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ABSTRACT

This report presents results from three research studies that were designed to explore both the definition and the structure of the adaptive behavior construct. The first study investigated the structure of adaptive behavior as a function of age, developmental level, and type of handicap through an exploratory factor analysis of both the individual items and the subscales of the "Scales of Independent Behavior." Samples for the study consisted of 1,958 nonretarded individuals from preschool-age to adults, and 288 retarded individuals, aged 76 months to adults. The second study sought to extend a prior review of adaptive behavior factor analytic research through analysis of nine new studies and re-examination of seven sources. The third study explored the relationship between adaptive behavior, maladaptive behavior, and intellectual/academic ability through the application of multivariate statistical methodology with subjects from the first study and 556 additional children in grades 1-8. Results of the three studies showed that adaptive behavior, maladaptive behavior, and intellectual/academic ability represent related but different constructs. Current psychoeducational assessment practices provide good coverage of conceptual intelligence, practical intelligence, and social/emotional adaptation, but are weak in the coverage of social intelligence. (JDD)

Project Report Number 87-1

Minnesota • University Affiliated Program on Developmental Disabilities

Exploring the Structure of Adaptive Behavior

Robert H. Bruininks
Kevin McGrew

EXPLORING THE STRUCTURE OF ADAPTIVE BEHAVIOR

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December, 1987

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EXECUTIVE SUMMARY/ABSTRACT

Adaptive functioning, the extent to which an individual takes care of personal needs, exhibits social competencies, and refrains from engaging in problem behaviors, has received increasing attention over the past two decades in special education classification and program planning. Despite the increased focus on adaptive behavior in the assessment of handicapped individuals, problems have hindered utilization of the construct. Central to these problems is the fa t that no unified notion of the adaptive behavior construct has been established (Holman & Bruininks, 1985; Witt & Martens, 1984). Many fundamental questions regarding the dimensions of this construct remain unanswered (Keith, Fehrmann, Harrison, & Pottebaum, 1987). It is clear there is a cr· ·ial need to develop a comprehensive model of adaptive functioning--a theoretical formulation to guide future research and development efforts.

The most comprehensive contemporary attempt to elucidate the construct of adaptive behavior was Meyers, Nihira, and Zetlin's 1979 review of the adaptive behavior measurement literature from 1965 to 1979. Their extensive review of factor analytic studies revealed that adaptive behavior, as defined by available assessment instruments, is a two-dimensional structure. Meyers et al. (1979) noted that across studies with different instruments and samples, a consistent autonomy dimension was present (labeled "functional autonomy", "self-sufficiency", or "independence" by various researchers). The second factor identified across studies was interpreted as a responsibility dimension. When the maladaptive behavior domain was included in the studies reviewed, Meyers and his colleagues reported a consistent two-factor maladaptive structure. The two factors were interpreted to represent the extra-intra dimensions (e.g., extrapunitive-intrapunitive, extraversion-intraversion) frequently used to describe personal adjustment.

Most reported studies on the structure of adaptive behavior have employed a single instrument, the AAMD Adaptive Behavior Scale, (Lambert, Windmiller & Cole, 1975; Nihira, Foster, Shellhaas & Leland, 1969) and samples made up of retarded individuals living largely within institutionalized settings (Meyers et al., 1979; Holman & Bruininks, 1985). In recent years, a number of instruments were developed and standardized with nonretarded norming samples (Bruininks, Thurlow & Gilman, 1987). Little research is available on the factor structure of adaptive behavior scales using more recently developed instruments or samples with a broader range of characteristics and living environments. Expansion of studies with other instruments and samples is needed to assess the consistency of previously reported factors and dimensions of adaptive behavior.

The current report presents the results from three separate, but related, research studies that were designed to explore both the definition and the structure of the adaptive behavior construct. Research Study I investigated the structure of adaptive behavior as a function of age, developmental level, and type of handicap through an exploratory factor analysis of both the individual items and the subscales of a comprehensive, contemporary, nationally standardized measure of adaptive and maladaptive behaviors, the Scales of Independent Behavior (Bruininks, Woodcock, Weatherman & Hill, 1984). Research Study II also explored the structure of adaptive behavior by extending the factor analytic review of Meyers et al. (1979) through the use of formal quantitative research synthesis procedures with available factor analytic studies of adaptive behavior instruments. Research Study III explored the relationship between adaptive behavior, maladaptive behavior, and intellectual/academic ability through the application of multivariate statistical methodology (viz., factor, cluster, and canonical correlation analyses) in three samples which had been administered one of two contemporary co-normed adaptive behavior/intellectual assessment batteries (viz., Scales of Independent Behavior [Bruininks et al., 1984] and Woodcock-Johnson Tests of Cognitive Ability

[Woodcock & Johnson, 1977]; Vineland Adaptive Behavior Scale [Sparrow, Balla & Cicchetti, 1984] and Kaufman Assessment Battery for Children [Kaufman & Kaufman, 1983]).

An integration of all three studies suggested that adaptive behavior is represented by a large developmental or competence dimension. A two-factor structure was also suggested, although the second dimension was usually quite small. Significant methodological issues with item-based factor analytic research suggested that previous research (which has usually suggested a more multidimensional model of adaptive behavior) may have been misleading. Adaptive behavior, maladaptive behavior, and intellectual/academic ability, found to represent related but different constructs, require individual recognition in assessment practices and research efforts. The current results, when interpreted within the theoretical conceptualizations of adaptive functioning (viz., Greenspan's 1979 model of personal competence), suggested that current psychoeducational assessment practices provide good coverage of conceptual (i.e., intellectual/academic abilities) and practical intelligence (i.e., adaptive behavior), as well as of social/emotional adaptation (i.e., problem or maladaptive behavior), but are weak in the coverage of social intelligence.

INTRODUCTION

Adaptive functioning, the extent to which an individual takes care of personal needs, exhibits social competence, and refrains from engaging in problem behaviors, has received increasing attention over the past two decades in regard to special education classification and program planning. Witt and Martens (1984) note that the last 10 years have experienced an increased emphasis on the assessment of adaptive behavior in special education and human service programs.

In 1959, the concept of "adaptive behavior" was formally included in the definition of mental retardation (Heber, 1961). Subsequent revisions of the AAMD Manual (Grossman, 1973, 1977, 1983) continued to include the adaptive behavior component in the definition. In the most recent AAMD definition (Grossman, 1983), adaptive behavior is set forth as one of the essential components in the diagnosis of mental retardation. Impairments in adaptive behavior are defined as "significant limitations in an individual's effectiveness in meeting the standards of maturation, learning, personal independence, and/or social responsibility that are expected for his or her age level and cultural group" (Grossman, 1983, p. 11).

A number of developments are often cited for the increased emphasis on adaptive behavior assessment (Keith, Fehrmann, Harrison & Pottebaum, 1987; Witt & Martens, 1984). First, recent court decisions and legislation concerning the fairness of special education assessment, classification, and placement procedures have frequently resulted in the mandated assessment of adaptive behavior in special education identification and placement procedures. Second, the mainstreaming or normalization movement has increased the need to assess and subsequently train behaviors that will help individuals with handicaps make the transition into integrated learning environments, and increase their vocational and community living options (Holman & Bruininks, 1985). The domain of

adaptive behavior contains many of the fundamental behaviors critical to effective mainstreaming and social integration. Third, concern with nonbiased assessment has focused attention on assessment procedures that will reduce the disproportionate representation of ethnic minorities in special education programs. Adaptive behavior has been viewed as one means to insure fairness in assessment, classification, and placement decisions. Fourth, the assessment of adaptive behavior has been viewed as a means of effectively involving parents in educational planning decisions, and of gathering important information on non-school behaviors. Finally, changes in the definition of mental retardation by the American Association of Mental Deficiency (Heber, 1959; Grossman, 1983) have emphasized the need to include adaptive behavior instruments in routine assessment and identification practices.

Despite the increased focus on adaptive behavior, problems have hindered utilization of the construct. First, agreement on the operationalization of the adaptive behavior definition has been difficult. Although the construct now called adaptive behavior is relatively old, having its roots in Doll's (1934; 1953) social competency research and writings, current adaptive behavior definitions only provide a vague idea of the basic construct (Reschly, 1985). The elusive nature of the construct has resulted in noticeable variations in its operational definition and assessment (Witt & Martens, 1984). Second, Coulter (1980) and Keith et al. (1987) note that adaptive behavior assessment has been challenged as irrelevant, unreliable, impractical, and time-consuming (Baumeister & Muma, 1975; Clausen, 1972; Nagler, 1972). Keith et al. (1987) further note that adaptive behavior assessment has been questioned as having little utility in school environments and suffering from assessment instruments that have questionable psychometric properties. Third, Coulter (1980) notes that the adaptive behavior construct has been surrounded by a number of common misconceptions concerning its expected relationship with academic

success, appropriate degree of emphasis on school or non-school behavior, appropriate normative comparison groups, and its relationship with the construct of intelligence.

Central to the problem of adaptive behavior assessment is the fact that no unified notion of the adaptive behavior construct has been established (Holman & Bruininks, 1985; Witt & Martens, 1984). Many fundamental questions regarding the dimensions of the adaptive behavior construct remain unanswered (Keith et al., 1987). This situation has resulted in considerable debate concerning the proper definition and assessment of adaptive behavior (Witt & Martens, 1984). Mercer (cited in Greenspan, 1979, p. 517) notes that these assessment problems may be due in part to the fact that:

> researchers rushed into the void to develop assessment instruments before there was a clear and valid formulation of what the construct was supposed to measure. Although the debate over the meaning of adaptive behavior is still raging....considerable confusion continues to exist concerning what aspects of social and personal competence should be included.

It is clear there is a need to develop a comprehensive model of adaptive functioning--a theoretical formulation to guide future research and development efforts.

Probably the most comprehensive, contemporary, research-based attempt to elucidate the construct of adaptive behavior was Meyers, Nihira, and Zetlin's (1979) review of the adaptive behavior measurement literature from 1965 to 1979. The interested reader can consult Doll (1953) and Leland, Shellhaas, Nihira, and Foster (1967) for older reviews. In their review of research with published adaptive behavior instruments, Meyers et al. (1979) contributed answers to a number of theoretical questions concerning the nature of the adaptive behavior construct. First, an extensive review of factor analytic studies revealed that adaptive behavior, as defined by available assessment instruments, is characterized by a two-dimensional structure. Meyers et al. (1979) noted that across studies with different instruments and samples, a consistent autonomy dimension was present (labeled "functional autonomy", "self-sufficiency", or "independence" by various

researchers). The second factor was interpreted as representing a responsibility dimension. Meyers et al. (1979, p. 464) considered these two dimensions to be universal factors that "would universally be determined in any competent studies employing the usual broad-ranged AB scale."

When the domain of maladaptive behavior was included in the studies reviewed, Meyers et al. (1979) reported a consistent two-factor maladaptive structure. The two factors were interpreted to represent the extra-intra dimensions (e.g., extrapunitive-intrapunitive, extraversion-intraversion) commonly used to describe personal adjustment. Meyers et al. (1979, p. 465) concluded that "apart from the initial Nihira (1969a,b) data, no evidence exists that AB can be described as a general or unitary trait." Their review of available factor analytic research consistently indicated two adaptive (viz., autonomy and social responsibility) and maladaptive (viz., personal and social maladaption) dimensions. It is important to note, however, that nearly all of the early studies used the AAMD Adaptive Behavior Scale with institutionalized samples of retarded individuals. The primary use of the AAMD Adaptive Behavior Scale, initially developed with institutionalized samples, and the focus of studies on samples in restrictive living environments may limit, to some extent, the conclusions from available studies regarding the definition and conceptual organization of adaptive behavior.

The relationship between the constructs of adaptive behavior and intelligence is less clear. Meyers et al. (1979) highlighted a number of features that distinguish the assessment of adaptive behavior from that of intelligence of which three were related to construct differences. First, the two constructs differ in the degree of emphasis placed on everyday behavior and abstract thought processes. Adaptive behavior is usually defined to reflect everyday behavior, while intelligence is more reflective of abstract thinking and academic processes. Second, intellectual assessment, and thus the operationalized construct itself, emphasizes the maximal performance of the individual,

while adaptive behavior is concerned with common or typical functioning. Third, social-emotional or maladaptive behaviors, domains excluded from most conceptions of intelligence, are frequently considered to be integral aspects of adaptive functioning, particularly as reflected by operationalized assessment procedures (Bruininks et al., 1987).

