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NORM-REFERENCED CONSTRUCT VALIDATION OF THE ADAPTIVE BEHAVIOR SCALE FOR INFANTS AND EARLY CHILDHOOD (ABSI) USING COVARIANCE STRUCTURE MODELING (LISREL)

The Ohio State University

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ADAPTIVE BEHAVIOR SCALE FOR INFANTS AND EARLY CHILDHOOD
(ABSI) USING COVARIANCE STRUCTURE MODELING (LISREL)

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

by

David Weaver, B.A., M.A.

The Ohio State University

1985

Dissertation Committee:

H. Leland
R.C. MacCallum
D. Hammer

Approved by

Advisor

Department of Psychology
To Our Beloved
Eric Ebner Weaver
ACKNOWLEDGMENTS

I owe everything to Mary Anne whose love sustains me. I cannot adequately thank Leon H. and Helen W. Weaver for their support; Henry Leland and Robert C. MacCallum for their advice and teachings; David Hammer for his interest when most needed; Dale Svendsen for seeing me through all of it; Frank Mott for his tolerant patience; Joyce Davenport for typing and formatting; Cil Kinast, Doug McElwain, and Ann Wengler for listening to my questions; the staff of the Franklin County Board for Mental Retardation and Developmental Disabilities for kindly allowing and pleasantly helping me to collect these data; and the hundreds of disabled children whose behavior is analyzed in this dissertation and who will never, God willing, be unable.
VITA

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Open Door Clinic

1984-Present . . . . . . . Graduate Research Assistant  
The Center for Human Resource Research
## VII. Do you have problems with \textbf{UNTRUSTWORTHY BEHAVIOR} such as:

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<tr>
<td>31. Rough houses on furniture</td>
<td>yes</td>
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<td>32. Plays with forbidden objects such as TV set, stove, matches, etc.</td>
<td>yes</td>
<td>no</td>
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<td>33. Leaves yard without permission</td>
<td>yes</td>
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<td>34. Leaves group when on school outing</td>
<td>yes</td>
<td>no</td>
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<td>35. Not dependable in returning to the classroom or other assigned places</td>
<td>yes</td>
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<td>36. Tongue sticks out abnormally</td>
<td>yes</td>
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<td>37. Sucks or clicks tongue</td>
<td>yes</td>
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<td>38. Grinds teeth audibly</td>
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<td>39. Shakes and/or rocks head back and forth</td>
<td>yes</td>
<td>no</td>
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<td>40. Rocks body back and forth</td>
<td>yes</td>
<td>no</td>
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<tr>
<td>41. Chews or sucks on hands</td>
<td>yes</td>
<td>no</td>
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<td>42. Shakes or flaps hands</td>
<td>yes</td>
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<td>43. Moves legs up and down continuously while lying on back</td>
<td>yes</td>
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## IX. Do you have problems with \textbf{INAPPROPRIATE PERSONAL HABITS - MANNERS} such as:

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<tr>
<td>45. Plays in trash cans or ash-trays</td>
<td>yes</td>
<td>no</td>
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<tr>
<td>46. Chews excessively on clothing or shoes</td>
<td>yes</td>
<td>no</td>
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Chapter I
INTRODUCTION

Approximately two to three percent of the population of the United States is mentally retarded (MR). The diagnosis of mental retardation requires measured intelligence to be at least two standard deviations below the mean of an individually administered intelligence test (usually an IQ below 70), deficits in adaptive behavior, and that these deficiencies be manifested before the eighteenth birthday. Adaptive behavior is the effectiveness with which a person meets the standards of personal independence and social responsibility expected for his or her age and culture (Grossman, 1977).

The earlier problems are detected and the earlier aggressive treatment is begun, the more likely it is that persons will develop to their maximum potential. Both in terms of ethics and in terms of economics, it is best to identify and meet the special requirements of mentally retarded or developmentally disabled people as early as possible to optimize their quality of life and basic freedom and to minimize their cost to society. Identification and early intervention requires a measure specifying existing strengths and weaknesses, subsequent behavioral goals, and individual treatment plans for infants and children younger than six. The Adaptive Behavior Scale for Infants and Early Childhood (ABSI), (Leland, Shoae, McElwain, & Christie, 1980), (Appendix A), identifies detailed deficiencies in adaptive behavior and specific areas for intervention, as early as birth.
The ABSI is a downward extension of the **AAMD Adaptive Behavior Scale** (ABS), one of the most widely used scales for measurement of the adaptive behavior of people aged six and older (Smith & Polloway, 1979; Steltzer, 1983, p. 148). The ABSI is a criterion-referenced scale. A given child's behavior is compared to explicit behavioral competencies, rather than to the behavior of other children. There are two parts to the ABSI. Part I measures personal independence. Part II measures personal and social maladaptation. Only Part I will be discussed in this dissertation.

The validation of any test is an ongoing process which determines the meaning of the test's scores in different ways. **Construct validity** is needed when the test is used in research and theory. Construct validity is the degree to which the scores may be interpreted as measures of the psychological construct, in this case adaptive behavior, the test claims to measure (Messick, 1981). Construct validity specifies the constructs (hypothetical variables), their relationships to each other, and the relationships between the constructs and the observed variables (test items) which indicate the constructs (Bentler, 1978).

Covariance structure modeling (CSM), also known as LISREL (Joreskog and Sorbom, 1984), takes a hypothesis testing approach to construct validation. A CSM model may be composed of latent (hypothetical) variables, observed variables (items), relationships among the latent variables, and relationships between the latent and observed variables. Thus, a CSM model specifies the components necessary to determine the construct validity of a test (Bentler, 1978). CSM tests the plausibility of models by examining how well the model fits or represents the observed data. Alternative models of the
ABSI constructs and items may be specified and tested to determine which one of the rival models best represents the observed data. CSM allows the rigorous definition and testing of the constructs and variables of adaptive behavior in infancy and early childhood.

**Statement of the Problem**

The task is to obtain an ABSI model which sufficiently represents and fits the data as to be a plausible model of the ABSI. Alternative models of the ABSI's constructs and items are hypothesized and tested using CSM. A model surviving the stringent statistical test posed by CSM will contribute to the construct validity of the ABSI.

**Hypotheses**

The general hypothesis tested in this research is that a model will be found which fits and represents the ABSI data. Using covariance structure modeling, a plausible model of the constructs and scores of the ABSI which meets rigorous statistical requirements will be identified.

The Three Factor ABSI Model and the Physical Development As a General Influence (PDasG) ABSI Model are two alternative models hypothesized a priori to fit the ABSI data. These are two alternative models of the construct validity of the ABSI as a measure of the adaptive behavior of handicapped children younger than six. Both the Three Factor Model and the PDasG Models contain a group of specific hypotheses about the ABSI.

The Three Factor Model specifies that there are three correlated factors (hypothetical constructs) of the ABSI: Functional Independence, Cognition, and
Motivation. The observed variables which indicate the factor of Functional Independence consist of the three physical development and five independent functioning subdomains. The observed variables which indicate the factor of Cognition consist of the three communication subdomains and the conceptual skills domain. The observed variables which indicate the factor of Motivation consist of the play, self-direction, and responsibility-socialization domains. Other than the common influence of the factor on the observed variables, these variables are not related to each other.

The PDasG Model specifies the following set of specific hypotheses about the ABSI. There are four factors of the ABSI: Physical Development, Independent Functioning, Cognition, and Motivation. Physical Development exerts a general influence on the other three factors. Other than the common influence of Physical Development on the three factors, these factors are not related to each other. The Physical Development (PD) factor is indicated by the three PD subdomains. The Independent Functioning (IF) factor is indicated by the five IF subdomains. The Cognition and Motivation factors are indicated by the same domains as in the Three Factor Model.
Chapter II

LITERATURE REVIEW

Adaptive Behavior and Mental Retardation

Adaptive behavior has a long, but unrecognized history in psychology. As of 1978, standard textbooks on psychological assessment failed to mention adaptive behavior or its measurement (Coulter & Morrow, 1978). This is surprising since adaptive behavior was first studied in 1819, long before Wundt's 1879 laboratory. Adaptive behavior was studied by Itard and Haslen in 1819, Seguin in 1837, Voisin in 1843, Howe in 1858, Fernald in 1893, Binet in 1905, Goddard in 1912, and Doll in 1942 (Coulter and Morrow, 1978, p. 11-12; Lambert, Windmiller, Cole, & Figueroa, 1974; Leland, 1982). Yet measured intelligence was the sole criterion of mental retardation.

In the early 1960s some psychologists advocated another dimension—adaptive behavior. "Adaptive behavior, originally conceived as an adjunct to assessment of intelligence (Heber, 1961) was considered by some to be an alternative to traditional IQ testing" (Coulter & Morrow, 1978, p.12). The concept of adaptive behavior was required in order to counter-balance the excessive reliance on measured intelligence as the sole source of information for placement and treatment. "The central issue in the debate to include a measure of adaptive behavior for the identification of mental retardation was that the IQ test did not furnish enough descriptive information of relevance for training mentally retarded persons for normalization" (Coulter & Morrow, 1978, p.12).
The 1970s saw a vast increase in the assessment of preschool children. Compensatory early childhood education programs such as Headstart required effective program evaluation and preschool assessment (Kelley & Surbeck, 1983). "PL 94–142 (Federal Register, 1977)...provides for the education of all handicapped persons and for the downward extension of educational programs through the preschool years" (Leland, 1982, pg. 191). This public law requires "...a nonbiased assessment process to ensure equal treatment to all children within the public schools" (Coulter & Morrow, 1978, p.4). It mandated appropriate public education for handicapped children in the least restrictive environment, and required a written individual education plan for each child (Kelley & Surbeck, 1983).

Criticism of biased intelligence testing resulting in disproportionate numbers of minority children in special education classes led, in the early 1970s, to a series of lawsuits. The court found that standard intelligence tests are racially and culturally biased (Prasse, 1983). Now a measure of adaptive behavior is required when assessing minority children for educational placement so that intelligence tests are not the exclusive basis for decision-making (Larry P. v Riles, 1979).

Adaptive Behavior

The diagnosis of mental retardation is appropriate only if the person is deficient in both adaptive behavior and measured intelligence (Grossman, 1977). Adaptive behavior is the reversible aspect of mental retardation (Grossman, 1977; Leland, 1977, 1978, 1983a, 1983b; Leland, Schellhaas, Nihira, & Foster, 1967). Doll's work in the 1940s on social maturity and adjustment to the environment led to Heber's AAMD definition of adaptive behavior.
The first official definition of adaptive behavior was, "The effectiveness with which the individual copes with the natural and social demands of his environment...(1) the degree to which the individual is able to function and maintain himself independently, and (2) the degree to which he meets, satisfactorily, the culturally imposed demands of personal and social responsibility" (Heber, 1961, p. 61). Heber stressed that adaptive behavior is a function of a wide range of abilities which vary in primacy across the life span. Thus, "adaptive behavior scales are measuring different aspects of behavior at different ages" (Coulter & Morrow, 1978, p. 9).

Heber's work influenced Leland, Nihira, Foster, Shellhaas, and Kagan (1968) who defined adaptive behavior as

...the ability to adapt to environmental demand (Heber, 1961)...(1) Independent Functioning, ...the ability of the individual to successfully accomplish those tasks...in terms of...the typical expectations for specific ages, (2) Personal Responsibility...the willingness to accomplish those critical tasks...and...to assume...responsibility for his...behavior, (3) Social Responsibility...the ability of the individual to accept responsibility...and to carry out appropriate behaviors in terms of these group expectations (p. 5).

Coulter and Morrow (1978, p. 3) defined adaptive behavior as, "the manner in which persons perform the tasks expected of their particular age group." The current AAMD definition of adaptive behavior is "the effectiveness or degree with which an individual meets the standards of personal independence and social responsibility expected for his age and cultural group" (Grossman, 1977, p. 1).
Mental Retardation

The early definitions of mental retardation emphasized organic causes and intellectual disabilities as evidenced by performance on standardized intelligence tests (Kelley & Surbeck, 1983). Mental retardation was viewed as an irreversible disorder which was not amenable to treatment or training (Grossman, 1983; Kelley & Surbeck, 1983). IQ was the sole criterion for the diagnosis and placement of the mentally retarded (Leland, 1978).

The modern definition of mental retardation emphasizes functional ongoing behaviors. The person's adaptation to society and self-care abilities are at least as important as the person's measured intelligence. Retarded behaviors are modifiable. Training for life in the least restrictive environment is the goal.

Equal emphasis is now placed on measured intelligence and adaptive behavior. The first official definition of mental retardation that included adaptive behavior was Heber (1959). The revised definition (Heber, 1961, p. 3) defined mental retardation as, "...subaverage general intellectual functioning which originates during the developmental period and is associated with impairment in adaptive behavior." The present definition of mental retardation is, "significant sub-average general intellectual functioning existing concurrently with deficits in adaptive behavior and manifested during the developmental period" (Grossman, 1977, p. 1). Significant intellectual deficiency is an IQ score from an individually administered intelligence test more than two standard deviations below the mean. The developmental period is from birth to the 18th birthday. PL94-142 has extended it to age 22.
Early Identification and Intervention—The Need for the ABSI

Failure to intervene early results in problems throughout the disabled child's life span (Guralnick, 1986). Early intervention significantly improves the lives of both normal (Darlington, Royce, Snipper, Murray, & Lazar, 1980; Lazar & Darlington, 1982; Schweinhart & Weikart, 1980) and handicapped (Frotheringham, 1983; Guralnick, 1986; Garber & Heber, 1977; Hartlage & Telzrow, 1983; Ramey & Bryant, 1983) children. For normal preschoolers living in deprived environments, early intervention increases the percentage of children having higher school achievement, higher cognitive ability, higher self-concept, graduating from high school, avoiding drug use, avoiding criminal activity, obtaining employment, and delaying pregnancy (Schweinhart & Weikart, 1980).

For handicapped preschoolers, "a handicap does not have to become a disability" (Leland, 1983, p. 201). Early intervention, "can...help prevent further deleterious impact of the handicap on the child's development" (Hartlage & Telzrow, 1983). Frotheringham (1983) contends that "early intervention can foster the development of new skills if directed at moving specific existing skills to their next level of difficulty in the hierarchy (p. 211) ... There is considerable evidence that training programs focused on specific areas of behavior result in significant gains in such behavioral skills" (p. 218). "[I]ntervention at age 2 versus age 3 permits substantially greater possibilities for normalization, probably due to the neurological sensitivity of this period" (orton, 1979).

"The clamor for more adequate diagnosis and screening instruments is getting louder. Heber and Garber (1975) stressed the importance of early

The Adaptive Behavior Scale for Infants and Young Children (Leland, 1981; Leland et al., 1980) identifies disabilities of young children as early as two weeks and specifies criterion-referenced behaviors as intervention goals (Leland, 1983; Pagent & Bracken, 1983). The ABSI grew out of the need for a preschool adaptive behavior measure. Other scales did not meet the disabled preschooler's urgent need for early identification and programming. The ABS (Nihira, Foster, Shellhaas, and Leland, 1975) and the ABS - Public School Version (Lambert et al., 1974) both start at six years of age. The Vineland (Sparow, Balla, and Cicchetti, 1984) assesses adaptive behavior from birth to adulthood, but it excludes handicapped preschoolers from its normative sample, and it addresses only a limited set of adaptive behavior domains. The ABIC in Mercer's System of Multiculture Pluralistic Assessment (SOMPA) begins at five years of age (Mercer & Lewis, 1977) as does the Balthazar Scales of Adaptive Behavior (Balthazar, 1973). The Denver Developmental Screening Test (Frankenburg, Dodds, Fandal, Kazuk, and Cohrs, 1975) and the Early Intervention Developmental Profile (Rogers, DiEugenio, Brown, Conovan and
Lynch, 1977) were developed for preschoolers, but the handicapped population is excluded from their normative samples.

Description of the ABSI

The absence of an effective instrument which assesses the developmental and adaptive processes on which estimates of handicap can be based makes it difficult to establish appropriate programs for handicapped infants and preschool children. The specific areas of delay, the behaviors which have developed appropriately and those which have not, and the kind of coping successes the child has achieved are indicated by the ABSI. The presence of an adaptive handicap establishes that the child is growing and developing in an atypical and idiosyncratic pattern. To know the developmental pattern of a given child requires a criterion-based measure which records current ongoing behavior, gives that behavior's antecedents, and indicates the possible succeeding behavior around which training programs may be designed (Leland, 1981).

There are two parts to the ABSI (Leland, 1981; Leland et al., 1980). Only Part One will be studied in this dissertation. Part Two was not found to be an effective general measure of maladaptive behavior in early childhood and infancy. For a behavior to be socially maladaptive, the child's family or agency must see the behavior as a major problem. Behavior that is seen as maladaptive in later childhood and adulthood, is not viewed as maladaptive in infancy and early childhood (Leland, 1981).

Part One is organized along developmental lines and adaptive tasks to evaluate a child's skills and habits in seven behavior domains. A domain and its subdomains are coherent groups of related activities which are both necessary
and desirable for the child’s growth and development. The ABSI domains are: Independent Functioning with five subdomains, Physical Development with three subdomains, Communication Skills with two subdomains, Conceptual Skills, Play, Self-Direction, and Personal Responsibility and Socialization. Behaviors included in a domain's item are arranged in order of difficulty. The items were selected by subject matter experts based on a comprehensive review of the major behavior rating scales for infants and young children. The items were selected to be representative of the universe of adaptive behaviors. The person (parent, teacher, daycare attendant, or others) who has the greatest contact with the child and the most complete information about the child is either interviewed, or they answer the ABSI items themselves (Leland, 1981).

The ABSI is a downward extension of the ABS replicating the ABS domains to the extent that they are age appropriate. The ABS and ABSI overlap each other for years five and six, sharing a number of items in common. The ABSI is a behavior rating scale for delayed, emotionally maladjusted, and/or developmentally disabled infants and young children aged younger than six years. It provides objective descriptions of a child's adaptive behavior (Leland, 1981). It is a criterion-based measurement instrument because each item's "score is directly interpreted in terms of performance" (APA, 1974, p. 19). A criterion-referenced evaluation has a referent that is external to the child (APA, 1974) in the form of a skill mastery level or behavioral criterion (Coulter & Morrow, 1978; Cronbach, 1970; Livingston, 1978; Messick, 1983) which is the Instructional goal (Carver, 1974; Leland, 1983).
The ABSI was developed as a criterion-referenced scale because handicapped children develop skills and coping strategies in an atypical fashion. Each domain is a separate scale scored by comparing the child's behavior to the criterion behaviors in that domain. Areas of ability and disability portrayed as "hills and valleys" (Leland, 1981) in a profile of domain scores are used to develop individual habilitation plans. Norm-referenced information is also available by using the ABSI's tables of percentile ranks to compare a given child's profile to the sample of similarly aged disabled children. The profile facilitates proper placement and curricula planning (Leland, 1981).

