There has been increased use of behavior rating scales in educational use [Carlson 83]. There has also been a movement toward the use of factor analytic techniques as a means of deriving a classification system for childhood behavior disorders. Two kinds of variables that appear to generate a significant influence on factor analytic studies are population variables and factor structure variables. Examples of population variables are sex, age, severity, and race. Examples of factor structure variables are source and breadth of the item pool and decision rules concerning the number of factors to be extracted. It has been suggested that factor analytic studies may be the most influential approach to classifying maladaptive behaviors.

A summary of several of the most widely used teacher rating scales follows.

The Behavior Problem Checklist (BPC) contains 55 items and is rated on a 3-point scale. The BPC measures problem behaviors occurring in childhood and adolescence. The checklist yields four dimensions: Conduct Problem, Personality Problem (anxiety-withdrawal), Inadequacy-Immaturity, and Socialized Aggression. The BPC has test-retest reliabilities over two-week intervals of 0.82 to 0.98. There is a lot of normative data available on the BPC.

The Conners Teacher Rating Scale (TRS) contains 39 items and is rated on a 4-point scale. The TRS was developed to aid

in identifying hyperactive children and evaluating treatment effectiveness. The scale yields five factors: Hyperactivity, Conduct Problem, Inattentive-Passive, Tension-Anxiety, and Sociability. The TRS has test-retest reliabilities ranging from 0.70 to 0.90. There is a great deal of normative data on both normal and hyperactive children.

The Devereaux Elementary School Behavior Rating Scale (DESB) contains 47 items. The DESB is used to obtain descriptions of overt behavior which teachers believe to interfere with learning in the classroom. Three of the 47 items are singularly scored: Unable to Change, Quits, and Slow Work. The remaining 44 items comprise 11 factors: Classroom Disturbance (active, socially inappropriate, disruptive behaviors), Impatience, Disrespect-Defiance (rejection of teacher, classroom rules, and/or subject matter), External Blame (child's tendency to blame the teacher or circumstances for failure), Achievement Anxiety (overconcern and upset over inability to meet achievement demands), External Reliance (inabilility to make independent decisions), Comprehension (understanding of classroom material), Inattentive-Withdrawn (loss of contact with classroom activities, daydreaming), Irrelevant responsiveness (disruptive and/or irrelevant responses which interrupt class), Creative Initiative (self-initiated, positive involvement in classroom activities) and need for Closeness to teacher (desire for closeness to and friendliness with the teacher. The DESB has test-retest reliabilities ranging from

0.85 to 0.91.

The Pittsburgh Adjustment Survey Scale (PASS) consists of 94 items and is rated on a 3-point scale. It was developed to allow teachers to rate the emotional and social adjustment of elementary school boys. The scale yields four factors: Aggressive, Passive-Aggressive, Withdrawn, and Prosocial dimensions. The PASS can differentiate between normal boys and boys enrolled in a special class for emotionally disturbed children. The test-retest reliabilities for the PASS over a six month period range from 0.77 to 0.89. And the inter-rater reliability between teachers and teacher assistants ranges from 0.73 to 0.90. There is a lack of normative data for females.

The Problem Behavior Identification Checklist (PBIC) consists of 50 items and is rated on a 4-point scale. The checklist was derived from teachers' referral descriptions of children who exhibit chronic behavior problems. The PBIC yields five factors: Acting-out, Withdrawal, Distractibility, Disturbed Peer Relations, and Immaturity. There are no validity estimates of factor scores reported. The test-retest reliabilities range from 0.43 to 0.96. There is limited normative data for factor scores.

Population variables such as race, age, and sex seem to have an impact on the prevalence of behaviors in childhood. There is not much information on the effects of race on behavior. Spring, Blunden, Greenberg and Yellin [Spring 77] found that a higher proportion of blacks were identified as

hyperactive than whites. "Boys are more likely to exhibit acting-out or aggressive" [Quay372, Peterson 61, Werry 76] and hyperactivity [Goyette378, Arnold 74, Werry 68]. Werry and Quay report that anxiety or withdrawal disorders are more prevalent with girls. Graham [Graham 79] reports the frequency is equal. There seems to be a decrease of aggression, hyperactivity and anxiety-related symptoms with an increase in age.

Factor structure variables such as item selection, breadth of the initial item pool and number of factors obtained seem to be important determinants of the results of factor analysis. Some items are chosen by clinicians, some by teachers. When broad factors are obtained, variance is common in the results.

B.7 PROBLEMS AND ISSUES IN USING RATING SCALES TO ASSESS CHILD PERSONALITY AND PSYCHOPATHOLOGY

Rating scales are efficient and cost-effective for obtaining data on child behavior, but there are many unresolved issues about their use [Edelbrock 83]. No assessment procedure can provide perfectly accurate reliable and comprehensive data. Rating scales have the advantages of being less costly and time consuming than direct observations of psychological testing and usually yield more objective and reliable data than assessments based on projective techniques and clinical interviews.

When choosing a rating scale, we have a lack of knowledge regarding the origins, course and consequences of behavioral differences. Some of the issues in choosing a scale are summarized below. It is advisable to use what works as opposed to what is available or what is theoretically advised. When choosing items, items to avoid are those that don't pertain directly to behavior or those that reflect consequences of behavior rather than the behavior itself. When choosing response scaling it is advised to have at least a three step response scale. It has been generally agreed upon that multidimensional ratings involving simultaneous scores on two or more scales are superior to unidimensional assessments. Scales differ in their target phenomena. Empirically derived scales offer a greater descriptive validity and predictive power of these target phenomena. Many scales lack time frames. This can cause several problems. Informants may not have had enough time with the child to obtain accurate information or the information may be outdated. Standardization is crucial to the "social validation" of behavioral change. Norms should be stratified according to variables that account for a considerable amount of variance in behavioral ratings.

It is also important how and which informants are chosen. Many scales don't specify who the informant should be. Parents are generally better qualified to report on behaviors that occur at home, while teachers are better qualified to report on classroom behavior, peer relations, and academic

performance. Multiple informants allow a more comprehensive picture.

B.8 NATIONAL NORMATIVE AND RELIABILITY DATA FOR THE REVISED CHILDREN'S MANIFEST ANXIETY SCALE

An attempt was made to develop normative data for the Revised Children's Manifest Anxiety Scale (RCMAS) [Reynolds 83]. The scale was administered separately to black females, black males, white females and white males for the total Anxiety Scale, three subscales of anxiety and a Lie Scale. The three subscales of anxiety are Physiological Anxiety, Worry and Oversensitivity, and Concentration Anxiety.

The scale resulted in high internal consistency, high internal consistency reliability of $p <= 0.05$, and high stability of > 0.80. For the total Anxiety scale there was no difference in internal consistency for black males, white females and white males. For black females under age 12 reliability was not satisfactory.

Other results obtained from the RCMAS were that anxiety seems to affect cognitive task performance. The RCMAS was found to be a good icebreaker for discussions with children.