The correlations between adaptive behavior and intelligence measures have been noted to vary as a function of sample heterogeneity (Meyers et al., 1979). Meyers et al. (1979) located approximately 25 different correlations between measures of intellectual functioning (i.e., IQ or MA) and total adaptive behavior scores. A wide range from .09 to .83 was noted, with the average correlation being approximately .50. Keith et al. (1987) also noted that the majority of IQ/adaptive behavior correlations are in the moderate .40 to .60 range. Inspecting correlations between measures of intelligence and adaptive behavior to determine the relationship between the two constructs has not been fruitful, since much of the correlational variability appears to be attributable to other sources of variance. Relatively higher correlations are reported with retarded samples in residential settings where the range of talent is greater (a statistical condition which significantly increases correlation coefficients), or where the assessment of adaptive behavior and intelligence in severe and profound populations is often based on similar behavioral items (Meyers et al., 1979). The moderate correlations in normal or mildly retarded samples may reflect the greater relative homogeneity of these samples, and thus, a greater restriction in the range of scores that consequently lowers the correlations (Meyers et al., 1979). Meyers et al. (1979) also note that the relatively lower correlations in normal or mildly retarded samples may be a function of ceiling effects on some adaptive behavior scales, or real differences in the behavioral domains assessed by intellectual and adaptive behavior measures in these groups. Finally, differences in adaptive behavior instruments appears to be a major source of variability in the reported IQ/adaptive behavior correlations (Meyers et al., 1979; Reschly, 1982). Witt and Martens

(1984, p. 481) concluded that "it would seem that there are as many relationships between adaptive behavior and intelligence as there are measures of adaptive behavior." Keith et al. (1987) noted that, as yet, there is no clear understanding of the relationship between adaptive behavior and intelligence, an important association that has implications for both constructs (Reschly, 1982).

In contrast to the empirical review of Meyers et al. (1979), one of the more comprehensive attempts to theoretically define the structure of adaptive behavior, as well as to determine its relationship to intelligence, is Greenspan's (1979) model of personal competence. In this model, personal competence is divided into the following three major components: physical competence, adaptive intelligence, and socio-emotional adaptation. Physical competence, not dealt with extensively in the model, includes such variables as strength, size, and coordination. Drawing from commonalities in Thorndike's (1920) tripartite model of intelligence (viz., abstract, mechanical, and social intelligence) and the content plane of Guilford's (1967) three-dimensional structure-of-intellect model (viz., symbolic and semantic content=abstract intelligence; figural content=mechanical intelligence; behavioral content=social intelligence), adaptive intelligence is viewed as having three subcomponents. Conceptual intelligence is similar to traditional notions of intelligence, social intelligence is "a person's ability to understand and to deal effectively with social and interpersonal objects and events" (Greenspan, 1979, p. 483), while practical intelligence is very similar to current adaptive behavior definitions since it "represents the ability to deal with the physical and mechanical aspects of life, including both self-maintenance and vocational activities" (Greenspan, 1979, p. 510). The socioemotional adaptation component represents a variety of character and temperament variables similar in description to the maladaptive dimensions included in some adaptive behavior scales.

Greenspan (1979) argues that most adaptive behavior instruments ignore social intelligence competencies. Meyers et al. (1979) reinforce this position by noting that the construct of social intelligence is lacking in adaptive behavior instruments. Furthermore, Meyers et al. (1979) suggest that motivational orientation (i.e., cognitive style: outer-directedness versus intrinsic motivation) is also lacking in current operationalized attempts to measure adaptive functioning. These theoretical viewpoints suggest that Meyers et al.'s (1979) conclusions may only provide a partial picture of the structure of the adaptive intelligence construct since the adaptive behavior instruments used in their review emphasize aspects of practical intelligence and apparently do not include measures of social intelligence and motivational orientation.

It is clear from this review of adaptive behavior definitions, theoretical formulations, and construct related research, that the construct of adaptive behavior is ill-defined. As noted by Witt and Martens (1984), one sign of a mature science is the presence of clearly defined constructs. It would appear that adaptive behavior theorization and assessment is not a mature science (Witt and Martens, 1984). Considerable research is needed to specify and define critical dimensions of the adaptive behavior construct as a function of age, developmental level, and type of handicap, as well as to determine its relationship to other constructs (viz., intelligence, social intelligence, motivational orientation). The current report presents the results from three separate research studies that were designed to add to this knowledge base. Research Study I investigated the structure of adaptive behavior as a function of age, developmental level, and type of handicap through exploratory factor analysis of both the individual items and subscales of a comprehensive, contemporary, nationally standardized measure of adaptive and maladaptive behavior, the Scales of Independent Behavior (Bruininks, Woodcock, Weatherman & Hill, 1984). Research Study II also explored the structure of adaptive behavior by extending the factor analytic review of Meyers et al. (1979) through the use

of formal quantitative research synthesis procedures with available adaptive behavior factor analytic studies. Research Study III explored the relationship between adaptive behavior, maladaptive behavior, and intellectual/academic ability by applying multivariate statistical methodology to three samples which had been administered one of two contemporary co-normed adaptive behavior/intellectual assessment batteries, namely the Scales of Independent Behavior (Bruininks et al., 1984) with the Woodcock-Johnson Tests of Cognitive Ability (Woodcock & Johnson, 1977) or the Vineland Adaptive Behavior Scale (Sparrow, Balla & Cicchetti, 1984) with the Kaufman Assessment Battery for Children, (Kaufman & Kaufman, 1983). All three research studies are synthesized in the discussion section of this report.

RESEARCH STUDY I: AN INVESTIGATION OF THE STRUCTURE OF ADAPTIVE BEHAVIOR IN RETARDED AND NONRETARDED POPULATIONS

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Purpose

Research Study I was designed to extend the adaptive behavior construct research by using a relatively new, nationally standardized measure of adaptive and maladaptive behavior. The study was designed to explore the dimensionality of adaptive behavior as a function of age, developmental level, and type of handicap. Research Study I extends the existing research literature by exploring the structure of adaptive behavior in normal as well as retarded samples. The primary goal was to explore the structure of adaptive behavior in samples taken from community settings (e.g., natural homes, schools, community residential facilities) which have previously been under-represented in the literature, as well as to utilize a new scale unavailable at the time of Meyers et al.'s (1979) prior review. Most of the studies included in the Meyers' review of factor structure studies used a single instrument, the AAMD Adaptive Behavior Scale, (Lambert, et al., 1975; Nihira et al., 1969) and emphasized samples of persons living in state residential facilities. The present study was intended to extend previously reported studies by using a newly standardized measure of adaptive behavior, the Scales of Independent Behavior (Bruininks et al, 1984), with large samples of retarded and nonretarded persons residing in community settings.

Samples

Five nonretarded and two mentally retarded samples were used for Research Study I. The five nonretarded groups were nationally representative samples from the norming sample used in the standardization of the Scales of Independent Behavior (SIB) (Bruininks et al., 1984) and included Preschool (< 48 months; mean CA=22.2 months, SD=13.3 months; n=489), Early Childhood (48-95 months; mean CA=72.4 months, SD=12.3 months; n=460), Middle Childhood (96-167 months; mean CA=129.0 months, SD=20.8 months; n=496), Adolescent (168-215 months; mean CA=192.7 months, SD=15.3 months; n=315), and Adult (216+ months; mean CA=400.7 months, SD=67.9 months; n=198) samples. The two mentally retarded samples included Childhood (76-167 months; mean CA=120.5 months, SD=25.0 months; n=110) and combined Adolescent/Adult (168-676 months; mean CA=310.3 months, SD=123.7 months; n=178) individuals who were used in the validity studies reported in the SIB technical manual, Development and Standardization of the Scales of Independent Behavior, (Bruininks, Woodcock, Weatherman & Hill, 1985).

Procedures

All seven samples had been administered the SIB during the standardization of the scale. The SIB, generally administered through a structured interview, is a comprehensive measure of problem behaviors and functional independence in adaptive behaviors in motor, social and communication, personal living, and community living skills. The SIB consists of fourteen subscales of adaptive behavior and a scale of eight problem behavior areas. The scores for the fourteen adaptive behavior subscales were W part scores, a special transformation of the Rasch ability scales. This specific transformation is described by Woodcock and Dahl (1971), and is discussed further in Bruininks et al. (1985) and Woodcock (1978). Due to its equal-interval measurement characteristic, the W score is the preferred SIB metric for statistical analysis. A

description of the abilities measured by the fourteen adaptive behavior subscales is presented in Table 1. Detailed descriptions of the subscales can be found in Bruininks et al. (1985) and McGrew and Woodcock (1985).

Table 1
Behaviors Assessed by SIB Subscales

Subscale	Adaptive behaviors
Gross-Motor Skills	Large muscle tasks
Fine-Motor Skills	Small muscle tasks of fingers, hands, arms
Social Interaction	Socialization with other people
Language Comprehension	Understanding gestural, spoken, and written language
Language Expression	Talking and other means of expressive language
Eating and Meal Preparation	Eating, drinking, and preparing meals
Toileting	Using the toilet and bathroom
Dressing	Removing, putting on, selecting, and maintaining clothing
Personal Self-Care	Basic grooming and health maintenance
Domestic Skills	Skills in maintaining a home environment
Time and Punctuality	Time concepts and use of time
Money and Value	Determining the value of items and using money
Work Skills	Work habits and prevocational skills
Home/Community Orientation	Getting around the home, neighborhood, and community

From: McGrew, K., & Woodcock, R. (1985). Subtest norms for the WJ/SIB assessment system. Allen, TX: DLM Teaching Resources.

In addition, the 226 individual SIB item scores were available for the five nonretarded samples (Bruininks et al., 1985). Each SIB item, scored on a 4-point rating scale, assesses the degree to which an individual can perform the task represented by the item, without help or supervision.

Data Analysis and Results for SIB Subscales

Exploratory factor analytic procedures were completed for each of the five nonretarded and two retarded samples. Because of the developmental nature of the part scores used in the analyses, each factor analysis was preceded by the calculation of a subscale intercorrelation matrix with the effect of chronological age (CA) removed (i.e., partial intercorrelation matrix). The removal of CA effects is important to note since many prior studies did not partial out CA prior to factor analysis. Seven separate intercorrelation matrices, one for each sample, served as the input for each exploratory factor analysis. The specific factoring method employed was a principal component analysis with unities in the diagnosis. A combination of objective and subjective (viz., eigenvalues $\geq$ 1.0; scree test; and interpretability of factors) factor extraction criteria were employed. The resulting factor solutions were rotated to the varimax criterion.

Table 2 presents the $\underline{W}$ score means and standard deviations for the fourteen SIB adaptive behavior subscales.

Tables 3 through 5 present the factor solutions for the five nonretarded samples.

A review of Table 3 indicates the presence of three meaningful factors in the preschool sample. Interpretation of the three factors was guided by an inspection of the items within the subscales at this age level. Factor 1 appeared to represent a large general developmental factor with significant loadings on ten of the fourteen subscales. The items at this age level for the salient Time and Punctuality and Money and Value subscales for Factor 2 suggested an academic dimension with quantitative characteristics.

Table 2
Means and Standard Deviations for SIB Adaptive Behavior
Subscales for Nonretarded Samples

Subscale	Preschool (N=489)		Early childhood (N=460)		Middle childhood (N=496)		Adolescent (N=315)		Adult (N=198)	
	M	SD	M	SD	M	SD	M	SD	M	SD
Gross-Motor Skills	382.0	55.1	460.2	27.5	494.6	31.9	500.8	29.4	504.5	16.9
Fine-Motor Skills	386.9	43.1	465.2	25.7	497.1	31.4	515.9	34.5	529.1	13.5
Social Interaction	429.5	40.6	477.9	18.0	497.9	23.3	514.1	26.7	533.3	16.4
Language Comprehension	411.3	27.4	460.6	18.0	495.8	26.8	512.2	31.5	529.6	16.5
Language Expression	387.8	47.4	462.7	23.7	496.3	33.7	522.9	45.2	558.9	20.4
Eating	398.7	46.2	459.5	20.7	497.6	32.0	528.1	35.2	557.4	21.1
Toileting	405.0	41.6	476.5	19.4	496.3	21.5	505.2	20.6	511.6	2.4
Dressing	378.9	47.0	469.6	27.5	496.7	31.3	522.8	38.9	553.7	20.4
Self-Care	414.8	34.2	467.9	18.8	495.9	26.1	524.0	35.4	557.6	16.8
Domestic Skills	437.8	24.6	479.6	17.3	499.1	19.2	518.9	22.1	550.2	28.0
Time and Punctuality	335.7	31.2	430.4	36.6	490.7	38.0	506.6	42.4	525.2	13.4
Money and Value	399.1	24.6	452.2	20.6	495.9	32.1	528.6	43.5	566.9	18.8
Work Skills	411.3	39.7	466.1	22.0	497.4	26.3	524.6	34.0	549.1	13.3
Home/Community	384.3	43.5	449.7	26.3	496.2	33.2	520.8	36.4	554.6	21.8

Table 3

Varimax Rotated Three-Factor Matrix of SIB Subscales in Preschool Nonretarded Sample (<48 months) (N=489)

Subscales	Factors 1	2	3
Gross-Motor Skills	.84*	-.16	.02
Fine-Motor Skills	.80*	.01	-.08
Social Interaction	.86*	.02	-.03
Language Comprehension	.61*	.39	.25
Language Expression	.63*	.26	.21
Eating	.80*	-.16	.13
Toileting	-.21	.16	.69*
Dressing	.43*	-.05	.68*
Self-Care	.70*	-.00	.42*
Domestic Skills	.18	.16	.01*
Time and Punctuality	-.05	.86*	-.00
Money and Value	-.02	.77*	.26
Work Skills	.69*	.33	.19
Home/Community	.79*	-.12	.10
Eigenvalue (unrotated)	5.665	2.092	1.093
Percent of variance (unrotated)	40.5 %	14.9 %	7.8 %

Note. * Indicates loadings of .40 or above.