The ABSI may be used to develop an individual education plan (IEP), for program evaluation, and, with other information, for diagnosis and placement (Leland, 1981). The ABSI's domains and subdomains identify long and short range goals for IEPs that are required by Public Law 94–142. The items specify the next behavior toward which instruction is directed (Leland, 1983). Training priorities are established in the areas where the child has already demonstrated success because success motivates the child for the next succeeding behavior. As one source of information for diagnosis and classification, the ABSI takes into consideration age expectations and observed developmental delays. The diagnosis is a set of behaviors rather than a classification label. The child's current functioning is compared to other children of the same age who have various levels of deficit, the deficits are related to the child's history, and the areas of potential change are determined from the strengths and weaknesses of the profile summary (Leland, 1981).
Relationship of the ABSI to the ABS

The domains of both the ABS and ABSI are replicated to the extent that they are age appropriate and they have high interrater reliability, test-retest reliability, and internal consistency (Table 1). It is "necessary to group some domains together in order to understand...the child's performance" (Leland, 1983, p. 201). The structure of the ABS and ABSI is similar. The four groups of domains in the ABS and ABSI are Physical Development, Independent Functioning, Cognition, and Personal-Social Motivation. The ABSI revision of the ABS is needed because the coping problems of infants and young children are very different from those of older children and adults (Leland, 1981).

The ABSI and ABS are interpreted differently because there are different behavioral criteria in each domain and they assess different developmental levels because the development of the neurological system differs with age. Vygotskii and Luria (Luria, 1966) contend that the organization of neurological functioning in the CNS changes with development. In childhood, the physical and sensory processes are the foundation for higher mental processes. With maturity, the higher mental processes regulate the physical and sensory processes. Thus, Vygotskii and Luria concur with Coulter and Morrow's (1978) statement that "it is important to emphasize that adaptive behavior scales are measuring different aspects of behavior at different ages" (p. 9).

The Structure of the ABS and ABSI Domains

Certain Part One ABSI domains seem to relate to each other. They require the same types of developmental skills or the same types of responses to social demands. These associated domains and subdomains form the basis for
## Table 1 ABS and ABSI Domain Continuity and Reliability

<table>
<thead>
<tr>
<th>Domain</th>
<th>ABS 66 Items In 10 Domains</th>
<th></th>
<th></th>
<th></th>
<th>ABSI 62 Items In 7 Domains</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>Number of Items</td>
<td>Inter-rater</td>
<td>Domain</td>
<td>Number of Items</td>
<td>Inter-rater</td>
<td>Coefficient</td>
<td>Test-Retest</td>
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<td>Independent Functioning IF</td>
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<td>.92</td>
<td>IF</td>
<td>16</td>
<td>.99</td>
<td>.96</td>
<td>.88</td>
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<td>Physical Development PD</td>
<td>6</td>
<td>.93</td>
<td>PD</td>
<td>13</td>
<td>.99</td>
<td>.96</td>
<td>.94</td>
</tr>
<tr>
<td>Self-Direction SD</td>
<td>5</td>
<td>.71</td>
<td>SD</td>
<td>2</td>
<td>.98</td>
<td>.79</td>
<td>.94</td>
</tr>
<tr>
<td>Language Development LD</td>
<td>9</td>
<td>.87</td>
<td>Communication Skills</td>
<td>12</td>
<td>.99</td>
<td>.97</td>
<td>.82</td>
</tr>
<tr>
<td>Responsibility R</td>
<td>2</td>
<td>.83</td>
<td>R &amp; S</td>
<td>4</td>
<td>.99</td>
<td>.93</td>
<td>.88</td>
</tr>
<tr>
<td>Socialization S</td>
<td>7</td>
<td>.77</td>
<td></td>
<td>8</td>
<td>.99</td>
<td>.95</td>
<td>.81</td>
</tr>
<tr>
<td>Number and Time NT</td>
<td>3</td>
<td>.86</td>
<td>Conceptual Skills</td>
<td>8</td>
<td>.99</td>
<td>.95</td>
<td>.81</td>
</tr>
<tr>
<td>Vocational Activity VA</td>
<td>3</td>
<td>.76</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Domestic Activity DA</td>
<td>6</td>
<td>.91</td>
<td>Play</td>
<td>7</td>
<td>.98</td>
<td>.93</td>
<td>.87</td>
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<tr>
<td>Economic Activity EA</td>
<td>4</td>
<td>.85</td>
<td></td>
<td></td>
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</tr>
</tbody>
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*Leland et al. (1975)*

*Leland et al. (1981)*
comparison of the ABS and ABSI (Leland et al., 1975; Leland, 1981). Because the ABSI is a downward extension of the ABS with the same domains and overlapping items, the structure of the domains of the ABSI is based on that of the ABS. It is hypothesized that the relationships among the ABSI domains are similar to those of the ABS. Based on the ABS guidelines to interpretation (Leland, Shoae, & Vayda, 1975), the ABSI domains will be organized into a structural model by substituting the respective ABSI domains for the ABS domains as specified in Table 1.

On the ABS Physical Development stands alone and has no specific relation to any of the other domains. A sensory or motor deficit can affect performance in all other domains. It must be determined whether the physical deficit accounts for deficits in other domains (particularly Independent Functioning) or whether those deficits are due to a motivational or emotional cause. "A warning...[is] that an automatic relationship should not be drawn between the sensory or motor deficits of Domain 2 (PD) and other skill or adaptive failures, ...Since these deficits may only interfere with coping performance because of an emotional or habituated pattern rather than because the physical disability is really great enough to cause the deficit performance" (Leland et al., 1975, p. 51).

An individual's age and status on Physical Development will determine which of two models best represent the data. Physical Development relates to the other domains when, for the ABS, the adult has major deficits in physical development (Leland et al., 1975). Physical Development is central to the ABSI because the child is very young and so is developing rapidly (H. Leland, personal communication, October 1985). For physically intact and mature individuals,
the ABS domain of Physical Development is unrelated to deficits in the other
domains (Leland et al., 1975).

The second grouping of ABS domains, Personal Independence, is composed
of Independent Functioning and Domestic Activity. In the ABSI it is composed
of Independent Functioning. These are the core of the adaptive behavior
construct, "...the effectiveness...with which individuals meet the standards of
personal independence and social responsibility" (Grossman, 1977, p. 1).

The third group of ABS domains is composed of Economic Activity,
Language Development, and Number and Time Concept. In the ABSI the
cognitive area is composed of Communication Skills and Conceptual Skills
(Leland et al., 1975).

The fourth and last group of ABS domains is personal and social
motivation and responsibility. It is composed of Vocational Activity, Self-
Direction, Responsibility, and Socialization. In the ABSI it is called Personal-
Social Motivation and is composed of Self-Direction, Play, and Responsibility
and Socialization. Vocational Activity and Self-Direction reflect how much
personal motivation the person has (Play and Self-Direction in the ABSI).
Responsibility and Socialization reflect how much responsibility the person is
willing to take for the consequences of his or her own behaviors. These are the
coping strategies permitting an individual to interact "invisibly", or "normally",
with other people (Leland et al., 1975).

**Norm-Referenced and Criterion-Referenced Testing**

The "intended use of the information" (Leland, 1983, p.195) distinguishes
norm-referenced from criterion-referenced assessment (Carver, 1974; Messick,
180). Any test may be used in either manner (Carver, 1974; Coulter & Morrow, 1978; Cronbach, 1970; Leland, 1983; Messick, 1983). The ABS (Coulter & Morrow, 1978; Leland et al., 1975; Nihira et al., 1975) and the ABSI (Leland, 1981, 1983b) may be used in both a norm-referenced and criterion-referenced manner. Norm-referenced assessment compares a person's score to the scores of other people. Criterion-referenced assessment compares a person's score to an absolute standard of performance (Carver, 1974; Coulter & Morrow, 1978; Cronbach, 1970; Drew, 1972; Leland, 1983; Livingston, 1973; Messick, 1983).

A norm-referenced score determines a person's standing relative to other people, while a criterion-referenced score determines a person's standing relative to the performance standard (APA, 1974; Carver, 1974; Coulter & Morrow, 1978; Cronbach, 1970; Messick, 1983). Norm-referenced assessment is used to identify and place individuals into programs, while criterion-referenced assessment is used to determine the person's strengths and weaknesses, construct individual habilitation and/or education plans, and assess the amount of change during intervention (Carver, 1974; Coulter & Morrow, 1978; Leland, 1983).

**Implications for Data Analysis.** The distinction between the norm-referenced and the criterion-referenced approaches to testing has major implications for how to analyze the ABSI data. In norm-referenced testing, variances, covariances, correlations, and so on are all calculated based on deviations of scores from the mean item score. In criterion-referenced testing, all descriptive statistics and classical test theory indices are calculated based on deviations of scores from the item's criterion—the maximum number correct—which is the behavioral standard defined in each item. Livingston
(1972) derived the statistics by applying classical test theory to criterion-referenced assessment.

Rationale for Employing Norm-Referenced Analyses. The ABSI will be analyzed in a norm-referenced manner. Covariances will be calculated based on deviations from the items' means. The covariance structure models of these covariances will be norm-referenced models representing the relations among the ABSI variables as the relations are expressed in comparisons among people. The fit of the covariance structure models to the norm-referenced data will indicate the degree to which the model captures the information in the data and accurately represents a plausible theory of the between people relations among the ABSI constructs and measured variables.

The norm-referenced approach is the recognized standard practice in psychometrics (Carver, 1974). The ABSI should be investigated in the norm-referenced way because the vast majority of psychologists are familiar with norm-referenced testing.

All of the test development work on the ABS (Nihira et al., 1975) and on the ABSI (Leland, 1981), as well as the many factor analyses of the ABS (e.g., Nihira, 1978) used the norm-referenced approach to data analysis. Despite the pursuasive arguments of Carver (1974) and Leland (1983b), who emphasize the need to use the criterion-referenced approach, no criterion-referenced reliability or validity study of the ABS or ABSI has been found.

Information is needed on the ABSI when used in a norm-referenced manner. The ABSI was developed to achieve the criterion-referenced objectives of identifying the strengths and weaknesses of an individual child and being sensitive to the affect of intervention on the behaviors measured by its
items. Two of the three uses for which the ABSI was developed (Leland, 1981) are normative. First, it may be used to identify and place handicapped children into appropriate programs, a norm-referenced procedure (Coulter & Morrow, 1978; Drew, 1972; Leland, 1983). Secondly, the ABSI serves as a norm-referenced test when used as a formative program evaluation tool to compare groups of children.

Construct Validation of the ABSI

**LISREL.** LISREL (Bentler, 1983; Joreskog & Sorbom, 1979, 1984; Long, 1984) is a statistical technique combining factor and path analysis for analyzing data. LISREL stands for linear structural relations because the hypothetical constructs (factors) in the structural model underlying the covariances are assumed to be linearly related (as in factor and path analysis) to the observed variables and to each other. LISREL is also called covariance structure modeling because the covariances among the observed variables are assumed to have an underlying structure which can be modeled by a few latent constructs.

LISREL's measurement model specifies a few hypothetical constructs (factors) underlying a large number of observed variables that are measured with error, just like factor analysis. Just like path analysis specifies the relations among a set of observed variables, LISREL specifies relations among a set of latent variables or factors.

LISREL is used to test hypotheses about hypothetical constructs and their relationships to each other (Bentler, 1978, 1983; Joreskog & Sorbom, 1979, 1984; Long, 1983). Hypotheses about which observed variables indicate which latent constructs and about the putative relations among the constructs form a
model which is tested against the data. LISREL's capability to test networks of hypotheses allows it to be used in a confirmatory, inferential manner to statistically test theories (Bentler, 1978). Thus, LISREL is a rigorous method which subjects theories to the possibility of falsification as recommended by Popper (1958).

Models. The term "model" is used in three related ways in this dissertation. The first use of a model is in theorizing. A "model" is synonymous with theory. It is an organized collection of hypotheses, which structures current knowledge, proposes new knowledge, and does so in a testable manner (Bentler, 1978; Bromley, 1970; Popper, 1959; Reese & Overton, 1970; Torgerson, 1958) that is subject to falsification (Popper, 1958). Alternative models of adaptive behavior will be proposed and tested.

The second use of a model is in construct validation (Bentler, 1978). In this dissertation, a model will specify the constructs of the ABSI and each construct's items. A construct like a factor has items that load on it. The construct validation model specifies the number of constructs; their names; the items that indicate each construct; the relationships among the constructs for both converging, related constructs, and for discriminative, unrelated constructs; as well as the errors in measuring the items.

The final use of a model is in covariance structure modeling (Joreskog & Sorbom, 1984). The model specifies the parameters which reproduce the observed data's covariance structure as well as possible. These parameters are the variance of each construct, the loadings of items on constructs, the influences of one construct on another, and the errors in the items.
Model testing. Structural equation modeling subjects theoretical models to falsification (Bentler, 1978, 1980). Just as a hypothesis must be stated in a falsifiable manner so that it is testable because it is subject to rejection, so too must a model or organized collection of hypotheses be structured in a falsifiable manner so that the model is testable being subject to rejection (Bentler, 1978; Popper, 1958). A hypothesis can not be proven true, but can be rejected (Binder, 1970). So too in model testing, a theory can never be proven true; but it can be rejected (Torgerson, 1958). In covariance structure modeling the model must be specified so that it is testable. Some models can not be estimated or tested because they are improperly specified, (Bentler, 1980; Joreskog & Sorbom, 1984; Kenney, 1979).

The degree of a theory's corroboration depends on its degree of falsifiability and on the severity of the test (Popper, 1958). LISREL allows us to make severe tests of complex theories. LISREL enables the testing of alternative theories and their structured collection of hypotheses (Bentler, 1978, 1980). The more a theory withstands falsification, the more powerful a theory it is (Popper, 1958).

ABSI construct validation by testing rival models. This research examines the construct validity of the ABSI using the method of structural equation modeling (LISREL) to test a priori hypotheses about the measurement and structure of adaptive behavior constructs. Two alternative ABSI models are advanced. One is that the same network of constructs underlies both the ABSI and the ABS as factored by Nihira (1969a, 1969b, 1976, 1978). The other hypothesis is that the ABSI's network of constructs is different from the ABS's because physical development plays a major role in childhood. These will be discussed in more detail later.
The rival hypotheses tested in this research are from the results of several exploratory factor analyses of the ABS (Nihira, 1969a, 1969b, 1976, 1978; Guarnaccia, 1976), the clinical description of the ABSI (Leland, 1981), and the clinical interpretation of the ABS (Leland et al. 1975). Exploratory factor analyses of the ABS have replicated the adaptive behavior constructs (Meyers et al. 1979) and the items assessing those constructs (Nihira, 1978). Higher order factors have been proposed, but not extracted (Nihira, 1978; Meyers et al., 1979). Less is known about the ABSI.

Construct validity derives from relating a construct to other constructs and observed variables. The construct's place in a nomological network of constructs and data is defined by the construct's associations or lack of associations with other constructs and observed variables (Cronbach & Meehl, 1955; Torgerson, 1958; Bentler, 1978). Factor analysis has established the construct validity of the ABS (Meyers, Nihira, & Zetlin, 1979). Hypotheses derived from the accumulated exploratory factor analyses of the ABS are stated in a LISREL framework. These hypotheses are extended to the ABSI and are tested in a new sample. These hypotheses concern which domains reference the latent constructs of adaptive behavior, the number of and relationships among the constructs, and the presence of higher-order constructs.

Confirmatory factor analysis and other forms of structural equation modeling extend and strengthen the construct validity of a scale. As in exploratory factor analysis, the construct validity of a scale is described by the relations among items and factors and the relations among factors. Hypotheses concerning the relations among items and factors are specified in advance. Inferential statistical tests of these hypotheses, and descriptive statistics
concerning the ability to account for the relations among the observed variables are available (Bentler, 1978, 1980; Mulaik, 1972). These hypotheses are then rejected or not rejected by the fit of the hypothesized model to the data (Mulaik, 1972).

Overview of ABSI model testing using LISREL. A priori hypotheses concerning the measurement and structure of the constructs of adaptive behavior are tested by structural equation modeling (Joreskog & Sorbom, 1981). Figure 1 describes the process. The parameters of a hypothesized ABSI model are estimated by maximum likelihood. If they cannot be estimated, the model is rejected because it cannot be tested. The parameter estimates are most likely or best estimates of the parameters that produced the observed data. The model's parameters generate estimated variance-covariances which are compared to the observed variance-covariances. The goodness of fit between the estimated and the observed covariances is measured by three indices: chi-square, rho, and the root mean square residual (RMSR) of the covariances. If the model's fit to the data is good then the model is a plausible model. If the model's fit is poor then the model is rejected as a plausible representation of these data.

Two Alternative Models of Adaptive Behavior

Description of the Three Factor Model. The Three Factor Model hypothesizes that three correlated factors of Functional Independence, Cognition, and Motivation represent the ABSI data. The Functional Independence factor is composed of the three Physical Development subdomains and the five Independent Functioning subdomains. The Cognition
Figure 1 Overview of Model Testing Using LISREL

Hypothesized ABST Model

Cannot Estimate, Not Falsifiable

Model's Parameter Estimates

Estimated Covariances (Hypothesized)

Goodness of Fit

Chi-square, rho, RMSR

Good—Model is plausible

Poor—Model is rejected

Model's Observed Variables:
ABST Scores

Data

Sample's Covariances (Observed)

Figure 2 Three Factor Model

FI Cog Mo
factor is composed of the three Communication subdomains and the Conceptual Skills domain. The Motivation factor is composed of the domains of Play, Self-Direction, and Responsibility and Socialization.

This model emphasizes the reciprocal relationship among three groups of ABSI domains. The effects of Functional Independence, Cognition, and Motivation are not autonomous from each other. It proposes that improving any of a child's Functional Independence, Motivation, or Cognition will lead to improvement in both of the others. Children who are functionally independent behave in more motivated ways and have better cognition. Children who are dependent on others to meet their daily needs also have weak cognition and little motivation. Predictions can be made about Functional Independence from Cognition and Motivation, Cognition from Functional Independence and Motivation, and Motivation from Functional Independence and Cognition.

Justification of the Three Factor Model. The justification of the Three Factor Model of the ABSI rests on factor analytic studies and clinical guidelines of the ABS. Nihira (1976) factored the 25 ABS Part One subdomains into three oblique factors of social competence. Nihira labeled these correlated factors Personal Self-Sufficiency, Community Self-Sufficiency, and Personal-Social Responsibility. Independent Functioning and Physical Development loaded on Personal Self-Sufficiency. Independent Functioning, Economic Activity, Language Development, Number and Time, and Domestic Activity loaded on Community Self-Sufficiency. These two factors concern the person's ability to handle his or her immediate personal needs - the person's degree of autonomy in the personal and community sphere of activity. Vocational Activity, Self-Direction, Responsibility, and Socialization loaded on Personal-Social Responsibility.
Another study factored the 66 ABS items into 11 oblique age-dependent factors which are grouped into three "general dimensions", named Personal Self-Sufficiency, Community Self-Sufficiency, and Personal-Social Responsibility (Nihira, 1978). Although Nihira did not extract second-order factors from the eleven oblique factors by hierarchical factor analysis, he discussed the eleven oblique factors of the ABS as if they were grouped by three higher order factors.