B.9 RELIABILITY OF THE CONNERS ABBREVIATED TEACHER RATING SCALE ACROSS RATERS AND ACROSS TIME: USE WITH LEARNING DISABLED STUDENTS

The Conners Abbreviated Teacher Rating Scale (CATRS) was

investigated for inter-rater reliability. The CATRS was completed on two separate occasions, one month apart, by teachers and classroom aides of learning disabled children. The CATRS was designed to assess hyperactivity. Intra-rater reliability for teachers was found to be 0.866, and for aides it was 0.602. General inter-rater reliability was 0.702, which is acceptable. Intra-rater reliability examines "the extent to which a rater would score each item in the same way for a given student, despite the passage of enough time to assure some forgetting of previous scoring, but not enough time to result in major changes in the student's behavior. Inter-rater reliability examines the extent to which two raters would score each item on the scale similarly for a given student at a given point in time" [Epstein 83].

The high inter-rater reliability indicates that teachers and their aides tend to agree on behavior descriptions. Based on the results of this study, the CATRS seems to have sufficient reliability to justify continued application.

B.10 INCREASING TEACHER DELIVERY OF CONTINGENT PRAISE AND CONTINGENT MATERIALS USING CONSULTANT FEEDBACK AND PRAISE

A study was undertaken to assess the value of teacher delivery of contingent praise and contingent materials using consultant feedback and praise [Mace 83]. Some of the praise strategies used were token economies, response cost, time-out,

programmed instruction, self-regulation, group contingencies, peer reinforcement, and cognitive behavior modification. Teacher attention or praise is provided following task-relevant or achievement behavior and withheld during disruptive or off-task behavior. Teachers were also given feedback and praise from a consultant viewing their class, when the teacher's behavior was positive. This feedback and praise seemed most effective in changing teacher responses to students. The contingent praise and contingent materials also seemed to have a positive effect on student behavior.

B.11 IMPROVING THE UTILITY OF SCHOOL PSYCHOLOGICAL REPORTS THROUGH EVALUATION USING STUFFLEBEAM'S CIPP MODEL

The need for evaluation of psychological services in schools has become more apparent [Gilberg 83]. Many school psychologists are interested in evaluating the services they deliver, but few have done so because of a lack of proper training. One service that needs evaluation is the provision of school psychological reports. It has been shown that teachers perceive psychologists' recommendations useful only 50% of the time [Baker 65, Styles 65]. Positive changes were recognized in students in less than 43% of the cases [Styles 65]. Fifty two percent of school teachers surveyed by the United Federation of Teachers indicated that psychological services were not relevant to teaching [Kappan 68].

The CIPP, which calls for decision-oriented evaluation,

was used to evaluate psychological reports. Four stages were involved in the evaluation. Stage 1, context evaluation, provides a rationale for the determination of objectives. Stage 2, input evaluation, focuses on providing information regarding how to employ resources to achieve the objectives and to carry out the evaluation. Stage 3, process evaluation, involves implementing and monitoring the procedural design identified in Stage 2. Stage 4, product evaluation, involves measuring and relating the results of the evaluation comparing old reports to new reports.

B.12 PSYCHOLOGIST AS NEGOTIATOR IN SYSTEM CONTRACTS WITH ADOLESCENTS

Students referred to school psychologists are often deficient in problem-solving skills and responsible behavior. "A systematic form of contracting which involves students, parents, and teachers negotiating common issues is a time-limited cognitive-behavioral intervention that has the potential to maximize psychologists' impact upon schools" [Johnston 83]. Setting contracts between students, teachers and parents enforces accountability. In the process of setting contracts, family dynamics are often exposed. The contract is an approximation of the working world. It is both a goal and a method.

There are five steps of negotiating a contract. Step 1 involves selecting the behavior for focused change. In Step 2

the desired behavior change needs to be detailed in terms of responsibilities. Step 3 involves identifying meaningful privileges. Step 4 is consequence setting and can be the most crucial part of the process. Step 5 gives the contract a time frame for implementation.

It has been shown that these contracts are beneficial both for the classroom and the home. When setting the contract it is highly effective to have both parents present. The goal of the contracts is for teachers and parents to become managers of change rather than enforcers of punishment.

B.13 THE USE OF PROJECTIVE ASSESSMENT BY SCHOOL PSYCHOLOGISTS

A study was undertaken to examine the use of projective assessment by school psychologists. Sixty four randomly selected school psycologists kept daily records for four weeks of all the tests they administered, variables associated with each student they tested, and the reasons they used each test. Later, they completed a questionnaire that focused on their background characteristics, training in projectives and their attitudes toward projective assessment.

Results of the questionnaire showed that psychologists tended to use projective assessment more for "possible emotional disturbance" referrals [Vukovich 83]. Projective assessment was used more for quick screening, more for boys than girls, and more for children lacking verbal skills. The

results also showed that projective assessment was valued less than other tests for educational planning of children.

APPENDIX C

APPENDIX C - RULES FOR PMHP EXPERT SYSTEM

C.1 RULES

The following sections summarize the data collected in meetings between the psychology expert and knowledge engineer. Basically they are aiming toward two goals. The first is to collect the input from all the rating scales, and present a concise, comprehensive summary describing each child's strengths and weaknesses. The summary and questions will be taken to the placement conference held by the PMHP team and teacher to aid in decision making about placement. The second step is to provide recommendations for goals for the children who are referred to PMHP.

C.1.1 AML-R

The AML-R is a screening tool. Therefore it will be very important for step 1. Some of the rules follow:

1. Star any child scoring below the 30% mark on any scale
2. Double star any child scoring below the 15% mark on any scale
3. Especially note children with low scores on more than one scale
4. If all 3 scales are low the child may be too severe for PMHP
5. The healthy children (i.e., above 30%) are omitted from consideration very quickly

6. Items 6 and 12 help to detect if a child's learning difficulty is due to the child

7. Items 3 and 9 help to detect if a child's learning difficulty is due to the teacher

8. Items 4 and 10 point out immaturity

9. Items 1 and 7 point out problems with fighting

C.1.2 CRS

The CRS is a screening tool. Some of the rules follow:

1. Star any child scoring below the 30% mark on any scale

2. Double star any child scoring below the 15% mark on any scale

3. Star if there is a large discrepancy between the AML Acting Out scale and the CRS Acting Out scale

4. Star if there is a large discrepancy between the AML Shy scale and the CRS Shy scale

5. If there is a large discrepancy, the child may not be aware of his own behaviors

The CRS is also a diagnostic tool. Some of the rules follow:

1. If there is a divorce in the family, Acting Out is expected to be down

2. If there is a death in the family, Shy is expected to be down

3. Social Skills scores show if the child has control or needs assistance

4. If Social Skills are down, other peers may need to be brought in to work on goals

5. If there is a large discrepancy between any of the first three scales on the CRS and T-CRS, this should be noted

6. If T-CRS A scale is low and CRS A scale is high, high risk problem

7. If CRS A scale is low and T-CRS Peer Social is high, child is fine with peers but may have limits with adults

8. If CRS Social ok, and T-CRS Social low, child needs awareness of problems

9. If CRS Social low, and T-CRS Social ok, child may feel picked on, and could use teacher intervention

10. If CRS Shy is low, and T-CRS Shy is ok, note problem, may have an external cause

11. If CRS A scale is low and T-CRS Social is low, must learn skills with teachers and peers

12. If CRS A scale is high, T-CRS Social is low and T-CRS A scale is low, the child doesn't recognize problems, can't interact with adults or peers