Table 4
SIB Subscale Loadings on Unrotated General Factor for Early Childhood (48-95 months), Middle Childhood (96-167 months) and Adolescent (168-215 months) Nonretarded Samples

Subscale	Early childhood (N=460)	Middle childhood (N=496)	Adolescent (N=315)
Gross-Motor Skills	.76	.84	.79
Fine-Motor Skills	.84	.89	.91
Social Interaction	.76	.84	.87
Language Comprehension	.80	.88	.91
Language Expression	.81	.89	.94
Eating	.78	.84	.89
Toileting	.74	.84	.85
Dressing	.85	.85	.89
Self-Care	.82	.87	.91
Domestic Skills	.68	.79	.84
Time and Punctuality	.78	.89	.91
Money and Value	.79	.87	.91
Work Skills	.82	.91	.95
Home/Community	.66	.87	.93
Eigenvalue	8.496	10.424	11.190
Percent of variance	60.7 %	74.5 %	79.9 %

Table 5
Varimax Rotated Two-Factor Matrix of SIB Subscales in Adult (216+ months) Nonretarded Sample (N=196)

	Factor	
Subscale	1	2
Gross-Motor Skills	.07	.67*
Fine-Motor Skills	.54*	.41*
Social Interaction	.74*	.26
Language Comprehension	.68*	.40*
Language Expression	.67*	.45*
Eating	.74*	-.07
Toileting	.17	.00
Dressing	.77*	-.13
Self-Care	.78*	.10
Domestic Skills	.35	.30
Time and Punctuality	.63*	.21
Money and Value	.70*	.32
Work Skills	.57*	.54*
Home/Community	-.12	.82*
Eigenvalue (unrotated)	5.665	1.501
Percent of variance (unrotated)	40.5 %	10.7 %

Note. * Indicates loadings of .40 or above.

The third factor, with the most salient loadings for subscales tapping an individual's ability to look after his or her own personal needs (viz., Toileting, Dressing and Self-Care), was interpreted as a personal responsibility factor.

A review of Table 4 indicates that adaptive behavior, as defined by the SIB subscales, is largely a unidimensional developmental factor during the school-age years (i.e., Early Childhood, Middle Childhood, and Adolescent samples). Inspection of the unrotated factor loadings revealed high loadings across all fourteen subscales. This finding was consistent with the interpretation of a general developmental or independence factor which accounted for approximately 60 to 80% of the variance.

Inspection of the factor results in the Adult sample initially suggested a three-three-factor structure. However, the three-factor solution was not easily interpreted, with the resulting two-factor structure (Table 5) appearing to best represent the data. Consistent with the other age groups, a large (40.5% of the variance) general developmental factor was represented by Factor 1. Interpretation of Factor 2 required an examination of the individual subscale items in order to determine the commonality between the Home/Community Orientation, Gross-Motor Skills, and Work Skills subscales (the three highest loading subscales). A community orientation/vocational factor appeared to be the best interpretation of the second factor in the adult sample.

Tables 6 and 7 present the factor solutions for the two retarded samples. Although the Childhood sample produced a two-factor solution (Table 6), the most striking finding was the presence of a large (70.5% of the variance) general developmental factor (Factor 1). Factor 2 appeared to represent an academic/conceptual factor since the subscales with salient loadings were those emphasizing cognitively oriented skills. The Adolescent/Adult retarded sample (Table 7) was characterized by a large (82.0% of the variance) single general factor. All subscales in the Adolescent/Adult sample had unrotated factor loadings at or above .81.

Table 6
Varimax Rotated Two-Factor Matrix of SIB Subscales in Childhood Mentally Retarded Sample (N=110)

	Factors	
Subscales	1	2
Gross-Motor Skills	.84*	.35
Fine-Motor Skills	.87*	.34
Social Interaction	.70*	.48*
Language Comprehension	.70*	.55*
Language Expression	.25	.87*
Eating	.32	.84*
Toileting	.57*	.68*
Dressing	.76*	.34
Self-Care	.43*	.75*
Domestic Skills	.51*	.74*
Time and Punctuality	.37	.83*
Money and Value	.54*	.67*
Work Skills	.76*	.40*
Home/Community	.83*	.31
Eigenvalue (unrotated)	9.874	1.101
Percent of variance (unrotated)	70.5 %	7.9 %

Note. * Indicates loadings of .40 or above.

When combined, the exploratory analyses produced four single-factor solutions, two two-factor solutions, and one three-factor solution. Close inspection of the percent of variance attributed to each factor, as well as of the first unrotated principal component in each solution, suggested that the second and third adaptive behavior factors were dwarfed by the presence of a large general competence or personal independence dimension. Although both the nonretarded and retarded samples produced single and two-factor solutions, possible differences were noted. The Childhood retarded sample produced a two-factor solution which was in contrast to the single factors isolated in all Childhood nonretarded samples. Also, the Adolescent/Adult retarded sample produced a single factor solution in contrast to the two factors in the Adult nonretarded sample.

Table 7
SIB Subscale Loadings on Unrotated General Factor
for Adolescent and Adult Mentally Retarded Sample (N=178)

Subscale	Loading
Gross-Motor Skills	.93
Fine-Motor Skills	.92
Social Interaction	.91
Language Comprehension	.95
Language Expression	.92
Eating	.90
Toileting	.89
Dressing	.91
Self-Care	.90
Domestic Skills	.88
Time and Punctuality	.88
Money and Value	.93
Work Skills	.93
Home/Community	.81
Eigenvalue	11.481
Percent of variance	82.0 %

Data Analysis and Results for SIB Items

Because of the large number of SIB items (i.e., 226), a single factor analysis of each of the five nonretarded sample age levels was not possible. Therefore, an attempt was made first to locate "marker" items. This approach involved factoring subsets of the total item pool with the goal of isolating factors within these subsets, as well as of identifying items which loaded highest on these factors (i.e., marker items). After the marker items were identified (a smaller number than the original 226), a factor analysis in each sample of this specific set of marker items was planned. The construction of four separate subsets of items was based on the placement of these items in the SIB adaptive behavior clusters. This resulted in 34 items from the Motor Skills cluster, 49 from the Social and Communication cluster, 79 from the Personal Living cluster, and 64 from the Community Living cluster. Each of these four item pools was subjected to principal component analysis with varimax rotation for each of the five nonretarded samples. The combination of objective and subjective (viz., eigenvalue $\geq$ 1.0; scree test; interpretability of factors) factor extraction criteria usually resulted in four separate exploratory analyses in each sample (i.e, typically two-, three-, four-, and five-factor solutions were examined).

Because of the large number of solutions that resulted, the large number of variables that were included in each solution and more importantly, the nature of the results, only two representative solutions are presented. Table 8 presents the three- and four-factor solutions for the 49 items from the Social and Communication cluster for the Middle Childhood sample. Inspection of the factors in the three-factor solution revealed evidence of item "difficulty" or developmental factors. The items with salient loadings (i.e., .40 or above) on Factor 1 were the Social Interaction subscale items 1-6, Language Comprehension subscale items 1-8, and Language Expression subscale items 1-10. Thus, the first factor was defined by the "easy" items from the three separate subscales contained in this cluster. Factor 2 was defined by "moderate" to "hard" items from the

Table 8
Rotated Three- and Four-Factor Solutions
of SIB Social and Communication Cluster Items
in Middle Childhood Sample

Subscale item	Three-factor solution			Four-factor solution			
	1	2	3	1	2	3	4
Social Interaction							
1	.73*	.07	.06	.45*	.06	.05	.66*
2	.71*	.24	.02	.61*	.25	.02	.36
3	.85*	.13	.04	.55*	.13	.03	.72*
4	.86*	.18	.03	.62*	.19	.02	.63*
5	.79*	.21	.05	.54*	.21	.04	.61*
6	.49*	.43*	.08	.22	.42*	.07	.55*
7	.37	.30	.22	.32	.30	.22	.18
8	.39	.40*	.14	.21	.39	.13	.39
9	.38	.48*	.19	.33	.48*	.19	.18
10	.31	.44*	.18	.24	.44*	.18	.20
11	.32	.43*	.19	.24	.43*	.18	.22
12	.34	.73*	.07	.31	.73*	.07	.12
13	.17	.52*	.16	.12	.52*	.16	.12
14	.06	.40*	.51*	.04	.40*	.51*	.05
15	.04	.46*	.49*	.01	.46*	.49*	.05
16	.05	.12	.55*	.04	.12	.55*	.02
Language Comprehension							
1	.68*	.22	.04	.39	.22	.04	.66*
2	.76*	.18	.01	.40*	.17	.00	.79*
3	.77*	.26	.05	.57*	.26	.04	.53*
4	.70*	.36	-.03	.59*	.36	-.04	.37
5	.46*	.28	.13	.33	.28	.13	.32
6	.48*	.48*	.11	.40*	.49*	.10	.26
7	.68*	.38	-.03	.50*	.38	-.03	.48*
8	.51*	.64*	-.01	.39	.64*	-.01	.33
9	.29	.72*	.11	.26	.72*	.11	.13
10	.23	.62*	.21	.17	.62*	.21	.16
11	.25	.67*	.07	.23	.68*	.07	.10
12	.14	.73*	.30	.10	.73*	.30	.09
13	.07	.65*	.39	.05	.65*	.39	.05
14	.06	.56*	.46*	.04	.56*	.46*	.03
15	.02	.43*	.62*	.00	.42*	.62*	.04
16	.01	.45*	.50*	.00	.45*	.50*	.03
Language Expression							
1	.74*	-.04	.08	.70*	-.03	.08	.27
2	.84*	.04	.07	.80*	.05	.07	.30
3	.89*	.15	.04	.92*	.17	.04	.21
4	.90*	.16	.04	.91*	.18	.04	.23
5	.77*	.15	.06	.78*	.17	.06	.20
6	.84*	.24	.02	.88*	.27	.02	.18
7	.79*	.29	.02	.84*	.31	.02	.14
8	.78*	.38	-.02	.78*	.40*	-.02	.23
9	.53*	.55*	.02	.55*	.56*	.02	.11
10	.59*	.59*	-.04	.50*	.60*	-.04	.30
11	.16	.73*	.21	.10	.73*	.21	.13
12	.12	.60*	.44*	.06	.59*	.44*	.13
13	.04	.10	.75*	.04	.10	.75*	.02
14	.02	.22	.65*	.01	.21	.65*	.02
15	.04	.03	.81*	.04	.03	.81*	.02
16	.02	.15	.76*	.02	.15	.76*	.02
17	.03	.03	.73*	.04	.03	.73*	.02

Note. *=Loadings of .40 or above

three separate subscales. Most of the items that loaded on Factor 2 were Social Interaction and Language Comprehension subscale items 8-15, and Language Expression items 9-12. Factor 2 appeared to represent the "moderate" range of item difficulty. Finally, Factor 3 was defined by Social Interaction and Language Comprehension items 14-16, and Language Expression items 12-17. The third factor was defined by the "hard" items in this item pool. Since the items in each subscale are ordered by item difficulty, which is in turn, perhaps a reflection of developmental level or the items, it was concluded that the three-factor solution represented item "difficulty" and/or developmental factors.

Inspection of the four-factor solution in Table 8 revealed similar findings. The first three factors again represented easy, moderate, and hard difficulty factors. Factor 4 appeared to be another "easy" factor, defined primarily by the easy items from the Social Interaction and Language Comprehension subscales.

The pattern of results presented in Table 8 was repeated across almost all analyses. The first two to four factors routinely represented difficulty and/or developmental factors. Increasing the number of factors extracted in each solution usually resulted in the splitting of one difficulty/developmental factor into two separate difficulty/developmental factors (e.g., moderate difficulty factor splitting into low-moderate and high-moderate). Inspection of the unrotated principal component in each analysis reinforced the presence of a difficulty or general developmental dimension since a large general factor was usually identified with most items loading at moderate to high levels. This finding was reinforced by an exploratory analysis in each sample with a subset of fifty items identified by the SIB's first author as those that were most consistent with the theoretical construct intended to be assessed in each of the fourteen subscales.

These analyses produced a large general factor with most items loading at moderate or high levels. The large general factor was usually followed by various difficulty factors and occasional nonmeaningful trivial factors. The consistency of all item-based factor analyses suggested that the presence of a large difficulty dimension may represent a single developmental factor. However, before reaching this conclusion, additional procedures were attempted.

A review of Thorndike (1982) indicated that the occurrence of difficulty factors in item factor analysis is not unusual. Thorndike (1982, p. 90) notes that dichotomous items "tend to produce unwanted 'difficulty' or 'popularity' factors that have nothing to do with the content of the items." Although the SIB items are scored on a four-point scale, the possibility existed that the items were behaving as dichotomies. Thus, it appeared that the prior results may have been a function of methodological variables. To investigate this possibility, Thorndike's (1982) recommendation to use tetrachoric intercorrelation matrices as the factor analysis input was followed. All SIB items were first recoded from the four-point scale into a dichotomous scale. Item tetrachoric intercorrelation matrices were calculated for each item subset for each of the five nonretarded samples. As a result of the recoding, a number of the items at the extremes of the subscales had standard deviations at or near zero. Tetrachoric correlations could not be computed for such items, and thus, the final intercorrelation matrices contained fewer items than were included in the first factor analysis based on the Pearson Product-Moment intercorrelation matrices.

In the same cluster (i.e., Social and Communication) and sample (i.e., Middle Childhood) used to describe the initial factoring efforts, a two-factor solution was obtained. Inspection of the relationship between the mean item scores and factor loadings suggested that a difficulty or general developmental factor that was still present which made it difficult to extract the variance that was due primarily to item content.