A third article (Meyers et al., 1979) reviews three factor analytic studies of adaptive behavior (Guarnaccia, 1976; Lambert & Nicoll, 1976; Nihira, 1976). All found three oblique factors of the ABS. Meyers et al. (1979) conclude that "...the data on adaptive behavior measurement denies unitary or general factors (p. 434) ...no evidence exists that adaptive behavior can be described as a general or unitary trait (p. 465)".

The fourth source is a clinical description of the 10 ABS domains for physically intact adults, and a clinical guide to their interpretation (Leland et al. 1975). Leland et al. (1975) also group the ABS domains into three interrelated groups if the person has no major physical disabilities. Leland uses different names for the three groups: Functional Independence, Cognition, and Personal-Social Motivation. These domains are the same domains as those found by Nihira (1976, 1978) to be oblique factors. Leland and Nihira differ as to which Independent Functioning items load on which group/factor, but they are in basic agreement about there being three factors in the ABS.

Because the ABSI is a downward extension of the ABS (Leland, 1981), a three factor model of the ABSI might be identified given Nihira's (1976, 1978) and Meyers et al.'s (1979) findings of three factors in the ABS. Should a three
factor model account for the ABSI data the comparability of the ABS and ABSI would be substantiated.

**Description of the PDasG Model.** The Physical Development as a general influence (PDasG) Model hypothesizes that four factors, one of which exerts a general influence on the other three, represent the ABSI data. The general influence of Physical Development is hypothesized to account for the reciprocal relations among the primary factors: Independent Functioning, Cognition, and Motivation. The PDasG Model hypothesizes that Physical Development, at the ABSI age levels, influences Independent Functioning, Cognition and Motivation which are inter-related because of Physical Development's influence on all three. With Physical Development accounting for the interrelations among the three factors, there is no need for other relations among the three factors.

Physical Development is indicated by the three PD subdomains, Independent Functioning by the five IF subdomains, Cognition by the three Communication subdomains and the Conceptual Skills domain, and Motivation by the domains of Play, Self-Direction, and Responsibility and Socialization.

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**Figure 3: PDasG Model**

![Diagram](image)

In this model, a child's Physical Development predicts Independent Functioning, Cognition, and Motivation which are related to each other because
of the general influence of Physical Development. Apart from their shared
dependence on Physical Development, neither Independent Functioning,
Cognition, nor Motivation contribute to the other. Children who have not or
will not physically develop due to delay or disability are dependent on others to
meet their daily needs and have deficient Cognition and Motivation. Children
who are physically intact function more independently, are better equipped to
handle cognitive tasks, and are more motivated than children who are
impaired. Severely physically disabled children are not as independent,
cognitive, and motivated compared to physically developed children.

The PDasG Model is a LISREL model which is distinguished from a
hierarchical (general factor) factor analysis model in two ways. Items directly
load on the independent latent variable and there may be directional relations
among the dependent latent variables. Neither can occur in factor analysis.
Both LISREL and factor analysis hypothesize a general influence from the
independent latent variable (general factor) to the dependent latent variables
(primary factors). In factor analysis, the primary factors must be correlated
for there to be a general factor which has no items directly loading on it. The
general factor accounts for the interrelations among the primary factors
because these reciprocal relations are due to the influence of the general
factor on the items. Items load on their primary factor and, due to its general
influence, all items also indirectly load on the general factor.

Justification of the PDasG Model. Leland et al. (1975) present a model of
the ABS domains in which the Physical Development domain is given
prominence only when the person is severely physically handicapped. Leland
(personal communication, October 1985) asserts that PD assumes primary
importance during the early months and years of development. According to Leland, Physical Development exerts a general influence on all the other domains during infancy and early childhood because PD is the keystone of growth and development. Because the ABSI is a downward extension of the ABS, a PDasG Model of the ABSI might be identified given Leland et al.'s (1975) use of a PDasG Model of the ABS when the person (older than six) is severely physically handicapped.

Another justification for Physical Development's contribution to Cognition, comes from the work of Piaget (1952; Flavell, 1963) on the development of cognition. Piaget found that cognition begins in the sensorimotor realm of behavior. Later preoperational thought arises to be followed by concrete and then formal operational thought. Thus, for Piaget, Cognition is built upon sensorimotor skills such as those included in the Physical Development domain. Sensory development, body control, and voluntary locomotion all seem to be antecedent and necessary to cognitive development. Receptive language, speech content, personal identification, and conceptual skills all seem to be built upon Physical Development.

As Tuber, Ronca, Berntson, Boysen, and Leland (1985) state, "...cognitive competence must ultimately depend to a significant extent upon sensorimotor integrity" (p. 101). Physical Development is the precursor of Cognition. A significant predictor of Cognition is Physical Development (Barclay, 1984). This is because...

...the higher mental functions do not remain the same during successive stages of development. In the early stages, relatively simple sensory processes, which are the foundation for the higher mental functions, play a decisive role....
development of a function: In the early stages of ontogenesis, a lesion of a particular area will predominately affect a higher (i.e., developmentally dependent on it) center than that where the lesion is situated, whereas in the stage of fully formed functional systems, a lesion of the same area of the cortex will predominately affect a lower center (i.e., regulated by it) (Luria, 1966, p. 36-37).

Robinson et al. (1968) contend that Physical Development is also developmentally antecedent to Motivation.

Clinical (PDasG) versus statistical (Three Factor) traditions. The PDasG and Three Factor models will be evaluated in terms of their ability to represent a large number of relations among the domains and subdomains of Part One of the ABSI in a large sample of children by a much smaller number of relations among hypothetical constructs. The Three Factor Model is from a statistical tradition—factor analysis. It describes the relations among the items in terms of a much smaller number of underlying constructs or factors. The PDasG Model is from a clinical tradition. It summarizes the manner in which the domains are combined and compared when the ABSI is used to describe the functioning of an individual. "It is designed to provide objective descriptions and evaluations of an individual's coping with the natural and social demands of his or her environment" (Nihira et al., 1975, p. 5). The focus is on the individual with the goal of improving his or her functioning. Now the PDasG Model is being used to explain the many relationships among observed variables by a few hypothetical constructs. Instead of describing an individual's functioning in order to plan beneficial treatment and training, it is representing the relations among domains in a large sample of people. Not only is the PDasG Model put to a statistical purpose, but how well it represents the data is evaluated by statistical criteria.
The comparison of the PDasG Model to the Three Factor Model is biased against the PDasG Model.

The ABSI and PDasG model are grounded on the ABS (Leland, 1981). The location of the Physical Development construct in the nomological network of adaptive behavior and its influence on the other factors depend on the age of the individual and/or the type and severity of the physical deficit (Leland et al., 1975; Leland, 1981). Mature physically intact individuals have normal scores on this domain. For them, this domain is independent of, and has no influence on, the other domains of the ABS. Physical Development influences all of the other domains for infants and children because they are physically growing, and for adults who have severe impairment in physical development.

Leland (personal communication, October 1984) stated that the implications for LISREL models of the ABSI would be that a correlated three factor model would represent the children's data less well than would a model having Physical Development as a general influence. A hierarchical model having Physical Development as a general influence would be a reasonable ABSI model because Physical Development plays a much more important role in infancy and early childhood. Therefore, the PDasG Model is hypothesized to fit the children's ABSI data better than the three correlated factor model fits these data.

In summary, there is a body of research on adaptive behavior measurement which specifies the latent constructs, observed variables, and relationships among variables. Both Nihira and Leland specify a three oblique factor model of adaptive behavior for physically intact adults. They specify different models for children younger than six and physically deficient adults. Nihira applies the same Three Factor Model for children and physically handicapped adults as for
physically intact, mature individuals. In contrast, for young children and physically deficient adults, Leland proposes the PDasG Model which has Physical Development exerting a general influence. These two competing models will be fit to ABSI data of young children to determine their relative merits.
Chapter III

METHODS

Description of Subjects

The Franklin County (Ohio) Board of Mental Retardation and Developmental Disabilities (FCBMR/DD) is a county agency providing services throughout the life span to the mentally retarded and developmentally disabled, and their families. The ABSI along with other information is used on an individual basis by FCBMR/DD as a screening device for preschoolers to make decisions about placement in the program, to identify strengths and weaknesses for treatment planning, and to document progress in the program.

The subjects for this research were drawn from the FCBMR/DD Early Childhood Education program. A total of 864 children younger than six years of age (Table 2) have been assessed with the ABSI since 1981. The sample was randomly assigned to a holdout or a derivation sample which are comparable on age, sex, and adaptive behavior level. The results obtained from the derivation sample can be replicated, cross-validating them in the holdout sample. The adaptive functioning and measured intelligence of these children range from nearly normal to profoundly handicapped. All kinds of disabilities are represented, ranging from environmental deprivation to neurological impairments including but not limited to cerebral palsy, Down's syndrome, and brain damage, anoxemia at birth, and premature birth.
Table 2 Subjects

<table>
<thead>
<tr>
<th>Age</th>
<th>Derivation Sample (N=436)</th>
<th>Holdout Sample (N=428)</th>
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</thead>
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<tr>
<td></td>
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<td>Boys</td>
</tr>
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<td>42</td>
</tr>
<tr>
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<td>27</td>
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<tr>
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<td>272 Boys</td>
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Covariance Structure Modeling (LISREL)

Introduction

Two alternative ABSI models were described in the Literature Review. Each hypothesized model will be fit to the data either rejecting, or failing to reject it. LISREL (Joreskog & Sorbom, 1979, 1981) or covariance structure modeling (CSM) (MacCallum & Ashby, 1986) is a powerful hypothesis testing procedure (Bentler, 1979, 1980; Cliff, 1983; Long, 1983). A covariance structure model is a hypothesis about a specific pattern of relationships among a group of latent and measured variables (MacCallum and Ashby, 1986). This section describes different types of LISREL models; details of model specification and estimation; procedures for assessing goodness of fit; and cross-validation.

A covariance structure model is composed of observed variables and their errors in measurement, latent constructs and their errors in prediction,
directional paths between variables and constructs, and directional paths among constructs. Variables are either measured (manifest) variables or they are unobservable hypothetical constructs (latent variables). Measured variables are used as approximations to latent variables. For example factor analysis items are indicators of, and affected by, the factor. Several indicators are used to give a reliable and valid representation of the latent variable (Bentler, 1980; Joreskog and Sorbom, 1979, 1981; Long, 1983; MacCallum and Ashby, 1986).

The variables and constructs are organized by paths of directional influence. Independent (exogenous) variables are not affected by any other variables. Dependent (endogenous) variables are affected by at least one other variable. The CSM model is composed of a structural and a measurement model which are specified by the elements of eight parameter matrices described in Appendix B. The "structural model" specifies the relationships among the hypothetical constructs. The "measurement model" specifies the observed variables which indicate each construct. The degree to which a measured variable is not accounted for by the latent variables is the error in variable or unique factor. The degree to which a dependent latent variable is not accounted for by the other latent variables is the error in prediction of the latent variable, or residual (Bentler, 1980; Joreskog & Sorbom, 1979, 1981; Long, 1983; MacCallum & Ashby, 1986).

Two populations are sampled, handicapped children younger than three, and handicapped children aged three through five. When there is more than one sample, the model defines the parameters of each population sampled. The hypothesis is that the model fits all the samples simultaneously. Covariances not correlations are used for comparisons across populations.
**Principles of inference.** Cliff (1983) applies established principles of scientific inference to LISREL, cautioning against making causal statements on the basis of nonexperimental data. He emphasizes the "...great increases in the rigor with which correlational data can be analyzed" (Cliff, 1983, p. 115) by LISREL.

1. Conclusions are tentative because variables which are not included may well influence the variables which are included.

2. Causal statements based on correlational data are not appropriate, even when variables are sequenced in time, because the variables are not actively controlled and manipulated by the experimenter. Causal hypotheses are only tested by manipulating the purported cause while holding all other variables constant. Only associational and directional, not causal, statements result from correlational data.

3. Measured variables are not theoretical (latent) variables. The distinction is important. Both the validity and reliability of observed variables must be documented before asserting that the observed variable indicates a latent variable. This is the "beauty of these new methods...when we have done our work in this respect, they can provide a more solid basis for our conclusions than we have previously had" (Cliff, 1983, p. 121).

4. Cross-validation of the model prior to assuming its plausibility is crucial. Ex post facto analyses are not confirmatory. Models found in the literature are not pristine hypotheses which, having been tested by data, are confirmed. What usually happens is that the initial model is falsified, revised by the researcher, and then tested with the same data, this time (or many revisions later) not falsified, and then published. All tests except the first were after the fact that the researcher looked at the data. Therefore, the relevant probability distributions and goodness-of-fit values no longer apply since the researcher might well have capitalized on chance (Cliff, 1983).

**Model specification and parameter estimation.** Specification of a LISREL model involves translating theory into equations. Because social science theories
are general and diffuse, a set of equations can not be directly specified. The researcher must make a number of additional theoretical assumptions or specifications to create a LISREL model. A specification error is said to occur when one or more assumptions in the model are incorrect. Specification errors may cause a model to fit poorly, to be unestimable, or to have incorrect results (Kenny, 1979).

The model's parameters are its parts. Parameters are factor loadings, errors in variables, errors in equations, and relations among the hypothetical constructs. Parameters may be free, fixed, or constrained. Free parameters will be estimated by LISREL, fixed parameters remain equal to some value (a zero excludes the parameter from the model), and constrained parameters have some relationship (i.e. equality) to another parameter. Assume for a moment that a particular model is true in the population. The parameters of this model will exactly reproduce the population variance-covariance matrix. In practice we have only an estimate of the population matrix, the variances and covariances of the sample. Given the sample's variance-covariance matrix, the model's free parameters are estimated by maximum likelihood resulting in estimates of the population parameters which are most likely to reproduce the observed variances and covariances. Estimation of a model's parameters from the covariances among the observed variables by maximum likelihood is not possible if a parameter is "unidentified", able to take on an infinite number of values. An unidentified parameter makes the model unidentified and untestable because it is not falsifiable.
Goodness of Fit

The power of covariance structure modeling comes from its ability to measure the degree to which an hypothesized model fits the observed data. A model's ability to represent the observed data is the degree to which the model's estimated parameters reproduce the observed data. This fit is measured by the inferential chi-square statistic and by two descriptive indices of fit, rho and the root mean square residual (RMSR). Goodness of fit measures indicate the degree to which the model represents the information contained in the sample's variance-covariance matrix. If the model closely reproduces the observed covariances, as indicated by the goodness-of-fit measures, then the model is a plausible model of those data. If the model does not reproduce the observed covariances, it is rejected.

A statement stronger than 'plausible' is not correct because of the manner in which models are evaluated. Even a model which exactly reproduces the observed data is insufficient evidence that the process (the model) which produced the estimates is the same as the process which produced the observed data. Identical outcomes do not mean that the processes producing the outcomes are identical. Different processes might produce the same data. It can only be concluded that the model produces estimates which reproduce the observed data. Therefore, it is a plausible model. Whether the process described by the model is the same process generating the data remains unknown. This is the limit of LISREL which, other than replicated controlled experiments involving contingency reversals, is the best tool available.

Nested or hierarchical models. One model, call it Small, is nested in another model (Large) when all of the variables and relations specified by Model
Small a subset of the variables and relations which compose Model Large. The nested Model Small has fewer parameters to estimate, consequently more degrees of freedom, is usually a poorer fit to the data, and consequently has a larger chi-square than does the hierarchical Model Large. Consider the two models diagrammed in Figure 4. Model Small is nested in Model Large because Model Small is a subset of Model Large having fewer free parameters (hypothesized relations) (Bentler and Bonett, 1980). Model Small is more restricted, having one more fixed parameter: there is no relationship between Independent Functioning and Cognition.

**Figure 4 Nested Models**

Model Small

\[
\text{PD} \rightarrow \text{Cog} \rightarrow \text{Mo}
\]

Model Large

\[
\text{PD} \rightarrow \text{Cog} \rightarrow \text{Mo}
\]

The Null Model. The null model defines one end of a continuum along which models vary. The Null Model is the poorest representation and most restricted model because it hypothesizes that the measured variables are uncorrelated. Hypothesizing that the measured variables are all independent of each other, the Null Model specifies that there are no common factors. Being most restricted, it is nested within all other models. The Null Model serves as a reference point for rho's evaluation of the goodness of fit of alternative hypothesized models. Rho measures the improvement in fit of a hypothesized
model over the null model. Using rho to compare the fit of a hypothesized model to the fit of the Null Model tests the hypothesis that the variables are mutually independent and indicates whether valuable information has been extracted from the data by the hypothesized model (Bentler & Bonett, 1980).

**Chi-Square and the Saturated Model.** Chi-square is an inferential statistic. Its statistical significance is dependent on sample size as well as on the degree of fit between the model and data. With large samples statistically significant differences between the model's estimates and the data, which are in fact quite substantively insignificant, are sufficient to reject the model. With small samples, almost any model, even substantively ridiculous models, are not rejected by chi-square, again due to the sample size. Therefore, descriptive statistics rho and root mean square residual (RMSR) which are not affected by sample size are used along with chi-square (Bentler & Bonett, 1980; Joreskog & Sorbom, 1979). CSM's goodness of fit measures increase our theoretical power by inferentially testing hypotheses about model parameters instead of simply describing parameters as in factor analysis.

Chi-square compares a given model to the saturated model (Bentler & Bonett, 1980). The saturated model, specifying a latent variable for each measured variable and hypothesizing that they are arbitrarily correlated, is the least restricted and most unstructured model possible. Therefore, all other models are nested in the saturated model because they specify some uncorrelated observed variables. The saturated model defines one end and the null model the other end of the restrictiveness and fit continuum along which models vary. Because all parameters are free, meaning that all variables are correlated with each other to an arbitrary extent, the saturated model is the
least meaningful model. There are zero degrees of freedom because the number of parameters to be estimated equals the number of observed variances and covariances (Bentler & Bonet, 1980).

Because the saturated model fits and reproduces the data perfectly, it is the ideal standard for comparison of alternative models. Chi-square compares the fit of a hypothesized model to the perfect fit of the saturated model. The null hypothesis is that the covariances generated by the hypothesized model and the saturated model are equivalent; no information is lost by using the more restricted hypothesized model. A nonsignificant chi-square fails to reject the null hypothesis, implying that the hypothesized model is a plausible model for these data. If the null hypothesis is rejected, then crucial information is missing from the hypothesized model since its estimated covariances are not equal to those estimated by the saturated model. A significant chi-square means that the hypothesized model is not a plausible representation of these data (Bentler & Bonett, 1980).