13. If CRS Shy is low, and T-CRS Social is low, low social skills, can't initiate discussions

14. If CRS Shy is low, CRS Social is high, and T-CRS Social is low, child has misperception, unawareness of problem

15. If CRS Shy is low, CRS Social is low, and T-CRS Social is low, the poor social skills could be causing each other

16. If CRS A scale is high, and T-CRS A scale is low, child has awareness problem

17. If CRS Shy is low, and T-CRS Frustration is low, child is immature

18. If CRS Social is low, and T-CRS Frustration is low, the child is aware and frustrated

19. If CRS Self Confidence is low and A scale is low, work with child immediately

20. If CRS Self Confidence is low and T-CRS Task is low, child may have a problem in the future

C.1.3 BIF

The BIF aids in diagnosing the child. Some rules

follow:

1. Check bottom items first. If any are marked go into crisis management
2. If emotionally or behaviorally handicapped, no for PMHP
3. If child has been in PMHP a year or more, question whether appropriate for PMHP
4. If child has been in PMHP 2 years or more, no for PMHP
5. If visits nurse frequently but not for on-going medical, psychosomatic
6. If more than one pull-out-program, maybe not good for PMHP
7. If frequently absent, may be school phobia
8. If poor grooming, will lead directly to goals

C.1.4 T-CRS

The T-CRS aids in diagnosing the child. Some rules follow:

1. Items 2,5 and 14 indicate shyness
2. Items 8,11 and 17 indicate anxiety

C.1.5 A-CRS

The A-CRS aids in reporting a child's progress. Some rules follow:

1. Participation: if low, must get child to participate, must develop rapport, trust should be established
2. Limits: limits needed, parameters need to be set for acceptable and unacceptable behaviors

3. Anxiety: relaxation exercises, become aware of source of anxiety, limit exposure to anxiety causing activities

4. Self confidence: if low, assist child in meeting frustrations; help child become aware

5. If Participation and Anxiety are low, it may be the setting. Question relationships with other adults

6. If Participation and Limits are low, there may be a question of conflict between child and worker

7. If Limits and Anxiety are low, unusual, but if true, prognosis is poor

8. If one or more scales below 15%, question if child is appropriate for PMHP

APPENDIX D - ADDITIONAL RULES FOR PMHP EXPERT SYSTEM

The following list is comprised of rules and hints given by the psychology expert and used by the knowledge engineer to help understand the PMHP project, but not necessarily to create rules.

1. If teachers' ratings are extremely high or extremely low for all students, these teachers' ratings are looked at in a relative light
2. Take into consideration any old scores that may exist on this child
3. Can tie in BIF and T-CRS to make generalizations
4. Item 4 is a really critical item because it gives the child's perspective
5. If CRS Shy is low, and T-CRS Social is high, no problem
6. If CRS A scale is low, T-CRS A scale is low, and T-CRS Frustration is low, child reacts externally, Shy will unlikely be low
7. If CRS Self Confidence is low, and A scale is high, will probably be an increase in A scale
8. Disciplinary visits to school office will be used in goals
9. Visits to nurse may lead to goal
10. If visits nurse frequently for on-going medical, no problem
11. If medical problems, ask more questions
12. If child does not seem easy to like, ask more questions

13. If foster care, ask why

14. Age is a critical factor

15. Sex is a critical factor

16. If CRS and T-CRS don't match, often times means child has an awareness problem

17. If only one scale is low, probably not referred

18. Acting Out and Shy are usually unrelated

19. Acting Out and Learning are moderately related

20. Acting Out and Frustration are typically related

21. Acting Out and Assertiveness are relatively independent

22. Acting Out and Task are moderately related

23. Acting Out and Peer Social are relatively unrelated

24. Shy and Assertiveness are related

25. Learning is the key moderating variable

26. Frustration is most highly related to Acting Out

27. Assertiveness is a communications skill

28. The A-CRS scale is hard to compare with norm, because only PMHP children are marked

29. The A-CRS is good to compare child with himself

30. If Limits and Self Confidence are low, this is a typical pattern

APPENDIX E

APPENDIX E - FIGURES

Key: Top to bottom == less severe

Top to bottom == return to classroom as soon as possible

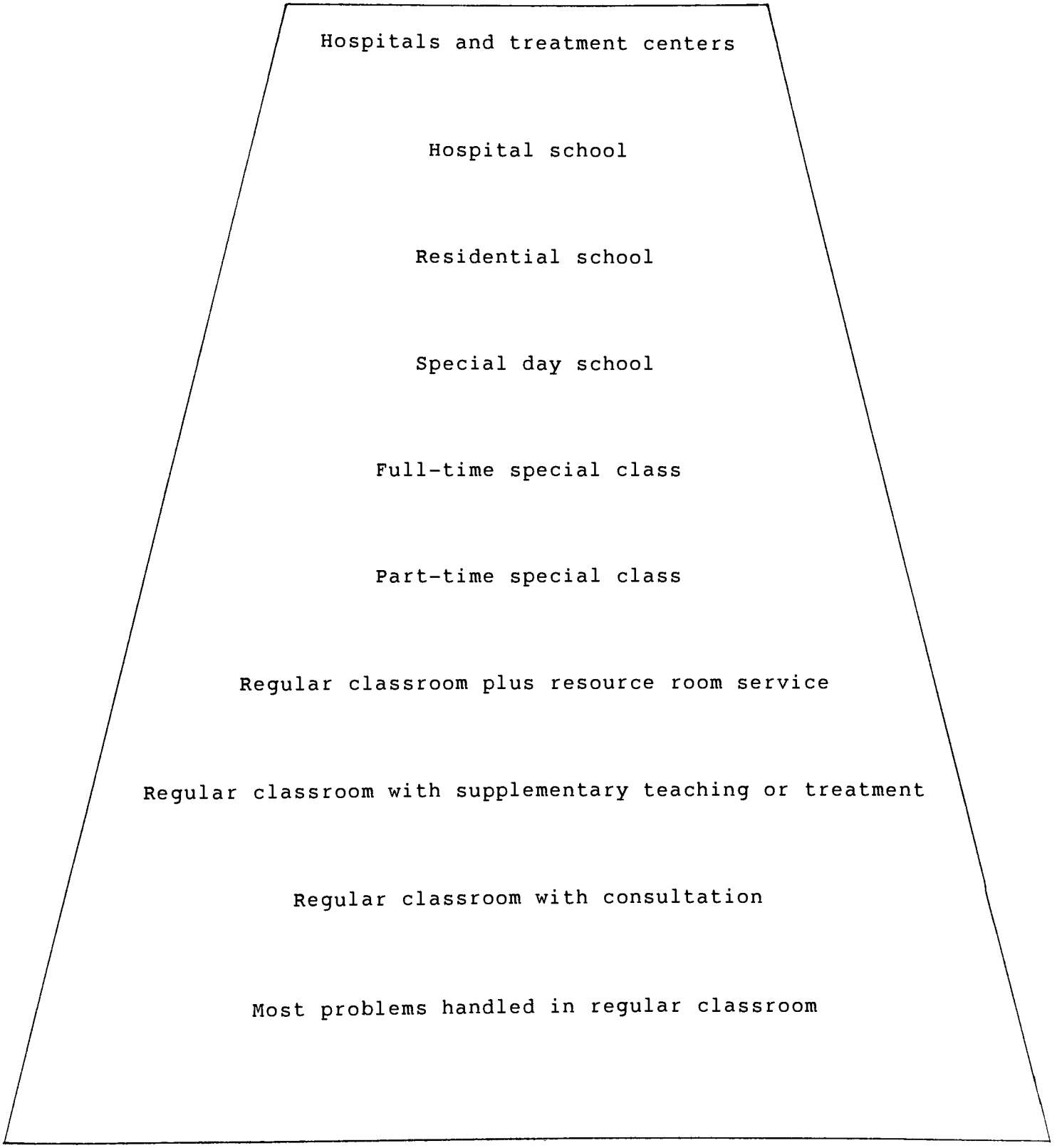


Figure 5-1

AML Behavior Rating Scale - Revised

Child's Name _____ Sex: M F Today's Date _____
(Last) (First) (circle one)