In the solution just described, correlations of .93 and -.77 were found between the item means and Factor 1 and Factor 2 loadings, respectively. The high positive correlation with one factor, and a high negative correlation with the other, is consistent with the presence of a difficulty or developmental factor (i.e., one factor represents the "easy" items and the other "hard" items). Inspection of other item means-factor loading correlations (in solutions where two factors appeared most appropriate) reinforced this finding. For example, pairs of correlations of .97/-.96 and .60/-.74 were noted for the Early Childhood and Adult samples in the subset of Motor items. Pairs of correlations of -.67/.84 and .53/-.38 were found for the Adolescent and Adult samples in the subset of Social and Communication items. One should note that the lower correlations in the Adult samples reflect a restriction of range on the item means.

These findings suggested that in the tetrachoric-based solutions a robust difficulty or developmental factor was still present. Unfortunately, it was not possible to clearly separate the variances attributable solely to item difficulty from those of item content. Items arranged by order of difficulty within components of adaptive behavior measures also vary by content. Behaviors assessed earlier in scales are more likely to measure maturational and learning characteristics (e.g., walking, talking, toileting), while those found later in an item sequence tend to tap into more complex results of learning, direct training, and opportunity (e.g., travel skills, use of telephone, etc.). The inherent hierarchical arrangement of adaptive behavior developmental items and Rasch scaled items makes it difficult to separate the influences of these separate, but highly related, factors. The consistency of these findings across all item subsets and samples suggested that factor analysis of adaptive behavior items must address the methodological issue of difficulty factors. Also, the robustness and size of the first principal component in all exploratory analyses suggested that a large developmental factor may underlie the construct of adaptive behavior as measured by the SIB.

RESEARCH STUDY II: THE STRUCTURE OF ADAPTIVE BEHAVIOR: A QUANTITATIVE SYNTHESIS

Kevin McGrew

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Purpose

The most comprehensive prior review of adaptive behavior factor analytic research has been Meyers et al.'s (1979) authoritative narrative synthesis of eight published sources (Gaurnaccia, 1976; Lambert & Nicoll, 1976; Levine & Elzey, 1968; Nihira, 1969a, 1969b, 1976; Owens & Bowling, 1970; Ross, 1970). Since that review, additional factor analytic research with various adaptive behavior instruments has been reported. The current investigation (Research Study II) extended the prior review by augmenting the eight sources identified by Meyers et al. (1979) with studies published since 1979. In addition, a systematic attempt was made to analyze this body of literature with a quantitative research synthesis methodology. Briefly, quantitative data synthesis involves the application of formal procedures for combining the results of several empirical investigations (Light & Pillemer, 1984; Pillemer & Light, 1980). The goal of these procedures is to "draw, in a systematic manner, as much information as possible from existing evidence" (Pillemer & Light, 1980, p. 178).

The primary purpose of this review was to extend the review of Meyers et al. (1979). A number of new adaptive behavior construct related research studies have been completed since the 1979 review of Meyers and his colleagues. These studies have explored the construct of adaptive behavior in new samples and with the use of instruments not available at the time of the 1979 review. The current review was designed to re-examine the conclusions of Meyers and his colleagues in light of the

research completed since 1979. More specifically, the current review sought to determine whether the structure of the adaptive behavior construct varied as a function of: (a) research methods used to investigate this construct, (b) adaptive behavior scale differences, and/or, (c) sample characteristics such as age, geographic location and living experiences, handicapped status, and/or degree of retardation.

Review Methodology

Location of Studies

Meyers et al. (1979) based their review on research published between 1965 and 1979. With the exception of Ross's (1970) factor analysis of the Fairview Self Help Scale, copies of the original manuscripts for all studies reviewed by the Meyers group were secured. To cover the published additional research from 1979 to 1987, a hand search of Psychological Abstracts was completed. Adaptive behavior factor analytic research studies were sought by examining titles under the following key words: behavioral assessment, factor analysis, factor structure, factorial validity, measurement, mental retardation, and mentally retarded. In addition, the SIB factor analysis presented in Research Study I, earlier in this report (Bruininks, McGrew & Maruyama, 1987) was included as a new source.

Only factor analysis studies that attempted to identify the simplest and most meaningful factors, without a priori judgments, were included in the review. For example, Sparrow and Cicchetti's (1978, 1984) factor analyses of the Behavior Rating Inventory for the Retarded (BRIR) and the Behavior Inventory for Rating Development (BIRD) were excluded, since both studies only attempted to extract a predetermined number of factors that conformed to the a priori structure of the instruments. In addition, factor research with two recently published comprehensive measures of adaptive behavior could not be included as originally planned. The very brief description of the

factor analysis of the revised Vineland subdomains in the manual (Sparrow, Balla & Cicchetti, 1984) did not provide sufficient information to allow the inclusion of those results in this review (the more detailed Vineland Technical and Interpretative Manual was not published at the time of this review). Also, the technical manual for the Comprehensive Test of Adaptive Behavior/Normative Adaptive Behavior Checklist (Adams, 1984) did not report any factor analysis results. Studies were also excluded if they failed to include a satisfactory number of variables to factor. The requirement of at least three variables for each possible factor is an often mentioned rule-of-thumb in the literature (Kim & Mueller, 1978a, 1978b). Studies which factor less than six adaptive behavior variables may produce single-factor solutions by default (i.e., there may have been a second factor, but there were not enough variables present to represent it). Since Meyers et al.'s (1979) review converged on the presence of two adaptive behavior factors, the minimum criterion of at least six adaptive behavior variables was utilized for inclusion in the current review. This exclusionary rule eliminated from consideration any factor studies of the four Vineland adaptive domain scales, the four SIB adaptive clusters, and the three ABS adaptive factor scores (e.g., Arndt, 1981). In all, nine new sources were located which, when combined with Meyers et al.'s (1979) seven sources, resulted in a total of sixteen sources for the current review. Tables 9 and 10 summarize the sixteen sources which served as the basis for the current review.

Coding of Study Characteristics.

A review of Table 10 revealed that many research reports presented the results for more than one sample. For example, Nihira (1978) completed a factor analysis of the ABS items in two retarded childhood samples and one retarded adult sample. Since an analysis of the structure of adaptive behavior as a function of age and handicapped status was considered important, each individual sample was treated as a separate unit of

Table 9
Adaptive Behavior Factor Analytic Studies Included in Review

Source	Scale[a]	Level
Levine & Elzey (1968)	SFVCS	Item
Nihira (1978)	ABS-Reg	Item
Silverman, Silver, Lubin & Sersen (1983)	MDPSBS	Item
Reynolds (1981)	PCS	Item
Nihira (1976)	ABS-Reg	Parcel
Widaman, Gibbs, Geary (1987)	CDER	Parcel
Owens & Bowling (1970)	PAR	Subscale
Song, Jones, Lippert, Metzgen, Miller & Borreca (1984)	WBRS	Subscale
Nihira (1969a)	ABCL	Subscale
Nihira (1969b)	ABCL	Subscale
Gaurnaccia (1976)	ABS-Reg	Subscale
Lambert & Nicoll (1976)	ABS-Psv	Subscale
Katz-Garris, Hadley, Garris & Barnhill (1980)	ABS-Reg	Subscale
Hug, Barclay, Collins & Lamp (1978)	PAR	Subscale
Millsap, Thackrey, & Cook (1987)	ABIC	Subscale
Bruininks, McGrew & Maruyama (1987)	SIB	Subscale

[a]SFVCS = San Francisco Vocational Competency Scale;
ABS = AAMD Adaptive Behavior Scale (Reg-Regular; Psv-Public School Version);
MDPSBS = Minnesota Developmental Programming System Behavioral Scales;
PCS = Personal Competency Scale;
PAR = Preschool Attainment Record;
WBRS = Wisconsin Behavior Rating Scale;
ABCL = Adaptive Behavior Checklist;
SIB = Scales of Independent Behavior;
CDER = Client Development Evaluation Report;
ABIC = Adaptive Behavior Inventory for Children.

Table 10
Description of Adaptive Behavior Factor
Analytic Studies Included in Review

Source	Age Category[a]			Degree of Retardation[b]				IQ Mean or Range	Placement[c]			
	C	A	CA	N	MM	SP	MX		N	C	IC	I
Levine & Elzey (1968)	0	1	0	0	0	0	1	20-75	0	0	1	0
Nihira (1978)	2	1	0	0	0	0	3	20-83	0	0	0	3
Silverman, Silver, Lubin & Sersen (1983)	2	2	0	0	0	4	0	---	0	0	4	0
Reynolds (1981)	0	1	0	0	0	0	1	12-94 mean=53.2	0	1	0	0
Nihira (1976)	6	2	0	0	0	0	8	Range of means = 29.3-45.8	0	0	0	8
Widaman, Gibbs, & Geary (1987)	6	8	0	0	9	5	0	---	0	9	2	3
Owens & Bowling (1970)	1	0	0	0	0	0	1	---	0	0	0	1
Song, Jones, Lippert, Metzgen, Miller, & Borreca (1984)	1	0	1	1	0	1	0	---	1	0	0	1
Nihira (1969a)	0	1	0	0	0	0	1	Unknown to 83	0	0	0	1
Nihira (1969b)	3	0	0	0	0	0	3	Unknown to >84	0	0	0	3
Guarnaccia (1976)	0	1	0	0	1	0	0	48-75 mean=61	0	1	0	0
Lambert &Nicholl (1976)	3	0	0	1	2	0	0	---	1	2	0	0
Katz-Garris, Hadley, Garris, & Barnhill (1980)	0	0	1	0	0	0	1	---	0	0	0	1
Hug, Barclay, Collins & Lamp (1980)	1	0	0	1	0	0	0	mean= 91.2	1	0	0	0
Millsap, Thackrey, & Cook (1987)	1	0	0	1	0	0	0	---	1	0	0	0
Bruininks, McGrew, & Maruyama (1987)	5	2	0	5	0	0	2	---	5	2	0	0

Note: Numbers indicate number of samples in each category.

[a]Age Category Codes: C=Childhood; A=Adult; CA=Childhood & Adult

[b]Degree of Retardation Codes: N=Normal; MM=Mild/Moderate; SP=Severe/Profound; MX=Mixed Sample of MM & SP.

[c]Placement Codes - N=Normal, living in community; C=Retarded, living in community setting; IC=Institutional and community setting; I=Institutional setting

analysis. As a result, 52 samples were obtained from the sixteen sources listed in Tables 9 and 10. Each of the 52 samples was reviewed and coded according to 20 study characteristics. Table 11 presents a detailed explanation of the coding scheme described below.

First, the date of each study was recorded. **Variable characteristics** included the adaptive behavior scale that was used in the investigation, the domains of behavior that were included in the factor analysis, and the number of variables included in the factor analysis (i.e., total number of variables, total number of adaptive behavior variables, and total number of maladaptive behavior variables). The final variable characteristic was the level of adaptive behavior measurement that was factored. That is, the studies listed in Table 9 differed as to whether the factoring was conducted at the item or the subscale/subtest level. A third level, labeled "item parcels", represents studies that used variables that were a combination of a small number of items (i.e., item parcels). The ABS subdomains lie between the items and the domains (subscales) and are considered item parcels for the current investigation.

Six **sample characteristics** were recorded for each sample. Sample type indicated the nature of the sample (i.e., nonretarded or retarded). Placement indicated the primary living arrangement/setting of the sample, while degree of retardation reflected the degree of retardation of the sample. The placement and degree of retardation classifications were made by the current authors from the sample description information included in the study reports. At times this information was sketchy and thus, these classifications should be viewed cautiously. Sample size represented the number of subjects included in the sample. Two coding variables represented the age characteristics of each sample. Age range was the difference between the highest and lowest ages reported for the sample. Mean chronological age was either the actual reported mean age or an estimated mean age. Studies often reported a frequency distribution of the sample ages, from which an average value was estimated by determining the approximate middle value.

Table 11
Summary of Coding System used in Review of Adaptive Behavior Factor Analytic Research Studies

Date - date of publication

Variable characteristics

Scale - 1=SFVCS (San Francisco Vocational Competency Scale; 2=MDPSBS (Minnesota Developmental Programming System Behavioral Scales); 3=PAR (Preschool Attainment Record); 4=WBRS (Wisconsin Behavior Rating Scale); 5=SIB (Scales of Independent Behavior); 6=ABS (AAMD Adaptive Behavior Scale); 7=ABCL (Adaptive Behavior Checklist); 8=PCS (Personal Competency Scale); 9=CDER (Client Development Evaluation Report); 10=ABIC (Adaptive Behavior Inventory for Children)

Domain - 1=adaptive; 2=adaptive and maladaptive; 3=adaptive, maladaptive and other miscellaneous; 4=adaptive and other miscellaneous

Total number of variables - Total number of adaptive and/or maladaptive variables included in the study

Total number of adaptive behavior variables - Total number of adaptive variables included in the study

Total number of maladaptive behavior variables - Total number of maladaptive variables included in the study

Level - 1=Items; 2=Item parcels; 3=Subscale/subtests

Sample characteristics

Sample type - 1=Retarded; 2=Nonretarded

Sample placement - 1=Normal; 2=Community; 3=Institutional/Community; 4=Institutional

Degree of retardation - 1=Normal; 2=Mild/Moderate; 3=Severe/Profound; 4=Mixture of mild/moderate and severe/profound

Sample size - The number of subjects in the sample

Age-range - The difference in years between the youngest and oldest subject in the sample

Mean chronological age - Mean age of sample in years. If reported, actual mean was recorded. In some studies an estimated mean age was determined by inspecting the distribution or range of ages reported and estimating the middle value.