\textbf{Rho.} Rho is a descriptive index of a model's fit to the data which varies between zero (no fit) and one (perfect fit). Unlike chi-square, rho is a valid index of fit across both nested and non-nested models. For citation, it should be greater than .9; rhos greater than .95 are considered 'good'. Rho indicates the hypothesized model's fit relative to the null model which states that the variables are uncorrelated in the population. Rho approaches one as the fit of the hypothesized model approaches that of the perfectly fitting saturated model. Rho is defined as

\[ \text{Rho} = \frac{Q_0 - Q_k}{Q_0 - 1} \] where,
**Qo** is the null model's chi-square divided by degrees of freedom,
**Qk** is the given model's chi-square divided by degrees of freedom,
**1** is the chi-square divided by degrees of freedom of the perfectly fitting model.

The ratio of the improvement of the hypothesized model over the worst fitting null model to the improvement in fit of the perfectly fitting saturated model over the null model, describes how well the hypothesized model fits (Bentler & Bonett, 1980).

**Rho** must closely approach one for a given model to be accepted as a plausible candidate for the data. Rho is the amount of information in the variances-covariances that is summarized by a model. One minus rho specifies amount of information remaining to be explained that is not yet captured by the hypothesized model. It is the increment in fit that might be obtained with a more adequate model (Bentler & Bonett, 1980).

**Root mean square residual.** The root mean square residual (RMSR) is a descriptive statistic of fit which indexes the average error in fit of the model's estimated covariances to the observed covariances. As the model's estimates approach the observed data, the closer RMSR is to zero and the more exact is the model's fit. Model plausibility increases as the fit improves. RMSR's proximity to zero is interpreted with consideration to the size of the observed covariances because the proximity of RMSR to zero depends on the scale of measurement of the observed variables. For correlations, RMSR values less than .1 are considered 'good' and values less than .05 are considered 'very good'.

**Unreasonable results.** If a variance is less than zero or if a correlation is greater than one then something is clearly wrong. These are two examples of unreasonable results which indicate an improperly specified model which should be rejected (Joreskog & Sorbom, 1984).
Summary of goodness of fit measures. Chi-square, rho, and RMSR provide three perspectives on the degree to which alternative models fit the ABSI data. A model's fit to the observed data is one important criteria by which the model is judged to be plausible. Models which have excellent goodness-of-fit indices must also be substantiated by prior research and theory. To conclude that a given model is a plausible representation of the data requires knowledge of the substantive area combined with interpretation of the model in light of existing professional opinion in addition to good fit. Other criteria important to the subjective evaluation of models are replication, parsimony of variables and relationships, and robustness to different populations.

Because chi-square is an inferential statistic we know the likelihood of accepting the null hypothesis (that the model fits) when it is false. With rho and RMSR we do not and the rejection of the model is a much more subjective decision. The power of chi-square (its ability to detect statistically significant differences) increases with the size of the sample. With sufficiently large sample sizes even the best of models will be rejected due to theoretically trivial, but statistically significant differences between the model and the observed data. Rho and RMSR are not affected by sample size. They also may be used to compare the relative fit of nested and nonnested models, while chi-square is appropriate only for nested models.

Modification of Models

Provided that there are substantive reasons for doing so a model may be modified to improve its fit to the data. Prior research or theory must justify the each of the many different ways of modifying a model. For example, adding or
deleting either measured or latent variables. In this research, models will be modified in only two ways: adding or deleting relational paths between latent variables by freeing or fixing to zero the parameter specifying the relationship between the two latent variables.

LISREL's output provides information about adding or deleting paths from the model. Modification indices report the minimum degree to which the model's fit will be improved by freeing the respective parameter which adds a path between two variables. T-values report the statistical significance of each parameter estimate. T-values less than 1.96 indicate that the parameter estimate is not significantly greater than zero (with an error rate equal or less than .05). Therefore the path is not needed and may be removed, simplifying the model without harming its fit by setting its parameter to zero.

Cross-Validation

When more than one model is tested on the same data the possibility occurs of capitalizing on chance relationships among the variables. A model capitalizing on chance incorporates meaningless relationships which are due to random errors in the sample, are without theoretical significance, and will not replicate in another sample. Therefore, cross-validation of models is as necessary in covariance structure modeling as it is in multiple regression.

Replication of a model in a holdout sample decreases the likelihood that the model capitalized on chance relationships. The sample is randomly split into a derivation and a holdout sample. Models are tested and modified in the derivation sample. The resulting plausible model is cross-validated in the holdout sample. The hypothesis that the model cross-validates is rejected if the
model's fit to the holdout sample is significantly less than its fit to the derivation sample.

Development of the LISREL Model

Using factor analysis as a starting point, LISREL will be described by several different models, each a simplified version of the general LISREL model. They are presented in order of complexity: from common factor model (first orthogonal, then oblique), to hierarchical factor model, and then the general LISREL model. LISREL's measurement model relates observed to latent variables. It is the common factor model.

Common factor analysis. Common factor analysis hypothesizes latent constructs or factors underlying observed variables. LISREL's latent variables are common factors. These constructs are interpreted as either the causes of, or summary descriptions of, the correlations among the observed variables (Rummel, 1970). A common factor is a function which linearly contributes to the common variance of a variable. It is a linear combination of the common portions of the variables. Factors may be either orthogonal and independent of each other, or oblique and related to each other. With orthogonal factors, the loading of a variable on a factor is the correlation between the variable and the factor. The loading specifies the degree to which the factor is related to an observed variable, the degree to which the variable indicates the factor (Rummel, 1970).

Components of variance in common factor analysis. In common factor analysis an observed variable's variance is composed of common and unique components (Figure 5). Common variance or commonality is that part of the
variable's variance which is shared in common with the other observed variables due to the influence of the common factors on the variables. A variable's commonality is the portion of the variable's variance accounted for by common factors, a lower bound estimate of the variable's reliability, and the sum of that variable's squared factor loadings (Cooley & Lohnes, 1971; Overall & Klett, 1970; Rummel, 1970).

Figure 5 Components of a Variable's Variance

Factor analysis's unique variance is LISREL's "errors in a variable", that part of an observed variable not accounted for by the common factors (latent variables). Unique factors account for unique variance which is composed of reliable specific and unreliable error variance. Unique variance (error in a variable) is not shared with the other observed variables. The reliable portions of an observed variable's variance are specific and common variance. Specific variance is due to a specific factor accounting for replicable influences specific to only that variable. Error variance is the unreliable portion of an observed variable's variance. It is due to random and nonreplicable influences on the variable.
Common factor model. The common factor model proposes that hypothetical constructs cause or account for the correlations among a set of observed variables. If the latent variables are hypothesized to be independent of each other then an orthogonal factor model (Figure 6) specifies no relations among the factors. The relations among the observed variables are accounted for by the shared influence of the common factor. The hypothesized pattern of loadings of observed variables on factors is specified by lambdas, elements of the factor pattern matrix which relates observed to latent variables. In this example, each observed variable has an error in variable or unique factor and each loads on only one factor.

Figure 6 Factor Analysis Models

If the latent variables are hypothesized to be related to each other then an oblique model specifies the relationships (phis) among the factors. Again, the relations among the observed variables are accounted for by the influence of the
factor which is common to them, each observed variable has an error in variables or unique factor, and the factor pattern matrix (lambda) maps observed to latent variables.

Hierarchical factor analysis. A hierarchical model having a general factor (Figure 7) results when the primary factors are inter-related and their correlations are factored. All observed variables are influenced by and therefore load on the general (or second-order) Physical Development factor. Analogous to a primary factor accounting for the correlations among observed variables, the general factor accounts for the reciprocal relationships among the primary factors. The relationships among the primary factors (dependent latent variables) vanish because they are accounted for by the influence of the general factor. Analogous to an observed variable's loading on a factor (lambda), gamma indicates the degree to which a dependent latent variable (primary factor) is influenced by an independent latent variable (general factor).

---

Figure 7 Hierarchical Factor Analysis Model

- Sensory
  - Bodyposn
  - Locomotn
  - Eatdrink
  - Toilet
  - Dressing

- Recep1ng
  - Speech
  - Concep

- Physical Development
  - Cognition

- Motivation
  - Play
  - SD
  - RS
General LISREL model. The general LISREL model (Figure 8) differs from the hierarchical factor model in that observed variables directly indicate the independent latent variable, and in addition to the influence of the independent latent variable, influences among the dependent latent variables may be hypothesized. For example, in addition to the general influence of Physical Development, Independent Functioning influences Cognition which affects Motivation. Independent Functioning influences Motivation indirectly through its influence on Cognition.

The details of the parameters and matrices of covariance structure modeling, the equations for the measurement and structural models, and the meaning and interpretation of the eight LISREL parameter matrices are discussed in Appendix B.
Chapter IV

RESULTS

Item Analysis

The ABSI was constructed in a criterion-referenced manner. Items were selected by expert review of existing instruments, item writing, and critical-incident analysis sampling specific criterion behavior from the adaptive behavior domain, rather than by item analysis. The traditional norm-referenced approach to item and data analysis will be employed. These results suggest that the ABSI has reasonable psychometric properties for a criterion-referenced test.

Item-Domain Correlations

Along with coefficient alpha (Table 1), item-domain correlations indicate the internal consistency of a scale. The correlation between an item and its domain score (excluding the item) indicates the degree to which that item measures the same construct that the domain measures (Ghiselli, Campbell, and Zedeck, 1981). Two Independent Functioning items correlate less than .40 with the domain score while the rest correlate greater than .48. One Physical Development item correlates less than .30 while the rest correlate more than .57. The Communication items correlate .64 or more. One Conceptual Skills item correlates less than .3 while the rest correlate .61 or more. The Play items correlate .51 or more. Self-Direction items correlate .68 or higher. Responsibility and Socialization items correlate .74 or higher. The item-total
score correlations indicate that the ABSI is a homogeneous test (Table 14, Appendix C). One item correlates less than .20, four items correlate less than .30, and the other 57 items correlate .44 or higher with the total score.

**Convergent and Discriminant Item Correlations**

When a test has several scales, the item's correlation with its own scale may be compared to the item's correlation with the other scales. Ideally, each item correlates only with its own scale and not at all with the other scales, thereby converging on the construct measured by its own scale while discriminating constructs measured by the other scales (Ghiselli, Campbell, and Zedeck, 1981; Jackson, 1970, 1971). The item-subdomain (excluding the item) correlations (Table 15, Appendix C) indicate that the ABSI items converge on their own subdomains, discriminating the other 14 subdomains. One item correlates less than .40 with its own subdomain. Five other items correlate less than .50 with their own subdomain. Thirty-five (56%) of the ABSI items correlate higher with their own subdomain than with the other subdomains. Twenty-seven (44%) of the ABSI items correlate higher with other subdomains than with their own subdomain. Of these "improper" items, 12 (19%) had higher correlations with one other subdomain, four (6%) had higher correlations with two or three other subdomains, three (5%) had higher correlations with four or five other subdomains, and eight (13%) had higher correlations with from seven to 11 other subdomains. An item correlating more strongly with another subdomain than with its own suggests locating it in that other subdomain because it is a better measure of that construct than of the construct measured by its present scale. Fewer subdomains may be appropriate because 37% of the ABSI items correlated with from two to 12 subdomains
Coefficient Alphas

Coefficient alpha is a measure of the extent to which a set of variables measure the same construct and may therefore be summed into a total score (Cronbach, 1951, 1970). The coefficient alphas for the entire ABSI and for each of its domains are high (Table 3). The domain alphas from the study which developed the ABSI are presented under the heading of Leland (1981). These high alphas indicate that the items in each domain and in the ABSI measure the same construct and may be summed into a total score.

Table 3 Derivation Sample's Coefficient Alpha and Inter-item Correlations

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<th>IF</th>
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<th>SD</th>
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<td>12</td>
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</table>
Inter-Domain and Subdomain Correlations

The domains of the ABSI are strongly intercorrelated (Table 4). The seven ABSI domains share from 36 to 75% of their variance in common with each other suggesting that similar, or highly related, behaviors are being measured. The correlations among the 15 ABSI (sub)domains (Table 5) range from .11 between Sensory Development and Personal Identification, to .92 between Locomotion and Body Position in the Young derivation sample and from .29 again between Locomotion and Body Position, to .83 between Speech and RS in the Old derivation sample. Performance in one is likely to be predictive of performance in the other domains and subdomains. Adaptive behavior seems to be an interdependent constellation of related behaviors.

<table>
<thead>
<tr>
<th>IF</th>
<th>PD</th>
<th>Comm</th>
<th>Concep</th>
<th>Play</th>
<th>SD</th>
<th>RS</th>
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<td>PD</td>
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<td>Play</td>
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<tr>
<td>RS</td>
<td>.83</td>
<td>.73</td>
<td>.87</td>
<td>.81</td>
<td>.84</td>
<td>.80</td>
</tr>
</tbody>
</table>

Testing Age Differences

Prior to covariance structure modeling, the presence and importance of age differences must first be assessed. If the relationships among the variables in the Young (0-2) sample differ from those in the Old (3-5) sample, then age should be taken into account in the analysis. The two samples, Young and Old,
Table 5  Derivation Sample Correlations Among ABSI Variables

<table>
<thead>
<tr>
<th></th>
<th>Eatdrink</th>
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<th>Dressing</th>
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<th>Travel</th>
<th>Sensory</th>
<th>Bodyposn</th>
<th>Locomotn</th>
<th>RecepIng</th>
<th>Speech</th>
<th>Persnlid</th>
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<td>.60</td>
<td>.80</td>
<td>.80</td>
<td>.80</td>
</tr>
</tbody>
</table>

Old Derivation Sample (N = 194)

should be analyzed separately. On the other hand, if the relationships in the Young and Old samples are not different, then age does not have to be taken into account in the analyses. The derivation sample, aged birth to five, should be analyzed as a whole.
The presence of differences between the Young and Old derivation samples' covariances is tested by chi-square. The null hypothesis is that there is no difference between the Young and Old derivation samples' covariances. A nonsignificant chi-square means that there are no statistically significant differences. The two samples may be combined and analyzed as one. A significant chi-square means there are statistically significant differences. The Young and Old samples should be analyzed separately.

<table>
<thead>
<tr>
<th>Table 6 Significance of Differences Between Young and Old Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>690.21</td>
</tr>
</tbody>
</table>

The difference between the Young and Old derivation samples' covariances is statistically significant (Table 6) meaning that they should be analyzed separately. The following LISREL analyses will simultaneously fit a model to the Young and Old derivation samples.

**Testing Models of Adaptive Behavior**

All the following covariance structure models will use the same (sub)domains to indicate the unobserved constructs. The (sub)domains, their labels, and the constructs they indicate are in Table 7.

**Three Factor Model**

The Three Factor ABSI Model hypothesizes three correlated factors of Functional Independence, Cognition, and Motivation. The five Independent
Functioning and three Physical Development subdomains are placed on the first factor of Functional Independence, the three Communication subdomains and the Conceptual Skills domain make up the second factor of Cognition, and the Self-Direction, Responsibility and Socialization, and Play domains compose the third factor of Motivation. No constraints (for example, of equality) were placed on the Three Factor Model's parameters as it was simultaneously fit to the Young (0-2) and Old (3-5) derivation samples.

<table>
<thead>
<tr>
<th>(Sub)Domain</th>
<th>Label</th>
<th>Construct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Development</td>
<td>Sensory</td>
<td>Physical</td>
</tr>
<tr>
<td>Control of Body Position</td>
<td>Bodyposn</td>
<td>Development</td>
</tr>
<tr>
<td>Locomotion</td>
<td>Locomotn</td>
<td>(PD)</td>
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<tr>
<td>Eating and Drinking</td>
<td>Eatdrink</td>
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<tr>
<td>Toileting</td>
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</tr>
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<td>Functioning</td>
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<tr>
<td>Cleanliness</td>
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<td>(IF)</td>
</tr>
<tr>
<td>Travel Skills</td>
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</tr>
<tr>
<td>Receptive Language</td>
<td>Receplng</td>
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<tr>
<td>Speech Content</td>
<td>Speech</td>
<td>Cognition</td>
</tr>
<tr>
<td>Personal Identification Skills</td>
<td>Persnlid</td>
<td>(Cog)</td>
</tr>
<tr>
<td>Conceptual Skills</td>
<td>Concep</td>
<td></td>
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<tr>
<td>Play</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>Self-Direction</td>
<td>SD</td>
<td>Motivation</td>
</tr>
<tr>
<td>Personal Responsibility and Socialization</td>
<td>RS</td>
<td>(Mo)</td>
</tr>
</tbody>
</table>

The Three Factor Model is inappropriate for these data. The goodness of fit measures (Table 8) indicate that the Three Factor Model fails to represent the data. The model's estimates and the data are significantly (by chi-square) different, and an insufficient amount of information (by rho) is captured by the
There is no support for the hypothesis that three factors underlie the ABSI as Nihira found for the ABS.

Three Factor measurement and structural models results. The measurement model specifies the latent constructs, their indicators the observed variables, along with the errors in measurement of the observed variables. The quality of the measurement model is indicated by the observed variables' loadings on the constructs, their communalities, and their modification indices. The loadings are statistically significant (Figure 10 for the Young and Figure 11 for the Old sample). The communalities (Table 9) are lower bound estimates of each observed variable's reliability (Cooley and Lohnes, 1971; Overall and Klett, 1972). The structural model specifies the relations among the latent constructs. The three factors are significantly intercorrelated in the Young (Figure 10) and Old (Figure 11) samples.