Student's
School ID# _____ Teacher _____ Grade _____ Repeat: No Yes
Grade (circle one)

Please rate the pupil's behavior as you have observed and experienced it since the beginning of school according to the following scale by circling the appropriate number:

(1) Never - You have literally never observed this behavior in this child.

(2) Seldom - You have observed this behavior once or twice.

(3) Moderately often - You have seen this behavior more often than once a month but less often than once a week.

(4) Often - You have seen the behavior more often than once a week but less often than daily.

(5) Most or all of the time - You have seen the behavior with great frequency, averaging once a day or more often.

This pupil:	Never	Seldom	Moderately Often	Often	Most or all of the time
1. gets into fights or quarrels with classmates-	1	2	3	4	5
2. has to be coaxed to work or play with peers -	1	2	3	4	5
3. is confused with school work - - - - - - - - -	1	2	3	4	5
4. is restless - - - - - - - - - - - - - - - - - -	1	2	3	4	5
5. is unhappy- - - - - - - - - - - - - - - - - - -	1	2	3	4	5
6. gets off-task - - - - - - - - - - - - - - - - -	1	2	3	4	5
7. disrupts class discipline - - - - - - - - - - -	1	2	3	4	5
8. feels hurt when criticized - - - - - - - - - -	1	2	3	4	5
9. needs help with school work - - - - - - - - - -	1	2	3	4	5
10. is impulsive- - - - - - - - - - - - - - - - - -	1	2	3	4	5
11. is moody - - - - - - - - - - - - - - - - - - -	1	2	3	4	5
12. has difficulty learning - - - - - - - - - - - -	1	2	3	4	5

	A	M	L	Total
Raw Score				
Percentile				

PMHP - Revised 5/86

Figure 5-2

CHILD RATING SCALE

NAME_____
FIRST LAST

1. SEX: BOY GIRL

2. AGE: 5 6 7 8 9 10 11 12 13 OTHER_____

3. GRADE: K 1 2 3 4 5 6 OTHER_____

4. ETHNIC GROUP(S): BLACK WHITE HISPANIC OTHER_____

5. TEACHER_____

6. SCHOOL_____

7. TODAY'S DATE_____

PLEASE DECIDE HOW MUCH EACH SENTENCE BELOW DESCRIBES YOU.

---IF IT IS <u>USUALLY NOT</u> LIKE YOU, CIRCLE THE <u>NO</u>.

---IF IT IS <u>SOMETIMES</u> LIKE YOU, CIRCLE THE <u>SOMETIMES</u>.

---IF IT IS <u>USUALLY</u> LIKE YOU, CIRCLE THE <u>YES</u>.

<u>EXAMPLES</u>:	<u>USUALLY NO</u>	<u>SOMETIMES</u>	<u>USUALLY YES</u>
A. I LIKE TO SWIM- - - - - - - - - - - - - - - -	NO	SOMETIMES	YES
B. I'M GOOD AT DRAWING PICTURES- - - - - - - -	NO	SOMETIMES	YES
C. I ENJOY COLD WEATHER- - - - - - - - - - - -	NO	SOMETIMES	YES

		USUALLY NO	SOMETIMES	USUALLY YES
1.	I BEHAVE IN SCHOOL- - - - - - - - - - - - - - -	NO	SOMETIMES	YES
2.	I GET MIXED-UP IN CLASS - - - - - - - - - - - -	NO	SOMETIMES	YES
3.	I HAVE MANY FRIENDS - - - - - - - - - - - - - -	NO	SOMETIMES	YES
4.	I LIKE TO DO SCHOOL WORK- - - - - - - - - - - -	NO	SOMETIMES	YES
5.	I BOTHER OTHER KIDS WHO ARE WORKING - - - - -	NO	SOMETIMES	YES
6.	I GET UPSET EASILY- - - - - - - - - - - - - - -	NO	SOMETIMES	YES
7.	MY CLASSMATES TEASE ME- - - - - - - - - - - - -	NO	SOMETIMES	YES
8.	I GET BORED IN CLASS- - - - - - - - - - - - - -	NO	SOMETIMES	YES
9.	I DO WHAT I'M SUPPOSED TO IN SCHOOL - - - - -	NO	SOMETIMES	YES
10.	I FORGET THINGS - - - - - - - - - - - - - - - -	NO	SOMETIMES	YES
11.	I WOULD RATHER DO THINGS BY MYSELF- - - - -	NO	SOMETIMES	YES
12.	SCHOOL IS FUN - - - - - - - - - - - - - - - - -	NO	SOMETIMES	YES
13.	I GET IN TROUBLE IN CLASS - - - - - - - - - -	NO	SOMETIMES	YES
14.	I WORRY ABOUT THINGS AT SCHOOL- - - - - - - -	NO	SOMETIMES	YES
15.	MY CLASSMATES LIKE ME - - - - - - - - - - - -	NO	SOMETIMES	YES
16.	I MAKE MANY MISTAKES ON MY SCHOOL WORK- - -	NO	SOMETIMES	YES
17.	I FOLLOW THE CLASS RULES- - - - - - - - - - -	NO	SOMETIMES	YES
18.	I'M NERVOUS AT SCHOOL - - - - - - - - - - - -	NO	SOMETIMES	YES
19.	OTHER KIDS CHOOSE ME LAST FOR GAMES - - - - -	NO	SOMETIMES	YES
20.	I LIKE TO ANSWER QUESTIONS IN CLASS - - - - -	NO	SOMETIMES	YES

		USUALLY NO	SOMETIMES	USUALLY YES
21.	I CALL OTHER STUDENTS NAMES - - - - - - - - -	NO	SOMETIMES	YES
22.	I FEEL LIKE CRYING AT SCHOOL- - - - - - - - -	NO	SOMETIMES	YES
23.	I MAKE FRIENDS EASILY - - - - - - - - - - - -	NO	SOMETIMES	YES
24.	WHEN SCHOOL WORK GETS HARD, I GIVE UP - - -	NO	SOMETIMES	YES
25.	I'M A TROUBLEMAKER IN CLASS - - - - - - - - -	NO	SOMETIMES	YES
26.	I'M SHY AT SCHOOL - - - - - - - - - - - - - -	NO	SOMETIMES	YES
27.	OTHER KIDS WANT TO SIT NEAR ME- - - - - - - -	NO	SOMETIMES	YES
28.	INTERESTING THINGS HAPPEN IN CLASS- - - - -	NO	SOMETIMES	YES
29.	I WAIT FOR MY TURN- - - - - - - - - - - - - -	NO	SOMETIMES	YES
30.	MY FEELINGS GET HURT EASILY - - - - - - - - -	NO	SOMETIMES	YES
31.	OTHER KIDS ARE MEAN TO ME - - - - - - - - - -	NO	SOMETIMES	YES
32.	I NEED HELP WITH SCHOOL WORK- - - - - - - -	NO	SOMETIMES	YES
33.	I'M AFRAID OF MAKING MISTAKES - - - - - - -	NO	SOMETIMES	YES
34.	I GET POOR GRADES IN THIS CLASS - - - - - -	NO	SOMETIMES	YES
35.	I'M BASHFUL IN CLASS- - - - - - - - - - - - -	NO	SOMETIMES	YES
36.	I'M GOOD AT SCHOOL WORK - - - - - - - - - -	NO	SOMETIMES	YES