Factor analysis method characteristics

Extraction - 1=Principal axes or components; 2=Other (e.g. key clustering) or unspecif d

Criteria - 1=Kaiser; 2=Scree Test; 3=Kaiser and interpretability; 4=Scree and interpretability; 5=Kaiser, Scree, and interpretability; 6=Other or unspecified

Rotation - 1=Orthogonal; 2=Oblique; 3=Orthogonal and oblique used; 4=Unspecified

Salience - The minimum factor loading used to identify variables that loaded on factors (e.g., .40, .45)

Number of Factors

Number of adaptive factors - Number of final adaptive factors that were identified and interpreted in the study

Number of maladaptive factors - Number of final maladaptive factors that were identified and interpreted in the study

Number of miscellaneous factors - Number of non-adaptive/maladaptive factors identified in studies that included other variables (e.g., age, sex).

Four **factor analysis method characteristics** were coded for each sample: extraction - the type of factor extraction procedure employed; criteria - the subjective or objective criteria used to determine the number of factors to be retained; rotation - the factor rotation method used; and salience - the minimum factor loadings for variables that were considered when interpreting the factors. The final coding category represented the **number of factors** obtained in each analysis. The number of adaptive factors, the number of maladaptive factors, and the number of miscellaneous factors were recorded for each sample. The "miscellaneous" factor category represented factors that emerged in studies that included non-adaptive/maladaptive variables (e.g., sex, age, use of medication) in the factor analysis.

One report (Hug et al., 1978) required re-analysis prior to coding. The originally reported PAR (Preschool Attainment Record) factor analysis was based on intercorrelation matrices that included composite scores as well as the subscales that contributed to these composites. A smaller matrix that only included the subscales was refactored by the current investigators from the intercorrelation matrix which was included in Hug et al.'s research report. Principal components analysis with Kaiser's objective criterion (as well a the interpretability of the results) produced one large general factor. These results were coded for the current review.

Description of Samples

Table 12 presents a summary of the characteristics of the samples used in the current review. The majority of the samples were at the subscale (21) or item parcel (22) level. Research at the item level involved nine samples. At the item and subscale levels a variety of adaptive behavior scales were factored, while only the ABS and the CDER were factored at the item parcel level. Across levels, the ABS was the most frequently factored instrument (16). Most research studies factored only the domain of

Table 12
Summary Characteristics of Samples
Included in Review of Adaptive Behavior Factor Analytic Research

	Measurement level of sample		
	Item	Parcel	Subscale
	(Number of samples in each coding category)		
Scales[a]			
ABIC	0	0	1
SFV	1	0	0
MDPSBC	4	0	0
PAR	0	0	2
WBRS	0	0	2
SIB	0	0	7
ABS	3	8	5
ABCL	0	0	4
PCS	1	0	0
CDER	0	14	0
Domains			
Adaptive	9	8	13
Adaptive+Maladaptive	0	14	3
Adaptive+Maladaptive+ Miscellaneous	0	0	4
Adaptive+Miscellaneous	0	0	1
Sample type			
Retarded	9	22	12
Nonretarded	0	0	9
Placement			
Normal	0	0	9
Community	1	9	5
Institution/Community	5	2	0
Institution	3	11	7
Degree of retardation			
Normal	0	0	9
Mild/Moderate	0	9	3
Severe/Profound	4	5	1
Mixed	5	8	8
Factor extraction			
Principal axes/components	9	22	17
Other	0	0	4
Extraction criteria			
Kaiser	0	0	4
Scree	0	0	1
Kaiser/Interpretability	9	0	12
Scree/Interpretability	0	0	0
Kaiser/Scree/ Interpretability	0	8	0
Other/Unspecified	0	14	3
Factor rotation			
Orthogonal	1	0	18
Oblique	8	22	0
Orthogonal/Oblique	0	0	1
Unspecified	0	0	1

(Table 12 continued on next page)

Table 12 continued

	Measurement level of sample					
	Item		Parcel		Subscale	
(Mean coding variable characteristics for samples)						
Mean sample size	769.1	(9)	582.6	(22)	414.7	(21)
Mean age range	22.6	(9)	7.2	(8)	16.7	(20)
Mean chronological age mean	23.1	(9)	23.1	(22)	16.1	(19)
Mean number of total variables	63.1	(9)	20.5	(22)	15.4	(21)
Mean number of adaptive variables	63.1	(9)	16.7	(22)	10.9	(21)
Mean number of maladaptive variables	----	(0)	3.8	(22)	4.0	(21)
Mean loading salience	.347	(6)	.300	(8)	.383	(15)
Mean number of adaptive factors	7.4	(9)	3.7	(22)	1.6	(21)
Mean number of maladaptive factors	----	(0)	2.0	(14)	1.9	(7)
Mean number of miscellaneous factors	----	(0)	----	(0)	2.6	(5)

Note. Value in parentheses indicates number of samples upon which the mean is computed.
[a]ABIC = Adaptive Behavior Inventory for Children;
SFVCS = San Francisco Vocational Competency Scale;
MDPSBS = Minnesota Developmental Programming System Behavioral Scales;
PAR = Preschool Attainment Record;
WBRS = Wisconsin Behavior Rating Scale;
SIB = Scale of Independent Behavior;
ABS = AAMD Adaptive Behavior Scale;
ABCL = Adaptive Behavior Checklist;
PCS = Personal Competency Scale;
CDER = Client Development Evaluation Report.

adaptive behavior (30), with maladaptive behavior being investigated only at the subscale (7) and item parcel (14) levels. The vast majority of research was conducted with retarded samples (43), with only nine normal samples included (all at the subscale level; five of which were with the SIB). Of the retarded samples, the majority were from institutional settings (21) and were a mixture of mild/moderate to severe/profound ranges of retardation (21). Of the retarded samples where a relatively clear classification of either mild/moderate (12) or severe/profound (10) was possible, only four samples were at the subscale level. Younger samples at the subscale level were noted by a chronological age sample mean of 16.1 years compared to 23.1 years for the item and item parcel studies.

Examination of the factoring characteristics of the research samples finds that almost all (48) obtained factors through principal-axes or principal-components procedures followed by either an orthogonal (19) or an oblique (30) rotation. Three of the four samples that did not utilize these procedures were those subjected to a key-clustering procedure by Lambert and Nicoll (1976). Samples with oblique rotations were identified primarily at the item (8) and item parcel (22) levels. The vast majority of studies (33) utilized Kaiser's criteria (exclusively or in combination with other criteria) to determine the number of factors to retain. No major differences in salience criteria were noted across levels, with the possible exception being a more liberal criterion in eight of the item parcel samples (i.e., mean item parcel salience of .30, versus .347 and .383 in item and subscale samples, respectively).

As would be expected, significant differences were noted in the number of variables factored at the three levels. The mean number of variables that were factored were 63.1, 20.5, and 15.4 for the item, item parcel, and subscale samples, respectively. The typical study factored 10.9, 16.7, and 63.1 adaptive variables at the subscale, item parcel, and item levels, respectively. An average of approximately four maladaptive variables were factored at the item parcel and subscale level studies. As would be expected when considering recommended subject/variable ratios for multivariate statistics (i.e., the larger the number of variables analyzed the larger the required sample), the mean sample size increased as the number of variables increased as a function of measurement level. The average item sample consisted of 769.1 subjects, while means of 582.6 and 414.7 were noted for the item parcel and subscale samples, respectively. When using the commonly accepted 10:1 subject-to-variable multivariate rule-of-thumb as a guide, inspection of the mean sample size and the mean number of variables indicated that most factor analytic studies of adaptive behavior instruments have been conducted with sufficiently large samples (i.e., average ratios of 12.2:1, 28.4:1 and 26.9:1 were noted for the item, item parcel, and subscale samples).

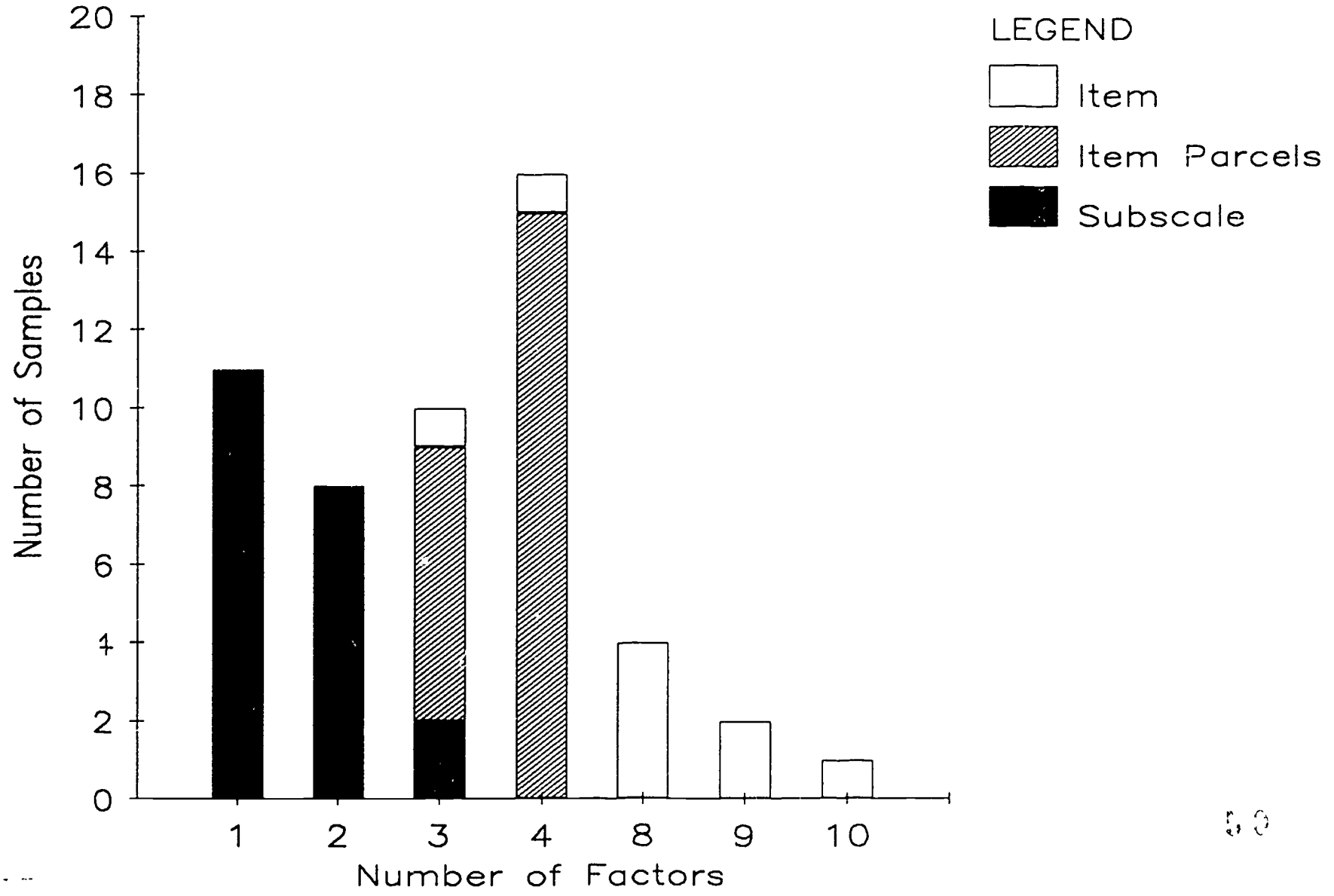
Analysis of Research Across Measurement Levels

Inspection of the mean number of adaptive factors in Table 12 revealed a relationship between number of adaptive behavior factors and measurement level. The mean number of adaptive factors were 1.6, 3.7, and 7.4 for the subscale, item parcel, and item levels, respectively. The mean number of maladaptive factors were 1.9 and 2.0 for the subscale and item parcel studies, respectively. Inspection of Table 12 suggested that the number of identified adaptive factors was a function of the number of variables that were included in the factor analysis which, in turn, was a direct result of the differences between the three measurement levels. This relationship was highlighted by a correlation of .86 (n=52, $p < .001$) between the number of adaptive variables included in the factor analyses and the number of identified adaptive behavior factors. This relationship between measurement level (which in turn includes the number of variables) and number of adaptive behavior factors was clearly evident in Figure 1.

Inspection of Figure 1 revealed the presence of three different distributions which were directly attributable to the measurement level of the adaptive behavior scales. It was obvious that item samples produced the largest number of factors (typically 8-10). The factoring of item parcels usually produced 3-4 factors. Subscale factor analysis studies produced solutions with 1-3 factors, with 19 of the 21 studies producing either a one- or two-factor solution.