Table 8 Overall Goodness of Fit Measures Simultaneously Fitting Young and Old Samples

<table>
<thead>
<tr>
<th>Model</th>
<th>Chi-square</th>
<th>DF</th>
<th>Q</th>
<th>Rho</th>
<th>Young RMSR</th>
<th>Old RMSR</th>
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<tr>
<td>Null</td>
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<td>210</td>
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<td>19.99</td>
<td>23.34</td>
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<td>Three Factor</td>
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<td>6.07</td>
<td>.84</td>
<td>1.28</td>
<td>1.75</td>
</tr>
<tr>
<td>PDasG1</td>
<td>1102.90</td>
<td>174</td>
<td>6.34</td>
<td>.83</td>
<td>1.51</td>
<td>1.97</td>
</tr>
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<td>PDasG2</td>
<td>1044.68</td>
<td>172</td>
<td>6.07</td>
<td>.84</td>
<td>2.09</td>
<td>1.98</td>
</tr>
<tr>
<td>PDasG3</td>
<td>834.08</td>
<td>170</td>
<td>4.90</td>
<td>.87</td>
<td>1.92</td>
<td>1.45</td>
</tr>
<tr>
<td>PDasG4</td>
<td>834.92</td>
<td>172</td>
<td>4.85</td>
<td>.88</td>
<td>1.90</td>
<td>1.47</td>
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</table>
Figure 10
Maximum Likelihood Estimates of the Three Factor Model
Young (0-2) Derivation Sample

The first number is the parameter estimate. The second number is the parameter estimate's t-value. All t-values are greater than 3.3 (p<.0001) indicating that all parameters are highly significant.
Figure 11
Maximum Likelihood Estimates of the Three Factor Model
Old (3-5) Derivation Sample

The first number is the parameter estimate. The second number is the parameter estimate's t-value.
All t-values are greater than 3.3 (p<.0001) indicating that all parameters are highly significant.
Table 9 Three Factor Models' Communalities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Young</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eatdrink</td>
<td>.57</td>
<td>.51</td>
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<td>Toilet</td>
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<tr>
<td>Dressing</td>
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<td>.78</td>
</tr>
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<td>Cleanli</td>
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<td>.71</td>
</tr>
<tr>
<td>Travel</td>
<td>.58</td>
<td>.48</td>
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<tr>
<td>Sensory</td>
<td>.23</td>
<td>.36</td>
</tr>
<tr>
<td>Bodyposn</td>
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<td>.50</td>
</tr>
<tr>
<td>Locomotn</td>
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<td>Play</td>
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<td>SD</td>
<td>.69</td>
<td>.66</td>
</tr>
<tr>
<td>RS</td>
<td>.87</td>
<td>.82</td>
</tr>
</tbody>
</table>

Physical Development as a General Influence (PDasG) Models

Given Physical Development's importance to the further growth and development of young children, the PDasG1 Model (Figure 12) was simultaneously fit to the Young (0-2) and Old (3-5) derivation samples. There were no constraints on the parameters. The goodness of fit measures (Table 6) indicate that the PDasG1 Model fails to represent the data. The model's estimates and the data are significantly (by chi-square) different, and an insufficient amount of information (by rho) is captured by the model.
Justification of Independent Functioning to cognition modification:

**PDasG2.** Perhaps the contribution of Independent Functioning to Cognition should be added to the PDasG1 Model. The modification indices were 38.6 for the Young and 4.2 for the Old samples. Independent Functioning is the basis of Cognition. Bennett (1975) found that the, "...ability to which the person is able to function independently is a foundation of cognition." Receptive language, speech content, personal identification, and conceptual skills are built upon Independent Functioning. Scarr (1985) found that a measure of self-care adaptive skills was predictive of cognitive, especially communication, skills. Independent Functioning is developmentally antecedent to Cognition. Heber (1961) contended that self-help skills are of primary importance in the preschool years while Cognitive abilities attain importance in the school years. Therefore, the PDasG1 Model was modified by adding a path from Independent Functioning to Cognition making the PDasG2 Model diagrammed in Figure 13.

---

**Figure 13 PDasG2 Model**

```
PD   IF
    ↓
  Cog
    ↓
  Mo
```

---

Despite the statistical significance of Independent Functioning's contribution to Cognition (Table 10), the model's overall fit (Table 8) is only slightly improved. This modification made a statistically significant improvement in the PDasG Model's fit to the data (Table 10) because the difference (between Models 1 and 2) chi-square is significant. The hypothesis that Independent Functioning
influences Cognition is not rejected by these data. The hypothesis that the PDasG2 Model fits the data is rejected.

Table 10 PDasG Difference Chi-Squares

<table>
<thead>
<tr>
<th>Models Compared</th>
<th>Parameter Tested</th>
<th>Difference Chi-Square</th>
<th>DF</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDasG1 vs PDasG2</td>
<td>IF to Cog</td>
<td>58.22</td>
<td>2</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>PDasG2 vs PDasG3</td>
<td>Cog to Mo</td>
<td>210.60</td>
<td>2</td>
<td>p&lt;.001</td>
</tr>
<tr>
<td>PDasG3 vs PDasG4</td>
<td>Removing PD to Cog</td>
<td>.74</td>
<td>2</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

Justification of Cognition to Motivation modification: PDasG3. Perhaps Cognition's contribution to Motivation should be added to the PDasG2 model. The modification indices were 70.0 for the Young and 119.8 for the Old samples. Independent Functioning, Cognition, and Motivation are inter-related due to their influence on each other besides Physical Development's influence on them. Kahn (1983) found Cognition to be predictive of Motivation. Cognition is developmentally antecedent to Motivation. Heber (1961) contended that the rate of learning is of primary importance during the school years while social adjustment and personal responsibility and socialization are of importance in adulthood. The play domain is developmentally ordered following the sensorimotor, concrete, and abstract Piagetian stages of cognitive development. Therefore, the PDasG2 Model was modified by adding the contribution of Cognition to Motivation making the PDasG3 Model diagrammed in Figure 14.
Figure 14 PDasG3 Model

Despite the statistical significance of Cognition's contribution to Motivation (Table 10), the model's overall fit (Table 8) is only slightly improved. This modification made a statistically significant improvement (Table 10) in the PDasG3 Model's fit to the data because the difference (between Models 2 and 3) chi-square is significant. The hypothesis that the PDasG3 model fits the data is rejected.

Justification for removing Physical Development's influence on Cognition: PDasG4. Physical development may not directly contribute to Cognition. The direct influence of Physical Development on Cognition can be removed from the PDasG Model, at no loss to the model's representation of the data, because the t-value of that influence is not significantly different from zero in the Young (t = .03) and Old (t = -.39) samples. Individuals who are severely physically impaired possess normal Cognitive abilities and those who are physically developed are nevertheless mentally retarded. People having cerebral palsy, the deaf, the blind, and quadraplegics may possess good Cognition while people with Down's Syndrome are physically intact and mentally retarded.

Therefore, the PDasG Model was modified a third time by removing the path from Physical Development to Cognition creating the PDasG4 Model (Figure 15). The direct effect of Physical Development on Cognition is not sustained.
after entering Independent Functioning's contribution to Cognition because Physical Development influences Cognition through Independent Functioning.

Figure 15 PDasG4 Model

The PDasG4 Model does not fit these data, its estimates are significantly (by chi-square) different from the data, and an insufficient amount of information (by rho) is captured by the model (Table 8). Removing Physical Development's contribution to Cognition hypothesizes one less relationship, uses one less free parameter, and simplifies the PDasG4 Model. The PDasG4 Model, is the most parsimonious model, fitting the data at least as well as the other models in the PDasG series because the difference (between Models 3 and 4) chi-square is not significant (Table 10). No other model modifications seem warranted. The PDasG models do not support the clinical hypothesis that Physical Development exerts a general influence on the other domains in this sample.

PDasG4 measurement and structural models. The loadings of the observed variables on the hypothetical constructs are statistically significant (Figure 16 for the Young and Figure 17 for the Old samples). The communality lower bound estimates of the observed variable's reliability (Table 11) is higher in the Old sample. At least 66% of the dependent latent construct's (Independent Functioning, Cognition, and Motivation) variances were accounted for by the PDasG4
The first number is the parameter estimate. The second number is the parameter estimate's t-value. All t-values are greater than 3.3 (p < .0001) indicating that all parameters are significant.
Figure 17
Maximum Likelihood Estimates of the FDaG4 Model
Qtd (3-5) Derivation Sample

The first number is the parameter estimate. The second number is the parameter's t-value.

All t-values are greater than 3.3 (p<.0001) indicating that all parameters are significant.
Model (Table 11). All directional paths between the latent constructs in the PDasG4 structural model are significant in the Young (Figure 16) and Old (Figure 17) derivation samples. In both samples, the largest influence is Physical Development on Independent Functioning which mediates Physical Development's contribution to Cognition.

Comparing the Three Factor and PDasG Models. Neither the Three Factor nor the PDasG Models fit these ABSI data. The PDasG4 Model has a lower Q-value, a higher rho, but slightly worse RMSR values than the Three Factor Model (Table 8). If the sole criterion was reproducing the covariances (indicated by

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Table 11 PDasG4 Model's Communalities

<table>
<thead>
<tr>
<th>Variable</th>
<th>Young</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eatdrink</td>
<td>.65</td>
<td>.47</td>
</tr>
<tr>
<td>Toilet</td>
<td>.52</td>
<td>.78</td>
</tr>
<tr>
<td>Dressing</td>
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<td>.80</td>
</tr>
<tr>
<td>Cleanli</td>
<td>.72</td>
<td>.74</td>
</tr>
<tr>
<td>Travel</td>
<td>.19</td>
<td>.50</td>
</tr>
<tr>
<td>Recepig</td>
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<td>.55</td>
</tr>
<tr>
<td>Speech</td>
<td>.85</td>
<td>.85</td>
</tr>
<tr>
<td>Persnli</td>
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<td>.60</td>
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<td>Concep</td>
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<td>.78</td>
</tr>
<tr>
<td>Play</td>
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</tr>
<tr>
<td>SD</td>
<td>.64</td>
<td>.66</td>
</tr>
<tr>
<td>RS</td>
<td>.75</td>
<td>.81</td>
</tr>
<tr>
<td>Sensory</td>
<td>.30</td>
<td>.39</td>
</tr>
<tr>
<td>Bodyposn</td>
<td>.94</td>
<td>.73</td>
</tr>
<tr>
<td>Locomotn</td>
<td>.82</td>
<td>.91</td>
</tr>
</tbody>
</table>

Squared Multiple Correlations for Dependent Latent Constructs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Young</th>
<th>Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF</td>
<td>.74</td>
<td>.66</td>
</tr>
<tr>
<td>Cog</td>
<td>.91</td>
<td>.82</td>
</tr>
<tr>
<td>Mo</td>
<td>.95</td>
<td>.99</td>
</tr>
</tbody>
</table>
RMSR), then the Three Factor Model is better. When the criteria of statistical fit (chi-square) and representing the information in the data (rho) are used, PDasG4 is the best model.

Testing Post Hoc Adaptive Behavior Models

The Three Factor and PDasG Models are rejected as plausible models of the ABSI data collected from FCBMR/DD. Neither the three factor theory of adaptive behavior nor the physical development as a general influence theory of adaptive behavior adequately account for these data. Three alternative theories of adaptive behavior in early childhood are proposed in an attempt to discover a plausible model. Because these post hoc models are hypothesized after analyzing the data, they may fit due to capitalizing on chance relations in the data. Replicating the results in a cross-validation sample partially guards against a model capitalizing on chance.


The same factor might be present in the ABSI. Infants and young children develop from an undifferentiated to an increasingly more articulated and differentiated pattern (Werner, 1957) suggesting one factor in infancy with more emerging as the children grow older. The coefficient alpha of the entire ABSI (Table 3), large intercorrelations among the domains (Table 4), and item-total score correlations (Table 14, Appendix C) suggest one common factor.

A One Factor Model was simultaneously fit to the Young (0-2) and Old (3-5) derivation samples. It is inappropriate for these ABSI data because it does not
fit, its estimates and the data are significantly (by chi-square) different, and it does not capture (by rho) all the information in the data (Table 12). The hypothesis that one factor accounts for the ABSI data is rejected. Note that the One Factor Model is a restricted case of the Three Factor Model where the off-diagonal elements of Phi are set equal to 1.0, thereby specifying three perfectly correlated factors—one factor.

Physical Development as a general influence and Play as a dependent factor: PDgLVP.
The Play domain is influenced by all other domains because all adaptive behaviors contribute to Play (Leland, personal communication, October 1985). In early childhood, Physical Development and Play are of major importance. The PDasG Model, is modified by moving the Play domain out of Motivation and placing it where it is directly influenced by Independent Functioning, Cognition, and Motivation, and indirectly influenced by Physical Development's contribution to the other domains (Figure 18). The PDgLVP Model characterizes Physical Development's general influence on, and Play's dependency on, all the other constructs.

| Table 12 Goodness of Fit Indices for Three Post Hoc Models |
|-----------|----------------|---------|----------------|----------------|--------|--------|
| Model     | Chi-Square     | DF      | Q     | Rho | Young RMSR | Old RMSR |
| Null      | 6692.04        | 210     | 31.87 | —   | 19.99      | 23.34   |
| One Factor| 1212.11        | 180     | 6.73  | .81 | 1.53       | 2.06    |
| PDgLVP1   | 1094.64        | 170     | 6.44  | .82 | 1.53       | 2.01    |
| PDgLVP2   | 979.10         | 168     | 5.83  | .84 | 1.18       | 1.80    |
| PDgLVP3   | 88.22          | 166     | 4.75  | .88 | 1.61       | 1.35    |
| PDMOasG1  | 899.14         | 174     | 5.17  | .86 | 1.87       | 1.79    |
| PDMOasG2  | 856.50         | 172     | 4.98  | .87 | 1.70       | 1.52    |
| PDMOasG3  | 846.54         | 170     | 4.98  | .87 | 1.91       | 1.44    |
The PDgDLVPlay1 Model was simultaneously fit without constraints to the Young (0-2) and Old (3-5) derivation samples. It does not fit the data because the model's estimates and the data are significantly (by chi-square) different and an insufficient (by rho) amount of information is explained (Table 12). The modification indices for the path from Cognition to Motivation were 49.1 in the Young and 54.6 in the Old samples. The PDgDLVPlay1 Model was modified, creating PDgDLVPlay2 (Figure 19), by adding this path for the reasons discussed in the PDasG model.

The PDgDLVPlay2 Model does not fit (Table 12) because the model's estimates and the data are different (by chi-square) and it does not (by rho)
capture all the information (Table 12). Including Cognition's contribution to 
Motivation did make a statistically significant improvement in the model's fit to 
the data (Table 13), but the fit was only slightly improved. The modification 
indices for the path from Independent Functioning to Cognition were 62.9 for the 
Young and 95.4 for the Old samples. For the same reasons as in the PDasG 
Model, the PDgDLVPlay2 Model was modified by adding this path creating the 
PDgDLVPlay3 Model (Figure 20).

<table>
<thead>
<tr>
<th>Models Compared</th>
<th>Parameters Tested</th>
<th>Difference Chi-Square</th>
<th>DF</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDgDLVPlay1 vs 2</td>
<td>IF to Cog</td>
<td>115.54</td>
<td>2</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>PDgDLVPlay2 vs 3</td>
<td>Cog to PSMo</td>
<td>190.88</td>
<td>2</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>PDMOasG1 vs 2</td>
<td>PD to Cog</td>
<td>42.64</td>
<td>2</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td>PDMOasG2 vs 3</td>
<td>PD to IF</td>
<td>9.96</td>
<td>2</td>
<td>p &lt; .01</td>
</tr>
</tbody>
</table>

The PDgDLVPlay3 Model did not fit the data (Table 12). It is a statistically 
significant, but slight, improvement over the PDgDLVPlay2 Model because the 
difference (between models 2 and 3) is significant (Table 13).
No further modifications seem warranted. The PDgLDVPlay Models reject the clinical hypothesis that Physical Development exerts a general influence on all domains and that Play is influenced by all domains.

**Physical Development and Motivation as general influences: PDMOasG.**

Perhaps an early childhood model of adaptive behavior should give Motivation a more central role along with Physical Development. The severity of a handicap is often increased by a motivational deficiency (Zigler & Balla, 1977). The 'mental age deficit' is the observation that retarded people score lower than younger nonretarded people of the same mental age. Zigler (1966, 1969, 1973, 1975) explains the retarded's mental age deficit in terms of lower motivation. Correcting motivational problems is often the most important task of habilitation (Meyers et al., 1979).

Accordingly, the PDasG Model is modified by having Physical Development influence Motivation which influences Independent Functioning and Cognition (Figure 21). Physical Development through Motivation exerts a general influence. Both contribute to Independent Functioning and Cognition.

**Figure 21  PDMOasG1**

![Diagram](image)

The PDMOasG1 Model was simultaneously fit without constraints to the Young (0-2) and Old (3-5) derivation samples. The PDMOasG1 Model does not fit these ABSI data (Table 12). The modification indices of the path from Physical Development to Cognition were 15.9 for the Young and 16.5 for the Old
samples. Because Physical Development plays a central role in childhood development, the PDMOasG1 Model was modified by adding this path (Figure 22). This model hypothesizes that Physical Development contributes to Cognition directly as well as indirectly through Motivation.

Figure 22 PDMOasG2

The PDMOasG2 Model did not fit the data (Table 12). The direct affect of Physical Development on Cognition was statistically significant (Table 13), but the model's fit was only slightly improved (Table 12). Given Physical Development's role in early childhood development, the PDMOasG2 Model was again modified by adding a path from Physical Development to Independent Functioning. The modification indices were 1.3 for the Young and 5.8 for the Old samples.

Figure 23 PDMOasG3

The PDMOasG3 Model does not fit the data (Table 12). Despite the statistical significance of this modification (Table 13), the model's fit was only
slightly improved. No further modifications seem warranted. The PDMOasG Models do not support the hypotheses that Physical Development and Motivation exert a general influence on Independent Functioning and Cognition.

Comparisons Among the A Priori and Post Hoc Models

The a priori Three Factor and PDasG Models and the three post hoc models were hypothesized, tested, and rejected as plausible models of these ABSI data.

The post hoc PDgDLVPlay3 Model had the best fit to these data as indicated by the goodness of fit parameters (chi-square or Q, rho, and RMSR). The fit of this post hoc model is slightly better than that of the a priori PDasG4 Model. Because it is a post hoc model, PDasGDLVPlay3 may be capitalizing on chance. This possibility could be tested by cross-validating it in the holdout sample. No model will be replicated in the hold-out sample because none of the models fit the derivation sample well enough to warrant cross-validation.

There seems to be some support for the hypothesis that Physical Development exerts a general influence on the adaptive behavior of young children. Physical Development is an independent construct in the three best fitting models (PDasGDLVPlay3, PDasG4, and PDMOasG3). No support is found for the One or Three Factor hypotheses of the adaptive behavior of young children. These trends seem to indicate that adaptive behavior is a fairly articulated set of interrelated constructs among children younger than six.
Chapter V
DISCUSSION

This research has examined the statistical utility of ABSI models to account for a large number of relations among the ABSI's items by a greatly reduced number of relations among latent and measured variables. Finding that several ABSI covariance structure models are not plausible for these norm-referenced data contributes to the ongoing process of construct validation. This present failure to add to the norm-referenced construct validity studies of Leland (1981) and Barclay (1984) is no doubt a temporary situation. Like any test, how the ABSI is used determines the importance of the different types of validity. This research has not examined the criterion-referenced clinical utility of the ABSI in identifying the strengths and weaknesses of children younger than six, formulating early intervention treatment plans, and monitoring response to intervention. Such concurrent and predictive validity research, for example Leland (1981), is left to others.

It has been argued that the ABS and ABSI are structurally comparable because the ABSI is a downward extension of the ABS, both group the domains similarly, and the ABSI replicates the ABS domains as they are age appropriate (Leland et al. 1975; Leland, 1981). Although physical development is the keystone for further growth and development (Leland, personal communication,
October 1985), such ABSI covariance structure models were rejected as plausible models of these data. Therefore the comparability, in terms of a general physical development construct, of the ABS and ABSI must be questioned. Both Vygotskii (Luria, 1966) and Coulter and Morrow (1978) contend that the interpretation of clinical and adaptive behavior data must change at different developmental levels. Perhaps ABSI modeling will be more successful if comparisons to the ABS are avoided. But, the possibility that the ABS and ABSI are comparable in some other form is not ruled out.