Figure 5-3

Child Rating Scale Report

Child's Name_____ Child Associate_____

Initial: Date_____

Rule Compliance/Acting-Out

1. I behave in school _____
5. I bother other kids 4-_____=_____
9. I do what I'm supposed to _____
13. I get in trouble 4-_____=_____
17. I follow the class rules _____
21. I call other students names 4-_____=_____
25. I'm a troublemaker 4-_____=_____

Total Rule =_____

Anxiety/Withdrawal

2. I get mixed-up in class _____
6. I get upset easily _____
10. I forget things _____
14. I worry about things _____
18. I'm nervous at school _____
22. I feel like crying _____
26. I'm shy at school _____

Total Anxiety =_____

Social Skills

3. I have many friends _____
7. My classmates tease me 4-_____=_____
11. I would rather do things 4-_____=_____
15. My classmates like me _____
19. Other kids choose me last 4-_____=_____
23. I make friends easily _____
27. Other kids want to sit near _____

Total Social =_____

Self/School Confidence

4. I like to do school work _____
8. I get bored in class 4-_____=_____
12. School is fun _____
20. I like to answer questions _____

Total Confidence =_____

Final: Date_____

Rule Compliance/Acting-Out

1. I behave in school _____
5. I bother other kids 4-_____=_____
9. I do what I'm supposed to _____
13. I get in trouble 4-_____=_____
17. I follow the class rules _____
21. I call other students names 4-_____=_____
25. I'm a troublemaker 4-_____=_____

Total Rule =_____

Anxiety/Withdrawal

2. I get mixed-up in class _____
6. I get upset easily _____
10. I forget things _____
14. I worry about things _____
18. I'm nervous at school _____
22. I feel like crying _____
26. I'm shy at school _____

Total Anxiety =_____

Social Skills

3. I have many friends _____
7. My classmates tease me 4-_____=_____
11. I would rather do things 4-_____=_____
15. My classmates like me _____
19. Other kids choose me last 4-_____=_____
23. I make friends easily _____
27. Other kids want to sit near _____

Total Social =_____

Self/School Confidence

4. I like to do school work _____
8. I get bored in class 4-_____=_____
12. School is fun _____
20. I like to answer questions _____

Total Confidence =_____

PMHP 8/86

Child Rating Scale (CRS) Profile

URBAN

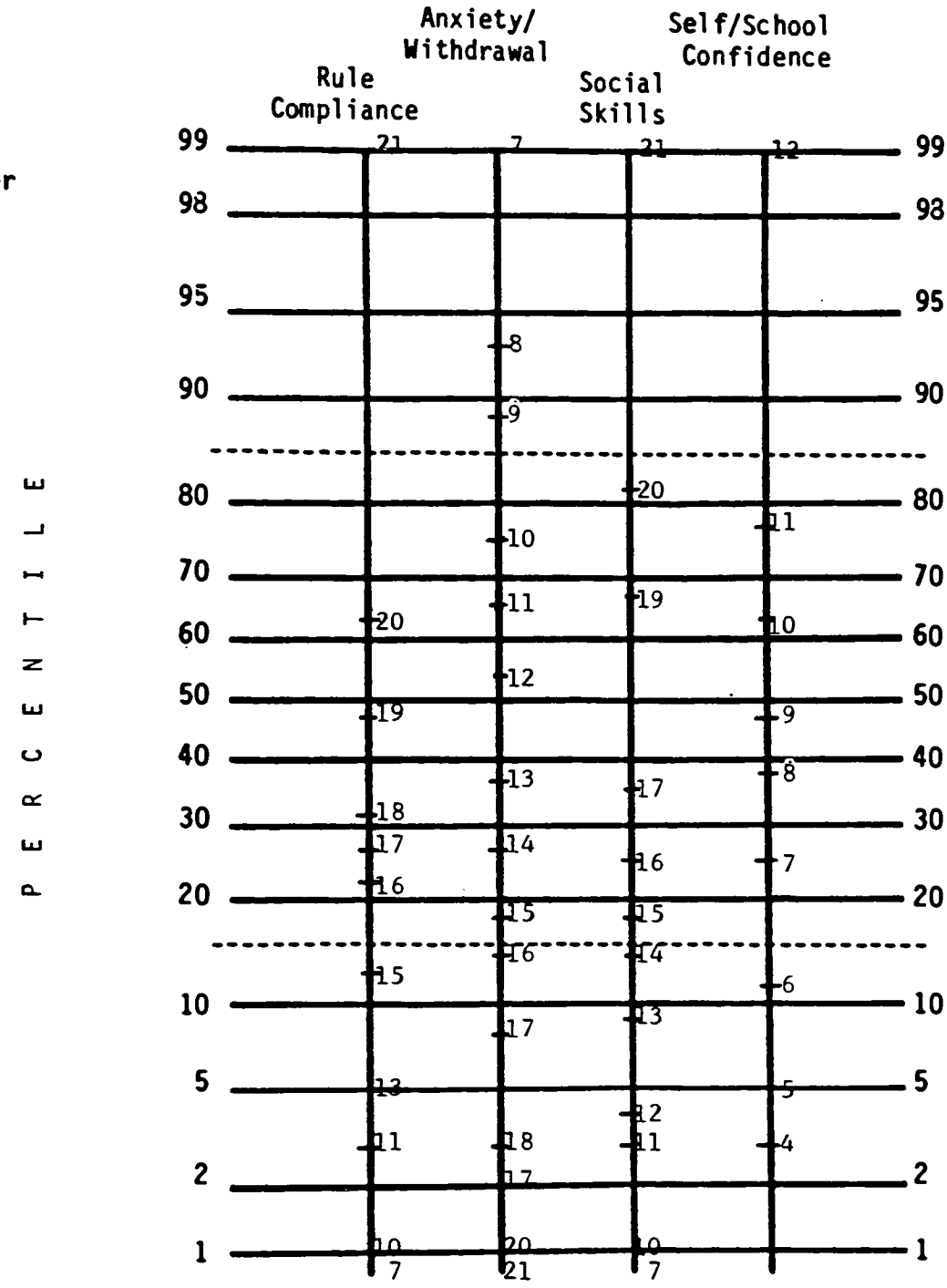
Figure 5-4

BOYS

Child _____

Associate _____

Teacher _____



O - Initial __/__/__ _____ _____ _____ _____

X - Final __/__/__ _____ _____ _____ _____

Rule Compliance

Anxiety Withdrawal

Social Skills

Self/School Confidence

PMHP 8/86

Background Information Form (BIF)