The apparent relationship between scale level and/or number of factored variables was verified by two additional procedures. First, a step-wise multiple regression analysis was completed where the number of adaptive factors was the dependent variable. Independent or predictor variables included in the analysis were the date of the study, sample type (dummy coded), sample size, mean chronological age, number of adaptive behavior variables included in the study, and level (dummy coded). Using an alpha level of .15 to determine when to enter or remove variables, highly significant results were

Figure 1 - Frequency of samples identifying number of adaptive behavior factors by level of scale measurement



obtained. The first variable to enter the regression equation was the number of adaptive behavior variables (R=.86), followed by the two dummy coded level variables (R = .92). Sample "date" entered last, but only increased the multiple R to .93. No other variables entered the regression equation. A multiple R squared of .87 was obtained which was significant beyond the .001 level (F=80.23; 4, 47 df). Thus, the highly related sample characteristics of number of adaptive variables and level of measurement appeared to account for almost all of the variance in the number of identified adaptive behavior factors in the studies included in this analysis. Since the inclusion of the other multiple category variables (e.g., placement, degree of retardation, factor method variables) in the regression analyses would require considerable dummy coding, which in turn would dramatically increase the number of independent variables and resultant sample size requirements, no regression analysis including these variables was possible. A similar situation existed with the scale variables (too many scales would require excessive dummy coding). However, an additional analysis was performed that ruled out the possibility that the relationship between measurement level and number of adaptive behavior factors had been confounded by the use of different scales at the different levels.

A review of Table 12 finds one scale (i.e., ABS) which had been factored across levels. The ABS had been factored in 3 item level samples, 8 item parcel level samples, and 5 subscale level samples. An analysis of the number of ABS adaptive behavior factors identified by level (Table 13) reinforces the finding that as one moves from the item to subscale level, the number of adaptive behavior factors decreases.

Table 13
Summary of Frequency of Samples Identifying Number of Adaptive Behavior Factors for the ABS Across Measurement Levels

Level	Number of identified factors					
	1	2	3	4	9	10
Item	0	0	0	0	2	1
Item Parcel	0	0	7	1	0	0
Subscale	1	3	1	0	0	0

Analysis of Research at Item Level

In light of the problems identified in Research Study I with item difficulty factors, a review of previously published item-based factor analysis research was conducted. This review of item-based factor analytic research studies listed in Table 9 suggested that most researchers have not been cognizant of the problem with "difficulty" factors. Levine and Elzey's (1968) factor analysis report of the San Francisco Vocational Competency Scale items makes no mention of difficulty factors and states that the product-moment correlation matrices were factored. Nihira's (1978) AAMD Adaptive Behavior Scale item factor report makes no mention of the type of item intercorrelation matrix that was factored, or, any mention of difficulty factors. The lack of ABS item mean scores and factor loadings in Nihira's (1978) report makes it impossible to determine if difficulty factors were indeed present.

The factor analysis by Reynolds (1981) of the Personal Competency Scale (PCS) item pool is also based on the product-moment intercorrelation matrix. Although Reynolds interprets his three PCS factors as representing adaptive, cognitive, and affective dimensions, inspection of the item means and item factor loadings suggests that an alternative interpretation based on item difficulty or general development is possible. Inspection of the four highest item loadings on each factor finds the following range and mean item scores for the three factors: Factor I (range=4.22-5.19; mean=4.20); Factor II (range=2.84-3.56; mean=3.12); Factor III (range=3.51-4.09; mean=3.82). Inspection of these summary item scores for the four highest loading items on the three PCS factors suggests that the factors may represent difficulty or general development dimensions (viz., easy, moderate, hard). Finally, the research of Silverman, et al. (1983) with the Minnesota Developmental Programming System Behavioral Scales is the only item-based research to acknowledge the presence of difficulty factors. Although Silverman et al. (1983) do consider an item difficulty interpretation for their factors, no recommended

procedures (e.g., factoring item tetrachoric intercorrelation matrices) for item factoring were conducted. To summarize, none of the item-based adaptive behavior factor analytic research reviewed appeared to address, or failed to report, how they dealt with the potentially confounding problem of item difficulty factors. As a result, little assistance can be found for interpreting the influence of developmental difficulty factors in prior item-based adaptive behavior factor analyses.

Summary Analysis of Research Across Measurement Levels

To summarize, an analysis of adaptive behavior factor analytic research reveals significant variability in the number of adaptive factors that have been identified. More importantly, this variability appears to be directly attributable to methodological features of the studies. Item-based studies identified the largest number of adaptive behavior factors (typically 8-10), followed by item parcels (3-4 factors), and subscale-based studies (1-2 factors). This finding suggested that when attempting to analyze the construct of adaptive behavior from a review of factor analytic research studies, researchers must take into consideration the level of the variables that are factored (i.e., items, item parcels, or subscales). Failure to consider this level of analysis could lead to inaccurate conclusions concerning the structure of adaptive behavior. A number of problems with items and item parcels argue against their consideration in the current review: (1) items and item parcels (which are typically only a combination of a few items) suffer from poor reliability, (2) the factoring of items scaled on difficulty introduces problems with the interpretation of difficulty factors (see Research Study I in this report), and (3) items and item parcels are typically only a means by which to develop the preferred, larger, and more reliable subscales. Because of these considerations, it was decided that subscale level factor analysis research would serve as the primary basis for further analysis of the adaptive behavior construct.

In contrast to the adaptive behavior factor results, the studies that investigated the factor structure of maladaptive behavior have been limited to the subscale and item levels. Generally consistent findings emerge that suggest the presence of a two-dimensional structure (mean number of maladaptive factors across subscale and item parcel samples of 1.9 and 2.0).

Analysis of Research at Subscale Level

Adaptive Behavior Factors

Relationship to study characteristics. As noted previously when inspecting Figure 1, subscale adaptive behavior factor analytic research has consistently suggested the presence of one to three factors. A one- (11 samples) or two-factor (8 samples) solution was produced by 19 of the 21 research samples. A partial discrepancy exists between the larger number of research samples suggesting a one-factor structure and the conclusion of Meyers et al. (1979, p. 464) that a two-factor solution "would universally be determined in any competent studies employing the usual broad-ranged AB scale." Since the current review seems to question the conclusion of Meyers et al. (1979), it was deemed important to investigate whether any of the variables coded for the research samples accounted for this discrepancy.

Table 14 displays a breakdown of the subscale studies by select study characteristics as a function of their inclusion, or noninclusion, in Meyers et al.'s (1979) review. Inspection of Table 14 suggests that the current review extends that of Meyers and his colleagues not only by increasing the number of subscale level studies (i.e., 12 new studies in the current review), but by extending the literature base to include a broader array of adaptive behavior scales and by including more samples with a greater diversity of experiences. Eighty-nine percent (8 of 9) of Meyers and his colleagues' subscale studies used the ABS or the ABCL (the predecessor of the ABS). In contrast, 92% (11

Table 14
Breakdown of Subscale Lev l Studies by Inclusion or Noninclusion in Meyers et al.'s (1979) Review

	Not included in Meyers et al.	Included in Meyers et al.
Scale[a]		
PAR	1	1
WBRS	2	0
SIB	7	0
ABS	1	4
ABCL	0	4
ABIC	1	0
Sample type		
Retarded	4	8
Nonretarded	8	1
Placement		
Normal	8	1
Community	2	3
Institution	2	5
Degree of retardation		
Normal	8	1
Mild/Moderate	0	3
Severe/Profound	1	0
Mixed	3	5

[a]PAR = Preschool Attainment Record;
WBRS = Wisconsin Behavior Rating Scale;
SIB = Scales of Independent Behavior;
ABS = AAMD Adaptive Behavior Scale;
ABCL = Adaptive Behavior Checklist;
ABIC = Adaptive Behavior Inventory for Children.

of 12) of the new samples added by the current review used scales other than the ABS/ABCL. Furthermore, Meyers and his colleagues' subscale study focus on primarily institutionalized samples is now balanced by the newer studies which focus primarily on both normal (8 of 12) and retarded (4 of 12) samples which, for the most part, reside in community settings (only 2 of the 10 new studies were classified as institutional). Thus, the addition of the twelve new subscale studies to those reviewed by Meyers and his

Table 15
Correlations Between Quantitative Study Characteristics
and Number of Adaptive Behavior Factors for Subscale Level Studies

Variable	Number of Studies	Mean	SD	r
Date of publication	21	1979	7.0	.11
Total number of variables	21	15.4	5.9	-.17
Total number of adaptive variables	21	10.9	2.5	.06
Total number of maladaptive variables	21	4.0	5.8	-.15
Sample size	21	414.7	491.3	-.12
Sample CA mean	19	16.1	13.0	-.18
Sample age range	20	16.7	20.1	.01
Factor loading salience	15	.38	.07	.46

Note. No correlations are significant at .05 level.

colleagues greatly expands the diversity of samples from which to examine the construct of adaptive behavior.

Table 15 presents correlations between quantitatively coded study characteristics and the number of adaptive factors identified in each sample. Caution should be exercised when interpreting the correlations in Table 15, because of the restriction of range in the number of adaptive behavior factors (i.e., 1-3). Although one of the eight correlations in Table 15 is at a moderate level (viz., .46 for factor loading salience), this correlation and the remaining seven correlations were nonsignificant. Thus, there appeared to be no significant relationship between the number of adaptive behavior factors identified in the research samples and the date of publication, the total number of adaptive or maladaptive variables that were factored, sample size, age characteristics of the samples, or the factor loading salience employed in the interpretation of the factors.

The relationship between the number of identified adaptive behavior factors and qualitatively coded study characteristics is presented in Table 16. With the exception of two breakdowns, analysis of the data in Table 16 was difficult and required a review of the original studies to clarify apparent trends. The simplest interpretations were the lack of any relationship between number of adaptive factors and type of sample or factor rotation. Since almost all subscale studies (18) utilized the orthogonal rotation, comparisons to other rotation methods was meaningless. Also, the similar distribution of one-, two-, or three-factor solutions for the retarded and nonretarded samples (i.e., breakdown by sample type) suggested no difference in the number of adaptive behavior factors in these two populations.

The remaining breakdowns all suggested a possible relationship between the number of adaptive behavior factors identified in the research samples and the scale that was analyzed, the type of factor extraction method employed, or an interaction of these two variables. The breakdown by scales indicated that the majority (i.e., 12) of research samples factored either the SIB (7) or the ABS (5). The larger representation of these two scales is appropriate since they represent the most comprehensive and extensively normed scales contained in this review. Although both the SIB and ABS have displayed evidence of one-, two-, and three-factor solutions, there was a tendency for the SIB to produce more single-factor solutions (i.e., 4 of the 7 SIB solutions were single factor) while the ABS produced more two-factor solutions (i.e., 3 of the 5 ABS solutions were two-factor). Another interesting finding was the apparent change in the ABS factor structure from its earlier version (i.e., ABCL). That is, the ABCL produced only one-factor solutions while its later version, the ABS, produced both two- and three-factor solutions.

Table 16
Analysis of Number of Studies Identifying Number of Adaptive Behavior Factors by Scale, Sample, and Factor Method Characteristics for Subscale Level Studies (N=21)

	Number of adaptive factors		
Breakdown	1	2	3
Scale			
Adaptive Behavior Inventory for Children (ABIC)	1	0	0
Preschool Attainment Record (PAR)	1	1	0
Wisconsin Behavior Rating Scale (WBRS)	0	2	0
Scales of Independent Behavior (SIB)	4	2	1
AAMD Adaptive Behavior Scale (ABS)	1	3	1
Adaptive Behavior Checklist (ABCL)	4	0	0
Domain included			
Adaptive domain	7	5	1
Adaptive and miscellaneous domains	0	0	1
Adaptive and maladaptive domains	0	3	0
Adaptive, maladaptive, and miscellaneous domains	4	0	0
Sample type			
Retarded	6	5	1
Nonretarded	5	3	1
Placement			
Normal	5	3	1
Community	1	3	1
Institution/Community	0	0	0
Institution	5	2	0
Degree of retardation			
Normal	5	3	1
Mild/Moderate	0	2	1
Severe/Profound	0	1	0
Mixed	6	2	0
Factor extraction method			
Principal axes or components	11	4	1
Other/unspecified	0	4	0
Factor extraction criteria			
Kaiser	1	3	0
Kaiser and interpretability	9	2	1
Scree test	0	0	1
Other or unspecified	0	3	0
Factor rotation method			
Orthogonal rotation	9	7	2
Oblique rotation	0	1	0
Unspecified	1	0	0

Instead of reflecting a scale difference, the possibility exists that the difference in the number of identified adaptive behavior factors may be a function of different factor extraction methods. The breakdown by factor extraction method suggested that studies classified as "other" produced more factors than did most studies using the principal axes/components procedures. However, three of the four "other" research samples were from the Lambert and Nicoll (1976) ABS report where a key-clustering procedure (Tyron & Bailey, 1970) was employed. According to Lambert and Nicoll (1976, p. 138), "methods of factoring based on more exact mathematical properties may produce slightly different but usually comparable results." Unfortunately, Lambert and Nicoll did not report results using more traditional factor methods which would allow for a direct evaluation of the possibility that the key-clustering procedure may produce more factors than the traditional methods. The finding of possible factor extraction differences suggests that scale differences may not exist (i.e., the differences may be due to the different factor extraction procedures which were applied in most of the ABS research).