To summarize, criterion-referenced construct validation using deviations from the criterion score is appropriate when a test is used in individualized treatment planning and assessment of behavioral change during intervention. Norm-referenced construct validation using deviations from the mean is appropriate when a test is used for identification and placement of people. This research has followed the norm-referenced approach to validation. Each person's score on the measured variables was related to the variable's mean score. The variance-covariance matrix summarized these relations. Covariance structure modeling was used to analyze these norm-referenced ABSI data comparing between people. The ABSI's norm-referenced construct validity was not increased because adaptive behavior models did not fit these norm-referenced data.

Hypothesis testing by covariance structure modeling involves fitting a model to data. The model is a collection of hypotheses about a test's observed variables, hypothetical constructs, relations between observed variables and hypothetical constructs, relations among hypothetical constructs, and errors in measurement of variables and in prediction of constructs. The extent of a
psychological test's construct validity is the degree to which a model of the
test's constructs fits the observed data. Goodness of fit measures summarize
the degree to which the model's estimated variance-covariances reproduce the
observed variance-covariances. The model's ability to adequately represent the
observed data implies that the model is a plausible representation of the
process that produced the observed data.

**Why None of the Models fit the ABSI Data**

It seems that existing theories of adaptive behavior in early childhood are
inadequately specified to survive hypothesis testing by covariance structure
modeling. It has not been demonstrated that the ABSI has norm-referenced
construct validity in this sample of children. Social science theories are often
not as well developed as the methodological tools which evaluate them
(Wiggins, 1973; Drew, 1973). In any science, theory is often less advanced than
the tools which advance it. LISREL is a tool which rigorously tests theories.
Because the power of LISREL is greater than the power of current theories of
adaptive behavior in early childhood, the proposed ABSI models were all
rejected.

**Problems with the models.** There are four possible reasons why none of
the models fit these data. A correct model may exist, but it was not tested.
Second, the construct of adaptive behavior may not exist or may be too vague
to be measured. Third, perhaps no covariance structure model will fit the
norm-referenced ABSI data due to the atypical developmental pattern of
handicapped children. And fourth, norm-referenced rather than criterion-
referenced measured variables were used to test the models.
The plausible model was not tested. Perhaps there is a correct model of infant and early childhood adaptive behavior, but it has not yet been found. Rejection of one, a few, or many hypothesized models does not preclude the possibility that a plausible model will eventually be found. Only after all possible models have been tested and rejected can one assert that there is no plausible model.

We have insufficient knowledge about early childhood adaptive behavior to successfully model its nomological network. The current literature insufficiently specifies adaptive behavior models to meet the demands of LISREL analyses. More research is needed on the observed variables, hypothetical constructs, linkages between observed variables and constructs, and linkages among constructs of adaptive behavior. Perhaps more theoretical work is also required on the adaptive behavior of older children and adults. Because the ABSI is grounded in the ABS, perhaps LISREL analysis of the ABS is needed.

More test development work is required on the ABSI. Perhaps the current ABSI items and grouping of items into subdomains and domains are an inadequate operationalization of adaptive behavior theory. Item analysis by item-domain correlations shows that about a third of the ABSI items load more highly on one to several other domains than they load on their own domain. This and the high coefficient alpha for the entire ABSI buttress the degree of item and domain overlap mentioned by Leland (1982). However, some items are "poor" indicators because they are related to several domains. These items can not be discarded precisely because they relate to many adaptive behavior domains, providing valuable criterion-referenced information. The relation of
these items to the domains needs to be represented by models in which items load on more than one domain. These more complex measurement models may be required for criterion referenced tests. Perhaps the wrong level (15 (sub)domain scores) of analysis was used for the measurement model. The 62 items could each be measured variables, the items could be grouped into say 30 measured variables, or the seven domains could be the measured variables.

**Definition of the adaptive behavior construct.** Perhaps adaptive behavior does not exist, or it is too vague a construct to be measured (Zigler, Balla, and Hodapp, 1984). "[T]he [AAMD] concept of social adaptation is simply too illusive and ill-defined to be a criterion of mental retardation" (p. 218). "The problem with many of our common terms is that they lack rigorous definition and are therefore confusing" (p. 222). "A probable reason why professionals generally avoid social adaptation indicators [such as the ABSI]...in opposition to the...views of certain prominent workers in the field (e.g., Leland, 1969) ...has to do with limitations of the construct. [B]ecause social adaptation is so far from basic definition, measures to assess it necessarily lack validity" (Zigler et al. 1984, p. 226, bracketed comments added). If there is no adaptive behavior, then there can be no model of it. If the adaptive behavior construct is undefined, then LISREL model testing is inappropriate until it is well defined.

**Atypical developmental pattern.** The behavior of young handicapped children may be so atypical, idiosyncratic, and heterogeneous that a norm-referenced covariance structure model can not fit their ABSI data. Leland (1983) asserts that "children do not fall into consistent developmental groups...[W]hen...scores are used to identify a child's level of functioning within specific domains, such as Independent Functioning or Conceptual Skills, we
again find inconsistencies in the results" (p. 196). Leland (1982) found a "...distinct developmental growth pattern that varied widely...[T]hese factors of atypical development indicate that increased chronological age or decreasing degree of retardation does not necessarily coincide with an increase in functional adaptation ... In dealing with adaptive behavior measurements...we are dealing with very idiosyncratic types of behaviors ...[l]nfants['] ... growth patterns are even more idiosyncratic than those of older children and adults" (Leland, 1982, p. 198-200). The relationships among the measured variables may change so much from child to child that it is impossible for a model to fit all the children. However, the strong inter-item and inter-domain correlations imply that stable and consistent relationships among the measured variables are present.

Perhaps a model of the adult ABS will fit even though models of the ABSI do not fit. Perhaps the heterogeneous developmental trajectories of young children causes the model to not fit the ABSI data, but it will fit the ABS data because the behavior of older children and adults has settled into more homogeneous patterns.

Criterion-referenced data should be analyzed. The best explanation of the failure to find a plausible model of adaptive behavior in early childhood is that the data were analyzed in a norm-referenced, rather than criterion-referenced, manner. ABSI models should be fitted to variances-covariances that are computed as deviations from the criterion, rather than the mean, score. Analyzing criterion-referenced data may result in a plausible model of early childhood adaptive behavior.
Carver (1974) called for an "edumetric" criterion-referenced approach to the construction, analysis, and use of measures designed to assess within-person change or development. Livingston (1973) translated the psychometric norm-referenced statistics of classical test theory (variance, correlation, etc.) into an edumetric criterion-referenced form. Livingston's insight was to compare a person's score to the criterion score (the item's passing score which in the ABSI is the total number correct).

The purpose of testing and the use of the results determine how one should assess (Carver, 1974; Coulter & Morrow, 1978; Leland, 1983; Messick, 1980; 1983;). When a measure is used in a norm-referenced manner assessing between-individual differences, then standard psychometric statistics are appropriate. When a measure is used in a criterion-referenced manner assessing within-individual development and response to intervention, then edumetric statistics are appropriate (Carver, 1974; Leland, 1983).

Criterion-referenced construct validation by fitting ABSI models to the criterion-referenced ABSI data is required because the ABSI was constructed by criterion-referenced procedures, to attain criterion-referenced goals, and it is most frequently used as a criterion-referenced test. Each item references criterion behaviors and specific behavioral tasks critical to early childhood development. Behaviorally specific individual education and treatment plans, and the assessment of development in response to such intervention, are based on the information from the ABSI's items, subdomains, and domains (Leland, 1981).

A test may be analyzed in both norm- and criterion-referenced ways, but its reliability and validity may change (Messick, 1983; Carver, 1974; Livingston, .
1973). When the mean is the criterion score than analyzing a measure in a norm-referenced manner is the same as analyzing it in a criterion-referenced manner. Usually a test's criterion-referenced reliability will be greater than its norm-referenced reliability because people are more distant from the criterion than from the mean. As the sample's ability approaches the criterion, the criterion-referenced reliability declines.

This research has modeled the comparisons of one child's adaptive behavior to another child's adaptive behavior as measured by the ABSI. The ABSI variances-covariances were computed and analyzed in the standard psychometric (Carver, 1974) norm-referenced (Coulter and Morrow, 1978; Crohbach, 1970; Drew, 1973; Leland, 1983; Livingston, 1973; Messick, 1983) manner. All prior research on the ABS and ABSI has taken this traditional approach. While high internal consistency and adequate item-domain correlations were obtained, no covariance structure model fits these norm-referenced ABSI data. None of the hypothesized models of early childhood adaptive behavior adequately represented the between-child individual differences in adaptive behavior. Hence, this work did not add to the construct validity of the ABSI when analyzed from a norm-referenced perspective. Should further norm-referenced investigations continue to find no support for the norm-referenced construct validity of the ABSI it would become increasingly likely that the use of the ABSI as a norm-referenced measure of adaptive behavior lacks construct validity.

This dissertation has not analyzed the criterion-referenced construct validity of the ABSI for its descriptions of a child's strengths and weaknesses relative to specific behavioral competencies for intervention purposes. As
Carver (1974) has contended "if test scores that measure gain well are desired, then the test should be designed, developed, and evaluated with a focus on edumetric principles" (p. 517). Such an edumetric approach using criterion-referenced statistics (Livingston, 1973) to compute the ABSI's variances-covariances holds promise for modeling the covariance structure of the Adaptive Behavior Scale for Infants and Early Childhood.
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APPENDIX A

THE ADAPTIVE BEHAVIOR SCALE FOR INFANTS AND EARLY CHILDHOOD (ABSI)
Adaptive Behavior Scale for Infants
and Early Childhood
(ABSI)

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ADAPTIVE BEHAVIOR SCALE FOR INFANTS AND EARLY CHILDHOOD (ABSI)

Child's Name ____________________________ (Last) (First) (MI)

Date of Birth ____________________________ Age: ________ (Month) (Day) (Year) Sex: M F

Source of information and relationship to person being evaluated (e.g. John Doe - Father; or Mary Smith - Physician).

(Name) ____________________________ (Relationship)

Additional information include any previous diagnosis: ________________

Date of Administration ________________ Name of Examiner ________________

Use of Medication Yes ______ No ______

If possible, specify names of medication ________________

This Scale consists of a number of statements which describe some of the ways infants and young children act in different situations. The method for administering and scoring appears in the accompanying Manual.

Instructions for Part One

There are two kinds of items in the first part of the Scale. The first requires that you select only ONE of the several possible responses. For example:

Early Feeding Skills (Circle only ONE)

Holds own bottle 3
Opens mouth on approach of nipple or spoon 2
Cooperates while being fed 1
Does not cooperate while being fed 0
Other ________________
Notice that the statements are arranged in order of difficulty: 3, 2, 1, 0. Circle the one statement which best describes the most difficult task the child can usually manage. In this example, the infant being observed can open mouth on approach of nipple or spoon (2), but cannot hold own bottle (3). Therefore, (2) is circled in the example above. In scoring, 2 is entered in the circle to the right.

The second type of item asks you to check ALL statements which apply to the person. For example:

6. Common Table and Eating Problems (Check ALL statements which apply)

- Tongue thrusts food out of mouth
- Usually swallows solid food without chewing or does not eat solid food
- Stuffs mouth with food
- Gags or chokes constantly when eating
- Leaves table, won't stay seated or tries to climb out of high chair
- Spits and/or throws food
- Spills food off of plate or is fed completely by caretaker
- Other

In the example above, the second and fourth items are checked to indicate that the infant "Usually swallows solid food without chewing or does not eat solid food" and "Gags or chokes constantly when eating". In scoring, the number of items checked, 2, is subtracted from 7, and the item score, 5, is entered in the circle to the right. Most items do not, however, require this subtraction; instead, the number checked can be directly entered as the score. The statement "Other" which is included for administrative purposes only, is not to be counted in scoring here.

Some items may deal with behaviors that are clearly not possible for the infant to perform because the opportunity does not exist, (e.g. Toilet Skills are not possible for a "babe in arms"). In these instances, you must still complete your rating, following the instructions on the rating scale. Write "UNO" for "has No Opportunity" next to the rating made in these cases. These notations will not affect the eventual scoring of that item, but will contribute to the understanding and interpretation of the person's adaptive behavior and environment.

Please observe the following general rules in completing the Scale:
1. In items which specify "with help" or "with assistance" for completion of task, these mean with direct physical assistance.

2. Give the person credit for an item even if he or she needs verbal prompting or reminding to complete the task unless the item definitely states "without prompting" or "without reminder."

This Scale is prepared for general use. Therefore, some of the items may not be appropriate for your specific setting, but please do try to complete all of them.
I. INDEPENDENT FUNCTIONING

A. Eating and Drinking

1. Diet (Circle only ONE)
   Diet consists primarily of:
   - Adult table food (may be cut into small pieces) ..... 4
   - Baby food and/or ground-up or mashed table food ..... 3
   - Bottle or breast fed, with some baby food .......... 2
   - Bottle and/or breast feedings .......................... 1
   - Inter-venous (I.V.) or tube feedings .................... 0
   Other ____________________________________________

2. Early Feeding Skills (Circle only ONE)
   - Holds own bottle ........................................... 3
   - Opens mouth on approach of nipple or spoon ....... 2
   - Cooperates while being fed ................................ 1
   - Does not cooperate while being fed .................... 0
   Other ____________________________________________

3. Sucking and Swallowing (Circle only ONE)
   - Sucks and swallows liquids effectively ............... 2
   - Sucking and swallowing is weak .......................... 1
   - Sucking and swallowing is absent ....................... 0
   Other ____________________________________________

4. Self-Feeding Skills (Circle only ONE)
   - Uses knife for cutting ..................................... 7
   - Uses fork properly ........................................... 6
   - Spoon feeds self all kinds of food, including soups, peas, etc. ............................................. 5
   - Spoon feeds self if food is the kind that stays on spoon (for example, pudding, oatmeal, etc.) ......... 4
   - Feeds self with special spoon .............................. 3
   - Needs help getting food on spoon, but brings spoon to mouth alone ........................................ 2
   - Feeds self some foods with fingers ..................... 1
   - Does not use utensils to feed self ........................ 0
   Other ____________________________________________

5. Chewing and Swallowing (Circle only ONE)
   - Sucks effectively through a straw and swallows ...... 4
   - Chews and swallows bite-sized pieces of solid food without difficulty ..................................... 3
   - Chews and swallows chopped bits of solid foods ....... 2
   - Swallows soft foods such as baby cereal, applesauce, pudding, etc ...................................... 1
   - Does not take solid foods ................................... 0
   Other ____________________________________________
6. **Common Table and Eating Problems** (Check All statements which apply)

- Tongue thrusts food out of mouth
- Usually swallows solid food without chewing or does not eat solid food
- Stuffs mouth with food
- Gags or chokes constantly when eating
- Leaves table, won't stay seated or tries to climb out of high chair
- Spits and/or throws food
- Spills food off of plate or is fed completely by caretaker
- Other

Add #1 - 8

7. **Drinking Skills** (Circle only ONE)

- Drinks from cup while holding it by self
- When drinking, helps caretaker hold cup
- Drinks from cup when cup is held by another person
- Drinks with help from special cup
- Does not drink from cup at all
- Other

8. **Common Drinking Problems** (Check All statements which apply)

- Throws cup
- When drinking from a cup, bites cup or sucks liquid
- Spills considerable amount of liquid when drinking from a cup held by either caretaker or self
- Gags or chokes constantly when drinking
- Other

Add #1 - 8

**A. Eating and Drinking**

**B. Toileting**

9. **Toilet Training** (Circle only ONE)

- Rarely has toilet accidents; and uses toilet on own initiative
- Rarely has toilet accidents and communicates need to go to the toilet (with gestures or words)
- Is toilet trained during the day with infrequent accidents
- Occasionally uses a potty chair or toilet but has frequent accidents
- Is aware when diaper is wet or soiled
- Is unaware of wet or soiled diapers
- Other
10. **Toilet Skills** (Check All statements which apply)

- Washes hands after using the toilet.
- Pulls pants up and snaps or zips them.
- Uses toilet paper effectively.
- Flushes toilet after use.
- Pulls pants up and down appropriately at the toilet.

Other _________________________________________

ADD # 9 - 10

B. **Toileting**

C. **Dressing**

11. **Undressing** (Check All statements which apply)

- Helps by pulling arms or legs out of openings in clothes.
- Takes off socks and shoes (may be untied).
- Takes off unbuttoned or unzipped shirts and coats.
- Takes off pullover shirts.
- Pulls off unfastened or elastic waist band pants.
- Unbuttons shirts and coats.
- Unzips zippers.
- Other _________________________________________

ADD #11 - 12

12. **Dressing** (Check All statements which apply)

- Dresses self completely; rarely needs help with small buttons, zippers and tying shoes.
- Zips own zippers (may occasionally need some help).
- Buttons own shirts and coats (may occasionally need some help).
- Puts on shirts and jackets (may be inside out, not necessarily buttoned or zipped).
- Puts on shoes and socks (not necessarily tied or on the correct foot).
- Puts on pants.
- Helps by extending arms or lets through openings in clothes.
- Other _________________________________________

ADD #11 - 12
D. Cleanliness

13. Toothbrushing (Circle only ONE)

Brushes teeth without assistance (puts paste on brush, turns water on and off, etc.) ................. 3
Attempts to brush teeth partially; must be prompted or supervised ............................................ 2
Cooperates when teeth are brushed or cleaned by caretaker ......................................................... 1
Does not cooperate when teeth are being brushed or cleaned by caretaker or is too young to have teeth brushed ................................................................. 0

14. Washing Hands and Face (Check All statements which apply)

Rubs hands together in water ........................................ 3
Soaps and rinses off hands and/or face without help ......... 3
Turns water on and off without help ................................ 3
Uses towel properly to dry hands and face .................... 3
Other ________________________________________________

15. Bathing (Circle only ONE)

Washes and dries self without aid (with caretaker present but not giving assistance) ..................... 3
Attempts to wash self (partially) while supervised or prompted by caretaker ................................. 2
Cooperates when bathed by adult or given sponge bath 1
Does not cooperate when bathed by adult or given sponge baths ................................................. 0
Other ________________________________________________

ADD #13 - 15

D. Cleanliness

E. Travel Skills

16. Travel Skills (Check All statements which apply)

Is able to cross streets safely by self .................. 3
Goes short distance from home without getting lost .. 3
Behaves safely in a car and sits on a regular car seat independently ........................................ 3
Behaves safely in a bus and sits on a regular bus seat independently ........................................ 3
Other ........................................................................

ADD #16

E. Travel Skills

INDEPENDENT FUNCTIONING

ADD TRIANGLES A - E
II. PHYSICAL DEVELOPMENT

A. Sensory Development

(There is no item 17.)