Figure 5-5

Child's Name _____ Sex: M F Birthdate _____
(Last) (First) (circle one)

Student's School ID# _____ School _____ Today's Date _____

Parent/ Guardian _____ Address _____ Phone _____

Teacher _____ Grade _____ Date referred to PMHP _____

Please circle and/or complete each of the following items for this child:

Educational characteristics:

1) Has repeated a grade- - - - - - - - - - - - - - - - No Yes If yes, which grade(s)_____
2) Has transferred schools - - - - - - - - - - - - - - No Yes If yes, how many times_____
3) Has been in PMHP before - - - - - - - - - - - - - No Yes

Is receiving the following school services:

4) Speech/Language - - - - - - - - - - - - - - - - - - No Yes
5) Educable or Trainable Mentally Retarded - - - - - No Part Day Full Day
6) Learning Disabled or Perceptually Handicapped - No Part Day Full Day
7) Emotionally or Behaviorally Handicapped - - - - No Part Day Full Day
8) Remedial Education (i.e., Reading, Math, etc.)- No Yes_____
(specify which)
9) Other_____ - - No Yes

Child characteristics:

1) Poor grooming - - - - - - - - - - - - - - - - - - - No Yes
2) Frequently absent - - - - - - - - - - - - - - - - - No Yes
3) Visits school nurse often - - - - - - - - - - - - - No Yes
4) On-going medical problems - - - - - - - - - - - - No Yes Specify_____
5) Child seems easy to like- - - - - - - - - - - - - No Yes
6) Disciplinary visit(s) to school office- - - - - No Yes If yes, number of times_____
7) Other_____ No Yes

Life Events:

1. Parenting situation: check (✓) the one(s) that apply

_____Both natural or adoptive parents in home
_____Single parent family--divorce or separation
_____Single parent family--other (e.g., death, never married)
_____Natural/adoptive parent with stepparent
_____Foster Placement
_____Other_____

2. Death of a family member- - - - - - - - - - - - - - No Yes Specify who_____
3. Serious illness of a family member- - - - - - - - - No Yes Specify who_____
4. Child lacks adult supervision after school- - - - No Yes
5. Possible family economic difficulties - - - - - - - No Yes
6. Other_____ - No Yes

Comments:

Teacher-Child Rating Scale (T-CRS)

Figure 5-6

Child's Name _____ Date _____ Initial Final (circle one)
(Last) (First)

Student's
School ID# _____ Teacher _____ School _____

I. Please rate this child on the following items by circling the number which corresponds to this scale:	Not a Problem	Mild	Moderate	Serious	Very Serious Problem
1. Disruptive in class	1	2	3	4	5
2. Withdrawn	1	2	3	4	5
3. Underachieving (not working to ability)	1	2	3	4	5
4. Acts silly	1	2	3	4	5
5. Fidgety, difficulty sitting still	1	2	3	4	5
6. Shy, timid	1	2	3	4	5
7. Poor work habits	1	2	3	4	5
8. Easily led, a follower	1	2	3	4	5
9. Disturbs others while they are working	1	2	3	4	5
10. Anxious, worried	1	2	3	4	5
11. Poor concentration, limited attention span	1	2	3	4	5
12. Drowsy, sluggish	1	2	3	4	5
13. Constantly seeks attention	1	2	3	4	5
14. Nervous, frightened, tense	1	2	3	4	5
15. Difficulty following directions	1	2	3	4	5
16. Stares into space	1	2	3	4	5
17. Overly aggressive to peers (fights)	1	2	3	4	5
18. Unhappy, sad	1	2	3	4	5
19. Learning academic subjects	1	2	3	4	5
20. Acts younger than classmates, immature	1	2	3	4	5
21. Poorly motivated to achieve	1	2	3	4	5
22. Lacks coordination (fine or gross motor)	1	2	3	4	5
23. Work is messy, sloppy	1	2	3	4	5
24. Bored, lacks interest in class	1	2	3	4	5

Problem Scale	Act-Out	Shy-Anx	Learn.
Raw Score			

II. Please rate the following items according to how well they describe the child:	Not at All	A Little	Moderately Well	Well	Very Well
1. Accepts things not going his/her way	1	2	3	4	5
2. Defends own views under group pressure	1	2	3	4	5
3. Completes work	1	2	3	4	5
4. Has many friends	1	2	3	4	5
5. Ignores teasing	1	2	3	4	5
6. Comfortable as a leader	1	2	3	4	5
7. Well organized	1	2	3	4	5
8. Is friendly toward peers	1	2	3	4	5
9. Accepts imposed limits	1	2	3	4	5
10. Participates in class discussions	1	2	3	4	5
11. Functions well even with distractions	1	2	3	4	5
12. Makes friends easily	1	2	3	4	5
13. Copes well with failure	1	2	3	4	5
14. Expresses ideas willingly	1	2	3	4	5
15. Works well without adult support	1	2	3	4	5
16. Classmates wish to sit near this child	1	2	3	4	5
17. Tolerates frustration	1	2	3	4	5
18. Questions rules that seem unfair/unclear	1	2	3	4	5
19. A self-starter	1	2	3	4	5
20. Well liked by classmates	1	2	3	4	5