The remaining four breakdowns (viz., breakdown by domains included, breakdown by placement, breakdown by degree of retardation and breakdown by factor extraction criteria) appeared to reflect scale and/or factor extraction procedure differences. The finding that samples that included both adaptive and maladaptive variables produced only two-factor solutions, while those including just adaptive behavior variables produced both one- and two-factor solutions, does not appear to reflect a methodological finding when one notices that the three samples which used combined adaptive and maladaptive domains were from the key-clustered Lambert and Nicoll (1976) research. Further evidence against the possibility that the inclusion of maladaptive variables in the factor analyses produces more two-factor solutions was the presence of four samples which also included maladaptive variables (as well as certain miscellaneous variables), all of which produced single-factor solutions. Again, these four samples investigated the ABCL, an

earlier version of the ABS, and more importantly, used a different factor extraction method (viz., principal axes or components).

The similar distributions as one-, two-, and three- factor solutions when comparing normal with institutional settings (i.e., breakdown by placement) and normal populations with mixed populations (i.e., breakdown by degree of retardation) is again a reflection of no apparent difference between retarded and nonretarded populations in terms of the number of adaptive factors. The possibility that more mild to moderately retarded individuals (who live primarily in community settings) may demonstrate a more diverse number of adaptive behavior dimensions (4 of the 5 community samples displayed 2-3 factors; all 3 mild/moderate samples displayed 2-3 factors) was determined to be mostly a function of the scales used in these samples. Three of the four community samples with 2-3 factors used the ABS (Gaurnaccia, 1976; Lambert & Nicoll, 1976). These same three samples represented all of the mild/moderate samples with 2-3 factors. Thus, what initially appeared to suggest that adaptive behavior may be more multidimensional in the more mild to moderate samples appears instead to reflect the particular adaptive behavior scale used in those studies. The lack of a sufficiently large number of severe/profound samples, and the preponderance of studies where degrees of retardation were confounded (8 of the 12 retarded samples were classified as mixed), made it impossible to specifically investigate whether any systematic relationship exists between levels of retardation and the dimensionality of adaptive behavior.

Finally, the three "other" or "unspecified" samples in the breakdown by factor extraction criteria produced only two-factor solutions, but again are those of Lambert and Nicoll (1976). In addition, the possibility that the different results may be a function of whether studies used the "Kaiser and interpretability" or only the "Kaiser" extraction criteria (the latter producing more two-factor solutions) was not confirmed upon further review of each study. The possible conclusion from Table 16 that research

samples that employed the Kaiser and interpretability criteria produced more single-factor solutions (9 of the 12 samples) than Kaiser alone, would require evidence in the form of investigators stating that second and th: factors (with eigenvalues greater or equal to one) were discarded as uninterpretable. A review of all studies indicated that this was an infrequent occurrence, therefore this was discounted as a possibility.

To summarize, the majority of subscale level adaptive behavior factor analytic research has indicated that the construct of adaptive behavior, as operationalized by available measurement instruments, is either a one- or two-dimensional construct. There does not appear to be any significant relationship between the number of factors reported in studies and study characteristics that include date of publication, number of variables factored, domains that were factored, sample size, age characteristics of the samples, type of samples (i.e., retarded vs nonretarded), or certain factor method characteristics (viz., type of factor rotation and salience criteria). However, there did appear to be a relationship between the number of identified adaptive behavior factors and the scale that was factored and/or the type of factoring method that was employed. It was impossible to disentangle these two confounded variables to determine if these research differences are due to different scales or to the use of different factor extraction procedures.

Type of Identified Factors. Based on their review of literature between 1965 and 1979, Meyers et al. (1979) concluded that adaptive behavior was a two-factor construct defined by autonomy and responsibility dimensions. The autonomy dimension was typically the first general factor to emerge in all studies. Various investigators have used different terms to label this general dimension, such as "functional autonomy", "self-sufficiency", and "independence", to name a few. Although the labels may differ, Meyers et al. (1979) concluded that this general factor represented the same dimension across studies. Since the current review doubles the research samples that were

available to Meyers et al. (1979), an analysis of the type of factors that have been identified was completed. In addition, the percent of variance accounted for by each factor in each investigation was analyzed. Table 17 presents the results.

A review of the first factor identified in the 21 research samples reinforced the conclusions of Meyers et al. (1979). Twelve of the factors were labeled personal independence and three were labeled functional autonomy; terms cited by Meyers et al. (1979) as representing the same general dimension. The remaining first factor labels, although appearing to differ from the independence or autonomy emphasis, were upon closer inspection, determined to represent the same dimension. Song et al.'s (1984) cognition factor was described by the authors as similar to the personal self-sufficiency factor reported by Nihira (1976). Katz-Garris et al. (1980) also considered their social desirability factor to be similar to personal independence and autonomy. Finally, Hug et al.'s (1978) general adaptive ability factor and Millsap et al.'s (1987) general adaptive functioning factor are clearly similar to the general factor interpretation of Meyers et al. (1979). The finding of a general dimension, labeled personal independence or autonomy, appears to be a consistent finding across the field of adaptive behavior factor analytic research.

Compared to the consistency of the first factor results, the second and third factors listed in Table 17 displayed greater variability. The most frequent second factor interpretation was that of social responsibility, a factor present in five of the research samples (Owens & Bowling, 1970; Gaurnaccia, 1976; Lambert & Nicoll, 1976). A small personal responsibility factor was present as a third factor in two samples (Gaurnaccia, 1976; Bruininks, McGrew & Maruyama, 1987). Similarly, two academic factors (i.e., academic-quantitative and academic-conceptual) surfaced in Bruininks et al.'s (1987) study. Physical developmental (i.e., psychomotor) factors were presented in three samples (Owens & Bowling, 1970; Song et al., 1984). Finally a community-vocational dimension surfaced

Table 17

Adaptive Behavior Factor Labels for Subscale Level Studies

Source/Date	Scale[a]	Sample	Factor label 1	2	3
Owens & Bowling (1970)	PAR	Retarded Child	Physical-Developmental	Social-Intellectual	---
Song, Jones, Lippert, Metzgen, Miller & Borreca (1984)	WBRS	Retarded Child/Adult	Cognition	Psychomotor	---
		Normal Child	Cognition	Psychomotor	---
Nihira (1969a)	ABCL	Retarded Adult	Personal Independence	---	---
Nihira (1969b)	ABCL	Retarded Child	Personal Independence	---	---
		Retarded Child	Personal Independence	---	---
		Retarded Child	Personal Independence	---	---
Gaurnaccia (1976)	ABS	Retarded Adult	Personal Independence	Personal Responsibility	Social Responsibility
Lambert & Nicoll (1976)	ABS	Retarded Child	Functional Autonomy	Social Responsibility	---
		Retarded Child	Functional Autonomy	Social Responsibility	---
		Normal Child	Functional Autonomy	Social Responsibility	---
Katz-Garris, Hadley, Garris & Barnhill (1980)	ABS	Retarded Adult	Social Desirability	---	---
Hug, Barclay, Collins, & Lamp (1978)	PAR	Normal Child	General Adaptive Ability	---	---
Millsap, Thackrey & Cook (1987)	ABIC	Normal Child	General Adaptive Function	---	---
Bruininks, McGrew & Maruyama (1987)	SIB	Normal Child	Personal Independence	Academic-Quantitative	Personal Responsibility
		Normal Child	Personal Independence	---	---
		Normal Child	Personal Independence	---	---
		Normal Child	Personal Independence	---	---
		Normal Adult	Personal Independence	Community-Vocational	---
		Retarded Child	Personal Independence	Academic-Conceptual	---
		Retarded Adult	Personal Independence	---	---

[a]PAR = Preschool Attainment Record;
WBRS = Wisconsin Behavior Rating Scale;
ABCL = Adaptive Behavior Checklist;
ABS = AAMD Adaptive Behavior Scale;
ABIC = Adaptive Behavior Inventory for Children;
SIB = Scales of Independent Behavior.

in one sample (Bruininks, McGrew & Maruyama, 1987). Beyond the common responsibility dimension (either personal or social), it appeared that the second and third factors were inconsistent across studies and appeared to be a function of scale differences. For example, with the possible exception of Owens and Bowling's (1970) socially oriented second factor, only the ABS produced a social responsibility factor. Alternatively, the academic and community-vocational factors were present only in the SIB research (Bruininks, McGrew & Maruyama, 1987). It appears that all adaptive behavior scales tap a general personal independence or autonomy dimension, but the other dimensions they may assess (if any) vary by instrument and/or research method.

Maladaptive Factors

Analysis of the maladaptive behavior domain was less complex than that for adaptive behavior since only seven research samples (Lambert & Nicoll, 1976; Nihira, 1969a, 1969b) were available, and all used the same scale (i.e., ABS). With only one exception (Nihira, 1969b), all samples produced a two-factor solution. In the absence of additional research since Meyers et al's (1979) original review, the conclusion that maladaptive behavior is a two-dimensional construct still appears to be appropriate. Meyers and his colleagues considered these two factors to be analogous to the extra-intra personality or adjustment dimensions frequently described in psychology, and labeled social and personal maladaption. Further analysis of the maladaptive factors was not possible since all studies were completed with the same scale, only a limited number of samples were available and more importantly, the results revealed little variability for investigation.

Summary of Subscale-Level Research

To summarize, the majority of subscale-level adaptive behavior factor analytic research consistently suggests that adaptive behavior, as operationalized by existing scales, is a one- or two-dimensional construct. Although less researched, maladaptive

behavior is also consistently defined by two factors. These findings are generally consistent with those of Meyers et al. (1979), although a few differences are noted.

Both the current review and that of Meyers et al. (1979) find adaptive behavior to contain a large general adaptive dimension (i.e., personal independence or functional autonomy). Although the current review and that of Meyers and his colleagues both offer support for the presence of a second adaptive behavior factor, the current review suggests that the presence of this dimension is inconsistent and may vary as a function of adaptive behavior scale. Meyers et al.'s review suggests that a consistent responsibility factor is present in the adaptive behavior domain. The current review, which included a broader range of adaptive behavior scales and samples (a significant portion of Meyers et al.'s review was based on the ABS in retarded samples), identified a number of second (and in some cases third) factors. A personal or social responsibility factor was most prevalent, although academic, physical developmental, and community/vocational dimensions also surfaced. Although it is clear that adaptive behavior contains a large general independence or autonomy dimension, the identification of a stable second dimension has yet to occur. This situation appears attributable to differences in adaptive behavior scales. In contrast, research on the structure of maladaptive behavior has produced a consistent extra-intra behavioral dichotomy. Social (i.e., directed towards others) and personal (i.e., directed towards self) maladaption appear to represent stable components of the maladaptive behavior domain. Caution must be exercised, however, since these findings are based on a more limited number of research studies.

RESEARCH STUDY III: AN INVESTIGATION OF THE RELATIONSHIP BETWEEN ADAPTIVE/MALADAPTIVE BEHAVIOR AND INTELLECTUAL/ACADEMIC ABILITY

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Purpose

Research Study III was designed to explore the interrelationships between the domains of adaptive behavior, maladaptive behavior, intelligence, and academic achievement. The goal was to determine the degree to which these domains represented distinct constructs, as well as to determine the degree of overlap (i.e., redundancy) between these constructs. The methods used in Research Study III were selected to go beyond the limited information conveyed by simple correlations between measures of adaptive behavior, maladaptive behavior, intelligence and achievement. A variety of multivariate procedures (e.g., principal component, cluster, and canonical correlation analyses) were applied to construct measures in six normal and two retarded samples. The resulting research design allowed an examination of the degree to which the relationships among the constructs of adaptive behavior, maladaptive behavior, and intellectual/academic ability vary generally, and the degree to which they vary as a function of handicapped status.

Samples/Instrumentation

Most of the samples for this study employed the adaptive behavior and problem behavior sections of the SIB. The five nonretarded and two retarded samples described previously for Research Study I served as the subject pool for Research Study III.

Briefly, this included Preschool, Early Childhood, Middle Childhood, Adolescent, and Adult samples drawn from the SIB standardization sample. In addition, two retarded samples (i.e., Childhood and Adolescent/Adult) drawn from the samples used in the SIB validity studies were used (Bruininks et al., 1985). The reader is referred to the sample descriptions in Research Study I for detailed descriptive information regarding these seven samples.

In contrast to the fourteen SIB subscales that served as the basis for Research Study I, the current investigation utilized the SIB cluster scores. Based on various combinations of the 14 subscales, four adaptive behavior cluster scores were available for all subjects in each sample. The Motor Skills cluster consists of the Gross-Motor and Fine-Motor subscales, and "assesses a range of motor proficiency tasks involving mobility, fitness, coordination, eye-hand coordination, and precise movements" (Bruininks et al., 1985, p. 11). The Social Interaction and Communication Skills cluster consists of the Social Interaction, Language Comprehension, and Language Expression subscales. This cluster was designed to measure a "subject's (a) interaction with others in various social settings; (b) understanding of language transmitted by signs, oral expression, or written symbols; and (c) communication of information through signs, oral expression, or written language" (Bruininks et al., 1985, p. 11). The Personal Living Skills cluster includes five subscales: Eating and Meal Preparation, Toileting, Dressing, Personal Self-Care, and Domestic Skills. This cluster measures a "subject's effectiveness in meeting the everyday demands of personal independence and autonomy, primarily in the home environment and, to a lesser extent, in interacting with other people in the community" (Bruininks et al., 1985, p. 11). Finally, the Community Living Skills cluster includes the Time and Punctuality, Money and Value, Work Skills, and Home/Community Orientation subscales. In general, this cluster assesses a "subject's level of independence in areas essential to successful community adjustment" (Bruininks et al., 1985, p. 11). The SIB adaptive

behavior cluster scores were in the form of W scores, a special transformation of the Rasch ability scales. The W scores are the preferred metric for statistical analysis due to their equal-interval measurement characteristic. Detailed information concerning the W scale is described in Bruininks et al. (1985), Woodcock (1978), and Woodcock and Dahl (1971).