18. Visual Awareness (check ALL statements which apply)

- Looks at objects within reach.
- Looks at own body parts, i.e., hands, feet, etc.
- Looks at objects or people across the room.
- Looks attentively from one object to another.
- Watches objects as they move in a variety of directions, i.e., as they move up and down, back and forth, etc.
- Other

*Blind (if checked, enter "0" score in circle to rt.)

19. Visual Attention Span (Check ALL statements which apply)

- Has difficulty maintaining eye contact with others.
- Eyes dart from object to object; looks at objects for only a brief period of time.
- Stares off into space inappropriately and/or excessively.
- Other

*Blind (If checked, enter "0" score in circle to rt.)

20. Auditory Awareness (Circle only ONE)

- Shows recognition of familiar sounds such as the telephone or doorbell.
- Locates source of sound.
- Recognizes mother's or caretaker's voice.
- Responds to unexpected loud noises.
- Does not respond to sound at all.
- Other

ADD #18 - 20

A. Sensory Development

B. Control of Body Positions

21. Head Control (Circle only ONE)

- Has good head control in all positions.
- Holds head erect and steady while in a sitting position.
- Lifts head while lying on back.
- Lifts and turns head while lying on stomach.
- Lifts head while on stomach.
- Holds head erect for at least a short period of time while in a sitting position, head may bob up and down.
- Has no control over head movements in any position.
- Other
If 0 on #22, then score 0 for #23

23. Difficulties in Reaching and Grasping (Check ALL statements which apply)

- Has difficulty bringing objects to mouth
- Frequently misses objects he/she is reaching for
- Objects easily slip from grasp
- Has difficulty opening hand for grasping (hand is often in a fist)
- Has use of only one hand for reaching or grasping

24. Sitting (Circle only ONE)

- Climbs into or seats self in a chair
- Sits steadily without using own hands or other objects for support
- Sits using hands for support without help from others
- Sits holding onto something for support
- Sits with support from chairs, pillows, caretaker's lap, etc
- Is not held or placed in a sitting position

25. Standing (Circle only ONE)

- Balances on one foot for at least 5 seconds
- Stands on tiptoes and maintains balance for at least 3 sec
- Goes from sitting to standing position without holding onto anything for support
- Stands without support
- Pulls self to standing position while holding onto furniture or other objects
- Stands holding onto solid objects for support
- Bears some weight on legs if held steady
- Bears no weight on legs if held steady

B. Body Control

ADD #21 - 25
C. Locomotion

26. **Primary Means of Locomotion** (Circle only ONE)
   - Walking ................................................................. 5
   - Moving on hands and knees ...................................... 4
   - Bunny-hopping or scooting on bottom or back .............. 3
   - Sliding on stomach or rolling .................................. 2
   - Turns self in different directions while lying on stomach but does not move forward or backward intentionally 1
   - Does not move about ................................................ 0
   - Other _____________________________________________

27. **Rolling** (Circle only ONE)
   - Rolls from back to back ........................................... 5
   - Rolls from back to stomach getting both arms out from under chest ...................................................... 4
   - Rolls from back to stomach ...................................... 3
   - Rolls from stomach to back ...................................... 2
   - Rolls from stomach to side or from back to side .......... 1
   - Does not roll at all .................................................. 0
   - Other _____________________________________________

28. **Walking** (Circle only ONE)
   - Walks alone and rarely falls ................................... 5
   - Walks alone and frequently falls ............................... 4
   - Walks without support for at least a few steps without falling ................................................................. 3
   - Walks sliding onto solid objects (cruising) .................. 2
   - Walks if supported by an adult ................................. 1
   - Does not walk even if supported by an adult ................ 0
   - Other _____________________________________________

29. **Traveling on Stairs** (Circle only ONE)
   - Walks upstairs or downstairs, alternating feet (may hold onto railing) ...................................................... 4
   - Walks upstairs or downstairs but does not alternate feet 3
   - Walks upstairs or downstairs with the help of another person ................................................................. 2
   - Creeps or scoots upstairs or downstairs ...................... 1
   - Does not move self upstairs or downstairs .................. 0
   - Other _____________________________________________

30. **Complex Motor Skills** (Check All statements which apply)
   - Runs well with only occasional falling .....................
   - Jumps in place, both feet off the floor .....................
   - Hops on one foot ....................................................
   - Jumps off or over objects ........................................
   - Other _____________________________________________

ADD #26 - 30
III. COMMUNICATION SKILLS

A. Receptive Language

31. Receptive Language (Circle only ONE)

- Recognizes and/or points to some familiar objects or pictures of them when they are named......................... 4
- Recognizes own name when spoken by another person........ 3
- Responds differently to various tones of voice............. 2
- Is often quieted by a familiar voice.......................... 1
- Shows no response when spoken to........................................ 0

Other ___________________________________________________ 0

32. Following Commands (Circle only ONE)

- Follows two step directions (for example, "Shut the door and turn off the light." or "Take off your coat and hang it up.").................................................. 3
- Follows simple one step commands such as "Take the ball." or "Sit down.".................................................. 2
- Understands some simple gestures (for example, looks where a person points or responds to a "come here" gesture).... 1
- Does not understand any type of command......................... 0

Other _____________________________________________________

ABC 31 - 32

A. Receptive Language

B. Speech Content

33. Mode of Expressive Communication (Circle only ONE)

- Indicates wants or needs using words or appropriate signs 3
- Indicates wants or needs using vocal sounds (not including crying)............................................................ 2
- Indicates wants or needs using gestures........................ 1
- Does not indicate wants or needs........................................ 0

Other _____________________________________________________
### 34. Early Sound Patterns (Circle only ONE)

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a vocabulary of at least 10 understandable words</td>
<td>8</td>
</tr>
<tr>
<td>Makes strings of sounds containing some understandable words</td>
<td>7</td>
</tr>
<tr>
<td>Uses sounds to label objects (for example, &quot;ca&quot; for car, &quot;oo&quot; for juice, etc.)</td>
<td></td>
</tr>
<tr>
<td>When babbling, combines different sounds (for example, &quot;ba-da&quot;, &quot;ee-ga&quot; etc.)</td>
<td>6</td>
</tr>
<tr>
<td>Babbles sounds over and over (e.g. &quot;na-na-na-na&quot;)</td>
<td>4</td>
</tr>
<tr>
<td>When alone, makes cooing, gurgling, sucking noises, or other sounds besides crying</td>
<td>3</td>
</tr>
<tr>
<td>Makes sounds when played with or talked to by caretaker</td>
<td>2</td>
</tr>
<tr>
<td>Has different cries when hungry, uncomfortable, lonesome, etc.</td>
<td>1</td>
</tr>
<tr>
<td>Cries sound the same in all situations and for all emotions</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

### 35. Sentence Production (Circle only ONE)

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses future tense in sentences (for example, &quot;I will play&quot;)</td>
<td>5</td>
</tr>
<tr>
<td>Produces sentences containing five or more words</td>
<td>4</td>
</tr>
<tr>
<td>Uses past tense in sentences (not necessarily using correct form, e.g. &quot;he good away,&quot; or &quot;he went away&quot;)</td>
<td></td>
</tr>
<tr>
<td>Uses three word phrases (e.g. &quot;he want milk&quot;)</td>
<td>3</td>
</tr>
<tr>
<td>Combines two words (e.g. &quot;more milk,&quot; &quot;daddy go&quot;)</td>
<td>2</td>
</tr>
<tr>
<td>Does not combine words</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

### 36. Intelligibility (Circle only ONE)

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strangers understand his/her words almost all the time</td>
<td>4</td>
</tr>
<tr>
<td>Strangers understand his/her words more than 50% of the time</td>
<td>3</td>
</tr>
<tr>
<td>Caretakers understand his/her words more than 50% of the time</td>
<td>2</td>
</tr>
<tr>
<td>Caretakers understand his/her words less than 50% of the time</td>
<td>1</td>
</tr>
<tr>
<td>Has no understandable words</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

### 37. Imitation Skills (Circle only ONE)

<table>
<thead>
<tr>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>When asked, repeats: Phrases of at least 2 words</td>
<td>5</td>
</tr>
<tr>
<td>Single words</td>
<td>4</td>
</tr>
<tr>
<td>Speech sounds (for example, &quot;la&quot; or &quot;ee&quot;, etc.)</td>
<td>3</td>
</tr>
<tr>
<td>Mouth movements (e.g., blowing, or puckering lips, etc.)</td>
<td>2</td>
</tr>
<tr>
<td>Gestures (e.g., clapping, pointing, or waving bye-bye, etc.)</td>
<td>1</td>
</tr>
<tr>
<td>Does not imitate when asked</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
38. **Vocabulary** (Check All statements which apply. Enter an example for each statement checked.)

If score on #35 is 3, 4, or 5, score 5 on #38.

Uses words or appropriate signs to indicate:

a. Parent or caretaker (e.g., ma-ma, da-dy, mom, etc.)
   Example

b. Objects (e.g., car, ball, cookie, etc.)
   Example

c. Actions (e.g., walking, throw, go, take, come, etc.)
   Example

d. Quantities (e.g., full, more, all gone, etc.)
   Example

e. Location of objects (e.g., there, here, in, under, etc.)
   Example

39. **Use of Pronouns, Plurals, Possessives, and Adjectives**
   (Check All statements which apply. Enter an example for each statement checked.)

Uses the following in speech or signs:

a. Adjectives (e.g., big, red, hot, pretty, etc.)
   Example

b. Pronouns (e.g., me, you, her, etc.)
   Example

c. Plurals (e.g., cookies, balls, blocks, etc.)
   Example

d. Possessives (e.g., mine, daddy's, his, etc.)
   Example

40. **Asks Questions**
   (Check All statements which apply. Enter an example for each statement checked.)

a. Asks questions through intonation of voice (e.g., "Mommy here?" "Daddy gone," or "Are we going?")
   Example

b. Asks "where" questions (e.g., "Where's Mommy?")
   Example

c. Asks the name of objects (e.g., "What's this?")
   Example

d. Asks "why" questions (e.g., "Why are you sad?")
   Example

e. Asks "when" questions (e.g., "When are we going?")
   Example

f. Asks "how" questions (e.g., "How does this go?")
   Example
41 Converses (Check All statements that apply)

- Can carry on simple conversations
- Gives simple definitions of common objects (e.g., "What is a coat?" or "What do you do with a cup?"
- Answers simple "where" questions
- Identifies common objects when asked "What's this?"
- Answers or nods "yes" or "no" to questions

ADD # 33-41

B. Speech Content

C. Personal Identification Skills

42 Identification Skills (Check All statements which apply)

- Gives first name when asked
- Gives last name when asked
- Gives address when asked
- Other

ADD #42

C. Personal Identification Skills

COMMUNICATION SKILLS

ADD TRIANGLES A, B, and C

IV. CONCEPTUAL SKILLS

43 Awareness of Body (Check All statements which apply)

- Watches and plays with hands
- Recognizes self in mirrors or in pictures
- Identifies or points to at least one body part
- Identifies or points to more than three body parts
- Knows own sex
- Other
44. **Shapes** (Check All statements which apply. Give an example for every statement checked.)

- Matches simple shapes (e.g., puts lids on boxes or pots, completes a very simple puzzle, or puts coins in a piggy-bank)

  Example

- Matches complex shapes (e.g., completes a puzzle containing more than 3 pieces)

  Example

- Identifies the following shapes (either verbally or by pointing):
  - circle
  - square
  - triangle
  - diamond

Example

45. **Number Concepts** (Check All statements which apply)

- When asked, picks up or points to the correct number of objects:
  - up to two
  - up to five
  - up to ten
  - more than ten
  - Other

46. **Size Concepts** (Check All statements which apply)

- Show understanding of size words:
  - big and little
  - long and short
  - fat and thin
  - Other

47. **Money Concepts** (Check All statements which apply)

- Knows that money is used to buy things
- Knows that coins and dollars are money
- Knows how to operate a simple coin machine in a store or a restaurant
- Makes a simple purchase (for example, indicates what she or he wants and exchanges money for an item)

Other
48. **Measurement** (Check All statements which apply)

- Knows purpose of:
  - Clock or watch (does not have to be able to tell time)
  - Calendar
  - Ruler, tape measure, or yardstick
  - Scale
  - Other

49. **Time words** (Check All statements which apply)

- Show understanding of time words:
  - Today
  - Tomorrow
  - Yesterday
  - Morning, afternoon, and nighttime (must know all three to be checked)
  - Before, after, now, and later (must know all four to be checked)

50. **Time Awareness** (Check All statements which apply)

- Correctly identifies the current:
  - Day of the week
  - Month
  - Season

---

CONCEPTUAL SKILLS

V. **PLAY**

51. **Spatial Relationships** (Check All statements which apply)

- Moves to get object from around barrier
- Looks behind self for object
- Looks over edge of chair, crib, etc. for lost object (visually searches)
- Visually follows objects or people to where they disappeared, e.g. ball rolls under table, mom leaves room
52. Exploratory Play with Objects (Check All statements which apply. If score on this is 4 or greater, assign item 53, a score of 8).

- Hammers and pounds objects
- Empties and fills container (w/sand, water beads, etc.)
- Stacks blocks, boxes, pillows, books, etc.
- Rolls, bounces, and/or retrieves balls
- Pushes and pulls wagon, blocks, pull toys, etc.
- Scribbles with a stick, crayon, chalk, etc.
- Digs in a sand box, dirt pile, etc.
- Builds small play buildings (e.g. houses, forts, castles).

*Does not show interest in playing with objects (If checked, enter a score of 0 in the circle to the right.)

53. Sensorimotor Play (Ask only if score on item 51 was less than 4. Check All statements which apply.)

- Puts objects in mouth
- Bats at objects with arms, hands, or other objects
- Shakes objects
- Attempts to pull, hold, or touch another's face, clothing, hair, etc.
- Bangs objects together
- Drops or throws objects intentionally
- Actively participates in peek-a-boo
- Actively participates in pat-a-cake

*Does not play (If checked, enter a score of 0 in the circle to the right.)

54. Amassing (Check All statements which apply)

- During play:
  - Opens cupboards and draws and removes contents
  - Puts objects into piles or groups
  - Collects common objects (rocks, leaves, dolls, trucks, etc)

Other

55. Imaginative Play (Check All statements which apply)

- Pretends he/she is going to be sleeping, eating, or dressing
- Uses toys during make-believe play in a way that corresponds to their intended use (e.g., toy telephones, tea sets)
- Pretends an object is something else (e.g., a stick becomes a rocket or a piece of clay becomes a cookie, etc.)
- Pretends to be another person (or animal) he/she knows well (pretends to be father or mother, baby sister, pet, etc.)
- Assumes the role of another person besides a family member (pretends to be a doctor, fireman, etc.)

*Does not engage in imaginative play (If checked, enter a score of 0 in the circle to the right.)
Social Play (Check adult and/or children categories as they apply. It is possible to have both categories checked for each statement. For item score, add total number of checks. Maximum possible score = 10.)

Plays simple board or card games (e.g. Old Maid, Slap Jack, Checkers, Candyland, etc.)

Knows the rules and actively participates in nursery rhyme or simple group games (e.g. Ring-Around-The-Rosey, London Bridge, Tag)

Engages in imaginative play with another person (e.g. plays house, cops and robbers, pretends to be an animal and wants adult to play along, etc.)

Engages in exploratory or motor play activities with another person (e.g. stacks blocks cooperatively, builds small play building together, teeter-totters, pushes wagons, plays chasing games, etc.)

Enjoys physical play (e.g. gentle bouncing, lifting in air, piggy-back riding, rough-housing)

Other

# Does not engage in social play (If checked, enter a score of "0" in the circle to the right.)

TOTAL

ART PLAY

Art Play (Check ALL statements which apply)

Uses clay or playdoh to make shapes or objects

Draws lines, shapes or pictures (rather than scribbles)

Cuts and pastes paper

Does pencil and paper games (dot to dot pictures, tic-tac-toe, mazes, hidden pictures, etc.)

Other

# Does not engage in art play (If checked, enter a score of "0" in the circle to the right.)

ADD #51 - 57

PLAY
VI. SELF DIRECTION

58. Initiative (Check ALL statements which apply)

- Pays attention to things happening around him/her
- Plays with a toy for an extended period of time
- Tries to take part in the activities of others
- Sometimes indicates he/she wants to do a certain activity (e.g., watch TV, go outside, etc.)
- Rarely depends on others for help to perform activities that he/she can do for himself/herself
- Makes and carries out decisions independently, e.g., sometimes chooses clothing, playmates, or food in a restaurant, etc. (may indicate decisions verbally or non-verbally)
- Occasionally starts group activities
- Other

59. Attention (Circle only ONE)

- Concentrates on an activity he/she likes for at least thirty minutes
- Concentrates on an activity he/she likes for at least ten minutes
- Usual attention span is between one to five minutes
- Usual attention span is less than one minute
- Does not seem to attend to anything
- Other

ADD #59 - 58

SELF DIRECTION

VII. PERSONAL RESPONSIBILITY AND SOCIALIZATION

60. Moral Development (Check ALL statements which apply)

- Gives excuses for why he/she did something wrong
- Usually dependable; does jobs he/she has been told to do, like putting his/her toys away or picking up clothes
- Frowns, scolds, or tattles when someone else does something wrong
- Stays away from most things caretaker has told him/her not to touch or go near (e.g., dangerous things like medicines, moving cars, fire and fragile household items)
- Stops what he/she is doing when a caretaker tells him/her "no" in a very firm voice, or when caretaker threatens to punish him/her if he/she doesn't
- Other
61: **Consideration for Others** (Circle only ONE)

- Tries to get help for a child that is hurt or crying..... 4
- Apologizes or tries to do something when he/she has been unkind................................................................. 3
- Comforts an unhappy person by hugging him/her, talking to him/her, or offering something to make him/her feel better................................................................. 2
- Helps caretaker perform small cooking or cleaning tasks.. 1
- Does not help others......................................................... 0
- Other__________________________________________________

62. **Awareness of Others** (Circle only ONE)

- Has information about people other than family members, such as what they do for a living, or where they go to school................................................................. 5
- Knows the names of friends and neighbors......................... 4
- Recognizes friends and neighbors........................................ 3
- Recognizes people he/she sees frequently (besides mother or primary caretaker). ........................................ 2
- Recognizes his/her mother or primary caretaker.................. 1
- Does not recognize any person............................................. 0
- Other__________________________________________________

63. **Personal Interaction** (Circle only ONE)

- Likes to show or tell caretaker when he/she has done something caretaker will like, such as eating his/her dinner or putting toys away................................................. 4
- Calls (not by crying) or comes to caretaker for help when he/she is in trouble.................................................. 3
- Prefers being with certain people........................................ 2
- Smiles or tries to talk to caretaker when caretaker smiles and talks to him/her........................................ 1
- Is unresponsive to caretaker............................................. 0
- Other__________________________________________________

ADD #60 - 63

PERSONAL RESPONSIBILITY AND SOCIALIZATION-------------------

(Because there is no Item 17, this is a 62 item test.)
## PART ONE
### SUMMARY SHEET

### I. INDEPENDENT FUNCTIONING A through E

- **A. Eating and Drinking.**
- **B. Toileting.**
- **C. Dressing.**
- **D. Cleanliness.**
- **E. Travel Skills.**

**Total A through E**

### II. PHYSICAL DEVELOPMENT A, B and C

- **A. Sensory Development.**
- **B. Control of Body Position.**
- **C. Locomotion.**

**Total A, B and C**

### III. COMMUNICATION SKILLS A, B and C

- **A. Receptive Language.**
- **B. Speech Content.**
- **C. Personal Identification Skills.**

**Total A, B and C**

### IV. CONCEPTUAL SKILLS

**Total**

### V. PLAY

**Total**

### VI. SELF DIRECTION

**Total**

### VII. PERSONAL RESPONSIBILITY AND SOCIALIZATION

**Total**
INSTRUCTIONS FOR PART TWO

Part Two contains only one type of item.