Competence Scale	Frust.	Assert.	Task O.	Peer Soc.
Raw Score				

Figure 5-7

TEACHER-CHILD RATING SCALE (T-CRS) PROFILE

URBAN BOYS

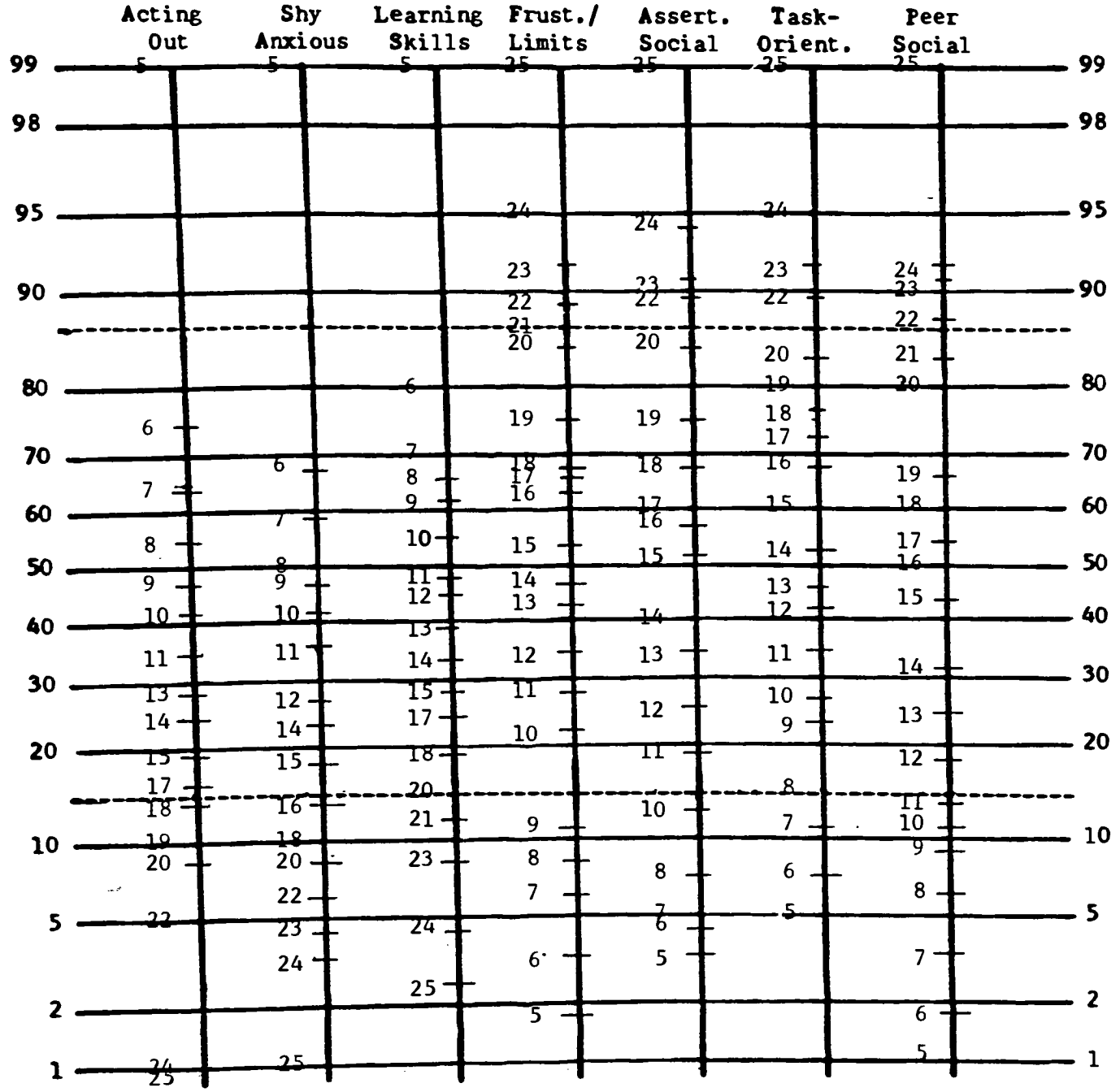
Child _____

Associate _____

Teacher _____

O = Initial Date __/__/__

X = Final Date __/__/__



Initial _____ _____ _____ _____ _____ _____ _____

Final _____ _____ _____ _____ _____ _____ _____

Acting Out | Shy Anxious | Learning Skills | Frust./ Limits | Assert. Social | Task-Orient. | Peer Social

PMHP 8/86
Rochester, NY

Figure 5-8

ASSOCIATE-CHILD RATING SCALE (A-CRS): INITIAL FINAL
(circle one)

Child's Name _____ Teacher _____ Today's Date _____
(Last) (First)

Student's School ID# _____ Contacts to Date: #Indiv._____ # Grp._____ Assoc._____ School _____

I. Based on your direct contacts with this child to date, please rate each of the behaviors according to how well it describes the child now by circling the corresponding number:

Describes child:	Not at All	A Little	Moderately Well	Well	Very Well
1. Looks forward to coming	1	2	3	4	5
2. Aggressive	1	2	3	4	5
3. Is fearful	1	2	3	4	5
4. Completes task	1	2	3	4	5
5. Expresses feelings openly	1	2	3	4	5
6. Tests limits	1	2	3	4	5
7. Anxious, worries about things	1	2	3	4	5
8. Copes well with failure	1	2	3	4	5
9. Participates enthusiastically	1	2	3	4	5
10. Fidgety, difficulty sitting still	1	2	3	4	5
11. Nervous, tense	1	2	3	4	5
12. Competes fairly	1	2	3	4	5
13. Good rapport with me (child worker)	1	2	3	4	5
14. Disruptive during sessions	1	2	3	4	5
15. Sad, unhappy	1	2	3	4	5
16. Tolerates frustration	1	2	3	4	5
17. Maintains eye contact when speaking	1	2	3	4	5
18. Stubborn, obstinate	1	2	3	4	5
19. Feelings are hurt easily	1	2	3	4	5
20. Mood is balanced and stable	1	2	3	4	5

	Part.	Limits	Anxiety	Self-
Scale Raw Scores				

II. Goals: Based on information about this child, two goals should be identified. Use goals and codes listed on the Associate's Goal List. Circle the phrase that best describes the child's status for each goal as compared to his/her behavior at the time of referral.

First Goal: (Code #:) Much Better | Somewhat Better | Same | Somewhat Worse | Much Worse

_____

Second Goal: (Code #:) Much Better | Somewhat Better | Same | Somewhat Worse | Much Worse

_____

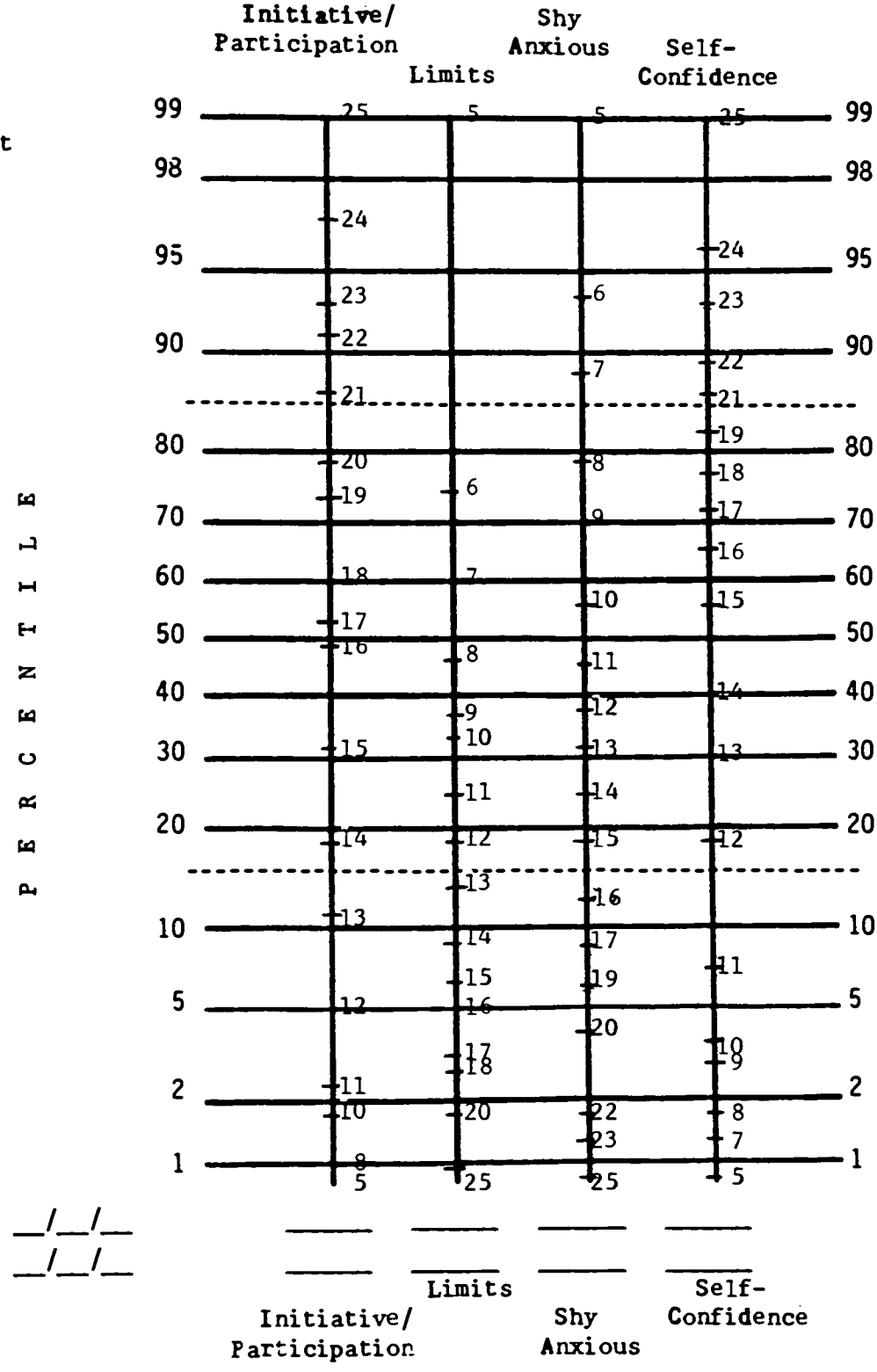
PMHP-Revised 6/86

Figure 5-9

ASSOCIATE-CHILD RATING SCALE (A-CRS) PROFILE

Child _____ Teacher _____

Associate _____



PMHP 8/86

Associate's Name Jane Jones School 47 School Year 86-87

Student's ID # & Name		Sex	Race*	Birth-date	Grade	Date of:			Term. Reason**	Crisis	PSI	# Sess./ Week	# Min./ Sess.	# Contacts re Child				On-Going Record of Contacts			
Last Name	First Name					Assign. Conf.	1st Contact	Final Contact						MH Team	Tchr.	Sr. Assoc	Other	Indiv.	Tot.	Group	Tot.
ID # 7163456																					
Smith.	Sue	F	1	10/14/78	3	10/15	10/17	11/5	4			2	30	1	II	II				++++ ///	8
ID # 6231926																					
Andrews.	Joseph	M	2	3/10/80	1	10/17	10/22					1	45	1	1	1		++++ II			
ID # 5432116																					
Hayes.	Daniel	M	1	11/26/79	2	10/17	10/21	12/8	1	✓		2	30	II	II	II		++++ ++++ II	12		
ID #																					
ID #																					
ID #																					
ID #																					
ID #																					
ID #																					
ID #																					

*1=White
2=Black
3=Native Am. Indian
4=Oriental
5=Hispanic-White
6=Hispanic-Black
7=Hispanic-Other
8=Other (mark with * & explain on back of log)

**1=child has met goals
2=school year is ending
3=child moved (or will be moving)
4=transferred to other agency
5=other (specify the reason on the back of the log)

PMHP 8/86

Figure 5-10

Figure 5-11
Professional Termination Report (PTR)

Child's Name _____ Student's School ID# _____
(Last) (First)

Associate's Name _____ School _____

Supervising Professional's Name _____ Date of PTR Completion ___/___/___

Instructions: This form should be completed at the time of the child's termination by the mental health professional currently supervising the above associate. This information should reflect your own perceptions of this child as well as inputs from the associate and teacher.

Section I: Indicate the child's improvement status as compared to his/her behavior at the time of referral by circling the appropriate number for each item. If a behavior never applied to this child, circle "NA," not applicable.

	Much Worse	Worse	Same	Improved	Greatly Improved	NA
1. Disruptive behavior- - - -	1	2	3	4	5	NA
2. Shy-Anxious behavior - - -	1	2	3	4	5	NA
3. Academic performance - - -	1	2	3	4	5	NA
4. Social skills with peers -	1	2	3	4	5	NA
5. Social skills with adults-	1	2	3	4	5	NA
6. Expression of feelings - -	1	2	3	4	5	NA
7. Overall school behavior- -	1	2	3	4	5	NA

Section II: Circle the most appropriate number for each item below:

1. Child is leaving PMHP at this time because

    1. child has met his/her goals.
    2. school year is ending.
    3. child is moving or has moved.
    4. child has transferred to another helping service (e.g., special ed. program in another school, BOCES, outside MH agency)
    5. other (please specify)_____

2. Recommendation for this child:

    1. Terminate from PMHP.
    2. Continue in PMHP next fall.
    3. Evaluate child's progress in the fall as a basis for decision about PMHP continuation.
    4. Continue in PMHP in next school, if available.
    5. Other (please specify)_____

Comments: _____

_____

PMHP - Revised 8/86

Figure 5-12

Associate's Goal List (AGL)

On Section II of the Associate-Child Rating Scale (A-CRS) associates are asked to specify two major intervention goals for a child, based on information from the Teacher-Child Rating Scale (T-CRS), assignment conference, and first four contacts. Listed below are goals most frequently mentioned by teachers and the PMHP Team. In some cases, specific examples are provided to clarify which types of behavior might be reflected by a general goal area. Some goals describe maladaptive problem behaviors to reduce; others describe skills and competencies (which a child may lack at the time of referral) to foster. Although the list provides a wide variety of commonly mentioned goals, it is not all-inclusive. If other specific goals are more applicable than the ones listed, associates should identify and record them, as 16, specifying the problem behavior to reduce or as 38, specifying the behavior to foster.

Code	Disruptive behaviors to reduce:
01	quarreling with peers (e.g., fighting, arguing)
02	defiant, obstinate behaviors (e.g., talking back to teacher)
03	verbal outbursts and impulsive behaviors
04	lying, cheating or stealing
05	overactive, out of seat behaviors (e.g., pestering others during work periods)
06	destructive behaviors (e.g., breaks or destroys class materials or others' belongings)
	Anxious, moody, immature behaviors to reduce:
07	nervous mannerisms - specify on A-CRS
08	fear of adults
09	overdependence on teacher to solve his/her problems
10	fear of coming to school
11	physical complaints - specify on A-CRS
12	daydreaming
13	crying, sulking, or pouting
14	fear of trying new things
15	withdrawn behavior (e.g., being a "loner", not participating in classroom activities)
	Other problem behaviors to reduce:
16	other specify on A-CRS

(Over)

8/86

Code	Social skills to foster:
17	cooperating with peers (e.g., sharing, helping)
18	making friends (e.g., playing with peers during free time)
19	effective handling of peer problems
20	speaking out in group situations
21	sensitivity to others' feelings
22	coping appropriately with failure or criticism
23	competing fairly and with good sportsmanship
24	following classroom rules and standards
	Self-related behaviors to foster:
25	personal grooming habits
26	positive self-image (e.g., expressing pride in accomplishments, feeling self-confident)
27	expressing feelings appropriately
28	accepting responsibility for own behavior (e.g., not blaming others)
29	making decisions independently
30	sense of stability and security
	Educational performance areas to improve:
31	attendance and punctuality
32	attention to directions on class assignments and activities
33	fine or gross motor coordination skills
34	completing classwork carefully and neatly
	Crisis/family related difficulties to address:
35	working through feelings about family crisis specify on A-CRS
36	exploring feelings about birth of a sibling
37	preparing for impending hospitalization
	Other behaviors to foster:
38	other specify on A-CRS