The following is an example.

I. Do you have problems with TEASING BEHAVIOR such as:

1. Teases peers or siblings by taking their toys from them
   - yes  no

2. Teases others by disrupting their activities
   - yes  no

3. Teases or bothers pets
   - yes  no

Other ______________________

Circle One

Select those of the statements which are true of the individual being evaluated, and circle "yes" if the behavior occurs, circle "no" if the behavior is absent.

Use the space for "Other" when:

1. The person has related behavior problems in addition to those circled.

2. The person has behavior problems that are not covered by any of the examples listed.

The behavior listed under "Other" must be a specific example of the behavior problem stated in the item.

Some of the items in Part Two describe behaviors which need not be considered maladaptive for very young children (for example, pushing others). The question of whether a given behavior is adaptive or maladaptive depends on the way that particular behavior is viewed by people in our society. Nonetheless, in completing this Scale you are asked to record a person's behavior as accurately as possible, ignoring for the moment, your personal biases; then, when you later interpret the impact of the reported behavior, you should take into consideration societal attitudes.
PART II

I. Do you have problems with
TEASING BEHAVIOR such as:

1. Teases peers or siblings by
   taking their toys from them
   yes no

2. Teases others by disrupting
   their activities
   yes no

3. Teases or bothers pets
   Other ______________________

II. Do you have problems with
AGGRESSIVE BEHAVIOR such as:

4. Breaks objects on purpose
   yes no

5. Angrily tears up books and magazines
   yes no

6. Breaks windows
   yes no

7. Spits on others
   yes no

   Other ______________________

III. Do you have problems with
PHYSICAL VIOLENCE towards others
   such as:

8. Attacks others with sharp instruments
   yes no

9. Kicks, strikes, or slaps others
   yes no

10. Scratches, claws or bites others
    yes no

11. Pushes other children
    yes no

12. Pulls other's hair, ears, etc.
    yes no

13. Grabs at other people
    yes no

   Other ______________________
IV. Do you have problems with TEMPER such as:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Throws objects when angry</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>15. Screams and runs wild through the house</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>16. Cries excessively</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>17. Screams when cannot get something he/she wants</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>18. Has temper tantrums in public places</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

V. Do you have problems with ANTI-SOCIAL BEHAVIOR such as:

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<tr>
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<tbody>
<tr>
<td>19. Curses or swears in public</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>20. Disrupts classroom activities</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>21. Will not talk when strangers are present</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>22. Will not talk to babysitter</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>23. Fights with other children</td>
<td>yes</td>
<td>no</td>
<td></td>
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<tr>
<td>Other</td>
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VI. Do you have problems with REBELLIOUS BEHAVIOR such as:

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<tbody>
<tr>
<td>24. Refuses to pick up toys</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>25. Throws objects when told not to</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>26. Deliberately spills food</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>27. Answers &quot;no&quot; to all questions</td>
<td>yes</td>
<td>no</td>
<td></td>
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<tr>
<td>28. Refuses to eat</td>
<td>yes</td>
<td>no</td>
<td></td>
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<tr>
<td>29. Refuses to get out of bed</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>30. Deliberately stalls when asked to do something</td>
<td>yes</td>
<td>no</td>
<td></td>
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<tr>
<td>Other</td>
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</tbody>
</table>
47. Plays with feces  yes  no
48. Tears off clothing  yes  no
49. Puts everything in mouth  yes  no
50. Intentionally touches other inappropriately  yes  no
51. Stuff things into or plays in toilet bowl  yes  no
Other ___________________________

X. Do you have problems with UNACCEPTABLE VOCAL OR ORAL HABITS such as:
52. Makes high-pitched or shrill sounds (not related to temper tantrums)  yes  no
53. Growls or makes gutteral sounds  yes  no
54. Drools excessively (not related to teething)  yes  no
55. Ruminates  yes  no
Other ___________________________

XI. Do you have problems with SELF-ABUSIVE BEHAVIOR such as:
56. Bites or chews on self  yes  no
57. Slaps or strikes self  yes  no
58. Bangs head or other parts of the body against objects  yes  no
59. Pulls own hair, ears, etc.  yes  no
60. Pokes objects in own ears, nose or mouth  yes  no
61. Scratches or picks self causing injury  yes  no
Other ___________________________
XII. Do you have problems with **EXCESSIVE NEED FOR ATTENTION** such as:

62. Excessively hangs on to adults **yes** **no**
63. Demands attention when mother interacts with others **yes** **no**
64. Acts silly to gain attention **yes** **no**
65. Pouts or cries for long periods after being reprimanded **yes** **no**
66. Grunts or whines for everything he/she wants **yes** **no**

Other __________________________

XIII. Do you have problems with **HYPERACTIVE TENDENCIES** such as:

67. Constantly runs or jumps around the room **yes** **no**
68. Moves or fidgets constantly **yes** **no**
69. Touches everything in stores or at home **yes** **no**

Other __________________________

XIV. Do you have problems with **OVERLY EMOTIONAL BEHAVIOR** such as:

70. Cries for no apparent reason **yes** **no**
71. Appears insecure or frightened in daily activities **yes** **no**
72. Vomits when upset **yes** **no**

Other __________________________
XV. Do you have problems with WITHDRAWAL BEHAVIOR such as:

73. Sits or stands in one position for a long period of time  yes  no
74. Does not seem to react to anything  yes  no
75. Has a blank stare  yes  no
76. Has a fixed expression  yes  no
Other

XVI. Do you have problems with SLEEP such as:

77. Sleeps excessively (more than 15 hours a day)  yes  no
78. Is often groggy and drowsy most of the day  yes  no
79. Has frequent nightmares, night terrors or bad dreams  yes  no
80. Frequently wakes up at night (excluding awakenings from nightmares, night terrors, or bad dreams)  yes  no
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<td>VIII. Stereotyped Behavior and Odd Mannerisms</td>
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<td>IX. Inappropriate Personal Habits</td>
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<td>X. Unacceptable Vocal or Oral Habits</td>
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<td>XII. Excessive Need for Attention</td>
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<td>XVI. Sleep Problems</td>
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Part One - Profile Summary
Adaptive Behavior Scale for Infants and Early Childhood

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APPENDIX B

THE PARAMETERS OF COVARIANCE STRUCTURE MODELING (LISREL)
APPENDIX B

What a Model's Parameters Mean

The parameters of a covariance structure model specify the model's parts. Each parameter has a substantive meaning. This section explains the parameters of covariance structure models while the next section more formally describes the components of LISREL models.

Parameters are either free, fixed, or constrained. Free parameters may take on any value. They specify the existence of relations or other components of a model. Fixed parameters are set to a specific value, usually zero or one. Fixing a parameter to zero indicates that the relationship specified by that parameter is absent from the model. Fixing either a factor's loading or variance to one sets the scale of measurement for that latent variable. Constrained parameters satisfy some criterion such as being equal to another constrained parameter.

In any of the parameter matrices, fixing to zero a parameter proposes that there is no relationship between the two variables indexed by that parameter. Allowing a parameter to be free proposes the hypothesis that there is a relationship between the two indexed variables. For example, fixing to zero factor loadings in lambda-x or lambda-y (see the next section for details of these matrices) asserts that the item does not load on the respective factor. Allowing certain factor loadings to be free means that the item loads on the factor. In this dissertation, a simple structure factor pattern having only one factor influencing any given variable is proposed. That is, all items load on only one factor.
Fixing to zero the off-diagonal elements of theta-delta and theta-epsilon proposes that the errors in variables, the unexplained variance including the unique factor, are uncorrelated with each other. Allowing the diagonal elements of theta-delta and theta-epsilon to be free asserts that each variable is measured with error. Each diagonal element is the unexplained variance of the respective variable which is that portion of the variance that is not accounted for by the factor on which the variable loads.

The degree of precision with which the factors are assessed and the adequacy of the items as indicators of the factors are indicated by the degree to which each variable has a high loading on its factor and a small unexplained variance (Bentler and Speckart, 1979, p. 459). "The factor loadings represent standardized regression weights for predicting observed variables from latent constructs and each error variance represents the variance that a variable does not share with other measured variables" (Bentler and Speckart, 1979, p. 458). Ideally, the majority of each variable's variance is accounted for by its factor and all variables load consistently high on each of their respective factors.

Just as items load on factors, in hierarchical factor analysis (but not in the general LISREL model) primary factors load on general factors. The lambda matrices, just described, contain the first order factor loadings. The second-order factor loadings are in the gamma matrix (Joreskog and Sorbom, 1981, p. 111). The elements of the gamma matrix reference the effect of the general factor on the primary factors when the model is a hierarchical factor model, but not when the model is a general LISREL model. Restraining one of these elements to zero means that there is no effect of the general factor on that primary factor. Allowing all of these elements to be free means that the general factor influences all of the primary factors.
The elements of the beta matrix reference the effect of one primary factor on another primary factor. These influences among the primary factors are distinctive to LISREL, being absent in factor analysis. Fixing to zero the element which indexes the influence of Independent Functioning on Cognition (found in the IF column and the Cog row of beta) proposes that Independent Functioning has no influence on Cognition. At the same time, the opposite influence of Cognition on Independent Functioning may or may not be present as indicated by whether the element in the IF row and Cog column in the beta matrix is free or fixed to zero.

Fixing to zero the elements of the phi matrix hypothesizes that the factors are independent of each other. This is, that they are orthogonal factors. Allowing these elements to be free proposes that the factors are related to each other, being oblique factors.

Fixing the off-diagonal elements of the psi matrix to zero proposes that the errors in equations (unexplained variance of the factor) are uncorrelated with each other. Allowing a diagonal element to be free hypothesizes that the respective primary factor is not completely explained by the other factors. For the standardized solution, the diagonal elements of psi are equivalent to 1-R in a multiple regression equation. These standardized residual variances of equations indicate the degree to which each primary factor is unaccounted for by the other factors having relations to it in the model (Bentler and Speckart, 1979, p. 461).

The strength and validity of the structural model is indicated by small diagonal elements of psi. Thus, the degree of precision with which factors are accounted for by other factors and the adequacy of the structural model is demonstrated by Psi.
Reference Table of LISREL Parameters' Definitions and Interpretations

Because there are so many parts (parameters) of a multivariate model, especially a covariance structure model, a comprehensive definition of them is provided in one location for future reference. The definitions of the model parameters and their meaning will be listed. These definitions and meanings are summarized from Joreskog and Sorbom (1981); Bentler (1980); and Long (1982). They will help all of us understand the statistical theory employed in this dissertation.

The eight LISREL parameter matrices are underlined below. These matrices are specified a priori. Elements set to fixed values of zero specify an absence of relationship between two variables in the model. Elements allowed to be free specify the presence of relationship between two variables in the model. The population covariance matrix $\Sigma$ is a function of these eight parameter matrices. The sample covariance matrix $S$ (the covariances of the measured variables) estimates $\Sigma$. Therefore, the eight parameter matrices are fit to the observed data by adjusting the free parameters in the eight parameter matrices so as to maximize the fit between $\Sigma$ and $S$. As a result, $\xi$, $\delta$, $\eta$, and $\varepsilon$ are estimated. Measured variables serve as indicators of latent variables or hypothetical constructs.
The general LISREL Model is:

\[ X = \Lambda \xi + \delta \] for the independent measured variables,

\[ Y = \Lambda \eta + \epsilon \] for the dependent measured variables, and

\[ \eta = \beta \eta + \Gamma \xi + C \] for the structural equation model.

There are: 
- \( q \) independent measured variables
- \( s \) independent latent variables
- \( p \) dependent measured variables
- \( r \) dependent latent variables

The assumptions of the general LISREL model are:
- \( C \) is uncorrelated with \( \xi \)
- \( \epsilon \) is uncorrelated with \( \eta \)
- \( \delta \) is uncorrelated with \( \xi \)
- \( C, \epsilon, \) and \( \delta \) are mutually uncorrelated
- \( B \) has zeroes in the diagonal and \( I - B \) is nonsingular
- \( (I-B)^{-1} \) exists

---

**Measurement Model** - Independent variables: \( X = \Lambda \chi \xi + \delta \)

- \( \Lambda \) (\( q \times s \))
- \( \lambda_{ij} \) in \( \Lambda \chi \) is the loading of \( \chi_i \) on \( \xi_j \). Loadings of independent latent variables or factors. \( \lambda_{ij} \) is that
accounted for by independent latent variable $\xi_j$. Link
independent measured variables to independent latent
variables.

$X (q \times 1)$

Observed variables which are measured with error (delta).
Expected value of the cross-products of these independent
measured variables is the population variance-covariance
matrix: $\Sigma = E(XX')$. The relation of the independent latent
variables to these independent measurement variables is: $X
= A \xi + \delta$ which estimates the independent latent variables
from the independent measured variables excluding the
relations among the latent variables (factors). Squared
multiple correlations for each observed variable is its
communality, the variance it shares with the other
independent measures variables and a lower bound estimate
of the variable's reliability.

$\Phi (s \times s)$

The covariance between the independent latent variables
(factors). It is diagonal if the factors are orthogonal and it
is symmetrical if the factors are oblique. Equal to the
expected value of the independent latent variable's cross
products: $\phi = E(\xi \xi')$.

$\xi$

The independent latent variables or common factors that
are related to the independent measured variables.
\( \theta \ (q \times q) \) \n
The covariance between the errors in independent measured variables, which may also be termed unique factors or error in measurement of the observed variables. It is diagonal if the errors are uncorrelated and symmetrical if there are correlated errors. Diagonal elements are the unique variance composed of reliable specific variance and unreliable error variance. Equal to the expected value of the errors in the variables' cross-products: \( \theta = E(\delta \delta') \).

\( \delta \ (q \times 1) \) \n
The unique factors (errors in variables) of the independent measured variables. That portion of the independent measured variable not accounted for by the independent latent variables: \( \delta = 1 - \lambda \). Note that a common factor does not completely explain an observed variable.

**Measurement Model** - Dependent variables: \( Y = \Lambda \eta + \epsilon \)

\( \Lambda_y \ (p \times r) \) \n
\( \lambda_{ij} \) in \( \Lambda_y \) is the loading of \( y_i \) on \( \eta_j \). Loadings of dependent measured variables on dependent latent variables or factors. \( \lambda_{ij} \) is that portion of dependent measured variable \( y_i \) that is accounted for by dependent latent variable \( \eta_j \). It links dependent measured variables to dependent latent variables.
\( Y (p \times r) \) Observed dependent variables which are measured with error (epsilon). Same as \( X \) except relate to dependent observed and latent variables. The relation of the dependent latent variables to the dependent measured variables is: \( Y = \lambda_Y \eta + \epsilon \).

\( \eta (r \times 1) \) The dependent latent variables or \( r \) common factors which are related to the \( p \) observed dependent variables. The dependent latent variables are measured without error, thereby requiring zetas. Hypothesized to equal the weighted relations within the structural model:

\[ \eta = B_\eta + r_\xi + C \]

\( \theta (p \times p) \) The covariance between the errors in dependent measured variables. Same as theta-delta except specifies the dependent measured variables. \( \theta = E(\epsilon \epsilon') \).

\( \epsilon (p \times 1) \) The unique factors or errors in variables for the dependent measured variables. Same as delta except it refers to the dependent measured variables. \( \epsilon = 1 - \lambda \). That portion of the dependent measured variable \( Y \) not accounted for by dependent latent variable \( \eta_j \).
Structural Model: $\eta = B \eta + \Gamma \xi + C$

$B \ (r \times r)$  
**Beta**

The direct effects among the dependent latent variables. Its diagonal is zero and it is nonsymmetric. $B_{ij}$ is the amount $\eta_j$ influences $\eta_i$ while $B_{ji}$ is the amount $\eta_i$ influences $\eta_j$. $B_{k1}^2$ is the portion of $\eta_k$ that is accounted for by $\eta_1$. That is, a unit change in $\eta_1$ results in a change of $B_{k1}$ units in $\eta_k$, all other variables held constant. $B$ is sometimes used: $B = (I - B)$. Factor analysis implicitly defines $B$ equal to zero.

$\Gamma \ (r \times s)$  
**Gamma**

The direct effects of the independent latent variables on the dependent latent variables. Specifies the links or relations among the independent and dependent latent variables. It is nonsymmetric. $\gamma_{ij}$ is the amount $\xi_j$ influences $\eta_i$, which is the loading of $\eta_i$ on $\xi_j$. A hierarchical factor analysis implicitly defines $\gamma_{ij}$ as the loadings of the primaries on the second-order factors. $\gamma_{ij}^2$ is the portion of $\eta_i$ that is accounted for by $\xi_j$. That is, a unit change in $\xi_j$ results in a change of $\gamma_{ij}$ units in $\eta_i$, all other variables held constant.

$\Psi \ (r \times r)$  
**Psi**

The covariance between the errors in equations or unexplained variance of the dependent latent variables. May or may not be diagonal, but it is symmetric. Equal to the
expected value of the errors in equations’ cross-products: $\bar{\eta} = E(\mathbf{CC}')$. If errors in equations are independent, it is diagonal. For the standardized solution, diagonal elements of $\Psi$ are equivalent to $1 - R^2$, the degree to which the dependent latent variable is explained by the other latent variables as in multiple regression.

$\mathbf{C} (r \times 1)$ Errors in each dependent latent variable’s equation or the error of each dependent latent variable. That portion of $\eta$ not accounted for by the independent latent variables, other dependent latent variables and dependent measured variables. Unknown variance. Note that measured and latent variables do not completely explain the dependent latent variables, which are not perfectly predicted by the structural equation: $\eta = B\eta + \Gamma \xi + \mathbf{C}_i$. $\mathbf{C}_i$ is the error in equation $i$ for $\eta_i$. 

$\mathbf{Zeta}$
Table 14
Item-Total Score Correlations for the Derivation Sample

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Occurrence of (sub)domains in which the item correlates as or more strongly than its own domain.

There is no item 17. This is a 62 item test.