In addition to the four adaptive behavior clusters, the SIB also provides three maladaptive clusters based on the combination of eight problem behavior areas (Bruininks et al., 1985). The Internalized Maladaptive cluster assesses maladaptive behaviors that are directed towards oneself, and includes the SIB problem behavior areas of Hurtful to Self, Unusual or Repetitive Habits, and Withdrawal or Inattentive Behavior. The Social Maladaptive cluster measures problems in social contexts, and includes the SIB problem behaviors of Socially Offensive Behavior and Uncooperative Behavior. Inappropriate behavior directed towards others or the environment is assessed by the Externalized Maladaptive cluster which includes the SIB problem behavior areas of Hurtful to Others, Destructive to Property, and Disruptive Behavior. Maladaptive cluster scores were in the form of maladaptive behavior indexes, a special scale where a zero mean approximates the average level demonstrated at any given age, and where a standard deviation of 10 represents the typical variability observed in an extensive variety of clinical samples (Bruininks et al., 1985). On this scale, large negative scores represent more significant problem behaviors.

Subsamples with intellectual/academic and adaptive/maladaptive measures

As described in the SIB technical manual, Development and Standardization of the Scales of Independent Behavior, (Bruininks et al., 1985), the SIB was statistically linked through an extensive equating and norming study to a measure of intellectual functioning. The SIB was linked with the Woodcock-Johnson Tests of Cognitive Ability (WJTCA) - one

component of the Woodcock-Johnson Psycho-Educational Battery (Woodcock & Johnson, 1977). This linking process allows user's of the SIB to compare and evaluate a subject's adaptive behavior with that of other subjects of the same chronological age and level of intellectual functioning.

In the equating study, approximately one-half of the SIB standardization sample (15 age levels between 3 to 40 years) was administered the WJTCA Preschool Broad Cognitive Ability cluster (Woodcock, 1978). Although labeled as a "preschool" cluster, it is actually a six-subtest short-form estimate of the complete WJTCA Broad Cognitive Ability cluster which is appropriate for use from preschool age to adulthood (McGrew, 1986). The WJTCA Preschool cluster was the general intellectual measure used in the equating process. In addition, certain subjects were also administered two achievement clusters from the Woodcock-Johnson Tests of Achievement (WJTA) (Woodcock & Johnson, 1977). The Skills cluster is a combination of the easiest subtests from the WJTA Reading, Mathematics, and Written Language clusters. The Skills cluster is a combination of basic reading, math, and writing skills. The Knowledge cluster is a general knowledge achievement measure in the other content areas, specifically a combination of social studies, science, and humanities. Similar to the SIB adaptive clusters, the WJTCA Preschool and WJTA Skills and Knowledge cluster scores were in the form of W scores, a special transformation of the Rasch ability scales. Thus, for certain subjects in this SIB standardization subsample, adaptive, maladaptive, intellectual, and academic measures were available.

Additional sample

Since the focus of Research Study III was to investigate the interrelationships between adaptive/maladaptive behavior and intellectual/academic ability with contemporary co-normed measures, an additional sample was analyzed. Keith et al. (1987) recently

investigated the relationship between adaptive behavior and intelligence through the application of confirmatory factor analysis in a sample of 556 children (grades 1-8) who served as part of the standardization of both the Vineland Adaptive Behavior Scale (ABS) (Sparrow et al., 1984) and the Kaufman Assessment Battery for Children (K-ABC) (Kaufman & Kaufman, 1983). According to Keith et al. (1987), this sample of 556 was a nationally representative sample of children. The scores used in Keith and his colleagues' analyses were the VABS domain scores of Socialization, Daily Living Skills, and Communication, and three K-ABC indexes of intellectual ability. Based on prior research with the K-ABC (Keith, 1985), Verbal Memory (K-ABC Sequential Processing Scale), Nonverbal Reasoning (K-ABC Simultaneous Processing Scale), and Verbal Reasoning (composite of K-ABC Faces and Places, Riddles, and Arithmetic subtests) measures of intellectual functioning were analyzed. The inclusion of the intercorrelation matrix of these measures in Keith et al.'s (1987) report allowed the current investigators to analyze these data via procedures that operated on correlational matrix input. The reader is referred to Keith et al. (1987) for details of their study and findings.

Description of Data Analytic Procedures

The samples in Research Study III were analyzed with one to three different exploratory multivariate statistical procedures (viz., principal components, cluster, and/or canonical correlation analyses). Each procedure was applied to the respective partial intercorrelation matrices (effect of age removed) in each sample. Exploratory principal component procedures were the main data analytic tool. Those procedures were utilized to identify the number and type of dimensions present in the combined pool of adaptive behavior, maladaptive behavior, and intellectual/academic ability domains. All analyses employed principal components analysis with unities in the diagnosis. A combination of objective and subjective (viz., eigenvalue $\geq$ 1.0; scree test; interpretability of factors)

factor extraction criteria were employed. All factor solutions were rotated to the varimax criterion.

To aid the interpretation of the component results, supplementary cluster analyses procedures were used with the measures of adaptive behavior, maladaptive behavior, and intellectual/academic ability. The supplementary cluster analyses used a hierarchical single-linkage or "nearest neighbor" algorithm (Aldenderfer & Blashfield, 1984). This procedure searches an NxN similarity matrix and sequentially merges the most similar variables. This sequential merging process is typically represented by a tree diagram called a "dendogram." These cluster analysis procedures produce nonoverlapping nested clusters. Although determining the number of clusters to retain is a fundamentally unresolved problem in cluster analysis (Aldenderfer & Blashfield, 1984), visual inspection of the dendograms was considered adequate for the current investigation (since the procedures were being employed as supplements to the primary principal components analyses).

Canonical correlation (Cooley & Lohnes, 1971; Thompson & Keeves, 1985; Thompson, 1984) is utilized in analyses where the objective is to determine the relationship between two variable sets when each set consists of at least two variables. In the context of the current exploratory research, the canonical methodology was selected since it allowed identification of shared abilities between two sets of measures (i.e., intellectual/academic ability and adaptive behavior), as well as the determination of the proportion of variance within each set of measures that is attributable to the shared abilities. For each canonical analysis, the following information was obtained: (1) canonical correlations and related statistics; (2) significant canonical variates and canonical loadings (i.e., structure coefficients) on the variates; (3) proportion of variance extracted by each pair of variates; and (4) overall redundancy coefficients. As originally advanced by Stewart and Love (1968), the redundancy coefficients represent the "average proportion of variance in the variables in one set that is reproducible from the variables in the other set" (Thompson, 1984, p. 25).

Investigation of the structure of the combined adaptive/maladaptive behavior domains

To investigate the extent to which adaptive and maladaptive behaviors represent separate or related constructs, principal components were extracted from the SIB adaptive and maladaptive measures in the five nonretarded and two retarded samples. Table 18 presents the breakdown of the number of subjects and the means and standard deviations for the adaptive and maladaptive scores in each sample.

Table 19 presents the principal component solutions for the seven samples. A review of Table 19 indicated that a consistent two-factor solution was present across the nonretarded and retarded samples. With only two isolated exceptions, the respective factor loadings revealed a crisp, delineated two-factor solution. That is, the adaptive variables loaded high on the adaptive factor (Factor 1), and very low on the maladaptive factor (Factor 2). Similarly, the maladaptive variables consistently loaded high on the maladaptive factor (Factor 2) and failed to load at even minimal levels on the adaptive factor (Factor 1). These results were interpreted as supporting the notion that adaptive and maladaptive behaviors represent two separate constructs.

The supplementary cluster analysis solutions presented in Figures 2 through 8 reinforced the principal component analyses. For example, inspection of the cluster dendogram in Figure 2 showed that the adaptive variables (i.e., Personal Living, Social/Communication, Motor and Community Living Skills) successively joined together first, with the maladaptive variables (i.e., Internalized, Externalized, and Asocial Indexes) grouped together separately. The higher-order adaptive and maladaptive clusters were observed to join together relatively late in the amalgamation process, a finding which indicated significant differences between the two clusters. Comparisons between all dendograms in Figures 2 through 8 revealed only slight differences which were attributed to sampling error. The supplementary cluster analyses of the adaptive and maladaptive variables supported the factor-based conclusion that these two domains represent distinct constructs that are not strongly related.

Table 18

Means and Standard Deviations for SIB Adaptive and Maladaptive Clusters for Nonretarded and Retarded Samples

		Nonretarded sample					Retarded sample	
		Preschool (N=489)	Early Childhood (N=460)	Middle Childhood (N=496)	Adolescent (N=315)	Adult (N=198)	Childhood (N=110)	Adolescent/Adult (N=178)
Motor	M	384.8	462.9	496.0	509.0	517.8	448.7	450.2
	SD	47.6	24.5	30.2	30.2	12.1	35.9	49.8
Social and Communication	M	410.6	466.9	496.6	516.0	539.4	450.5	454.8
	SD	36.1	17.6	25.7	32.0	15.2	31.3	44.9
Personal Living	M	408.1	470.5	497.4	520.8	547.6	462.6	474.7
	SD	35.0	17.5	23.5	28.3	12.7	28.4	39.3
Community Living	M	388.81	450.4	495.3	520.2	548.6	436.6	449.6
	SD	31.0	22.4	29.6	36.6	11.8	41.0	49.0
Asocial	M	1.9	.1	-2.4	1.2	.8	7.5	10.3
	SD	8.5	9.2	11.0	9.5	5.7	11.7	11.1
Internalized	M	.3	.1	1.4	.3	.7	8.3	8.7
	SD	6.6	7.5	8.2	7.7	7.2	10.7	9.7
Externalized	M	.9	.8	.6	1.0	.7	6.1	6.3
	SD	10.2	9.0	9.3	6.8	3.9	13.5	11.5

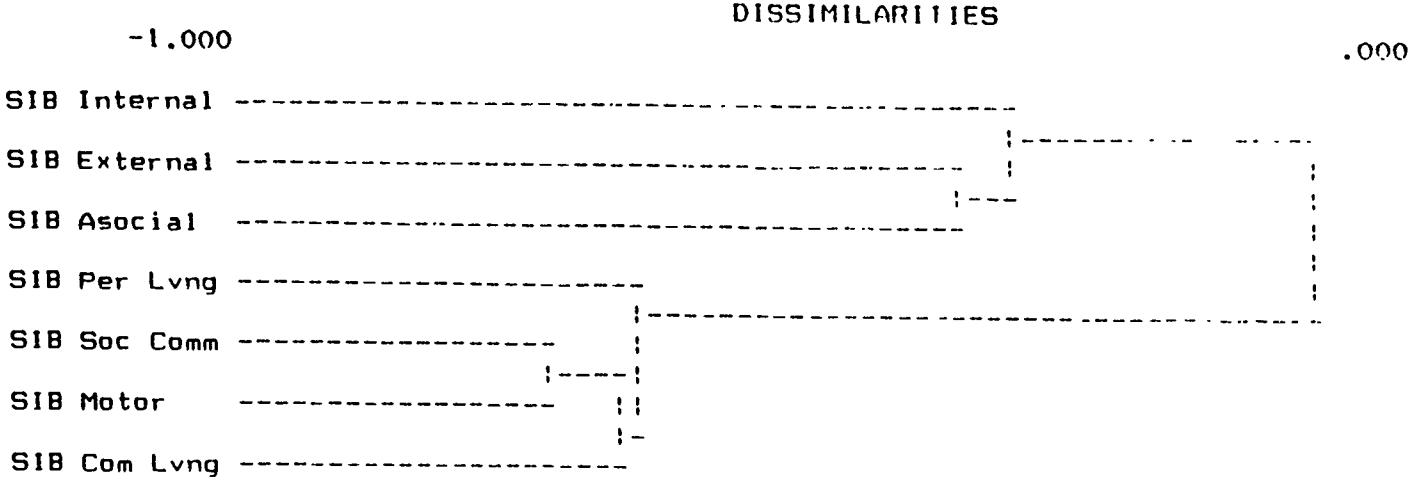
Table 19

Varimax Rotated Two-Factor Matrix of SIB Adaptive Clusters and Maladaptive Indexes in Five Nonretarded and Two Mentally Retarded Samples

Samples	Adaptive cluster				Maladaptive index		
	Motor	Social and Communication	Personal Living	Community Living	Asocial	Internalized	Externalized
Preschool (N=260)							
Factor 1 (2.997; 42.5%)	.84*	.90*	.84*	.81*	-.10	.15	-.15
Factor 2 (1.627; 23.2%)	-.13	-.05	.03	.00	.72*	.71*	.79*
Early Childhood (N=154)							
Factor 1 (3.179; 45.4%)	.86*	.88*	.86*	.88*	.02	.06	.12
Factor 2 (1.800; 25.7%)	.00	.08	.10	.12	.85*	.71*	.83*
Middle Childhood (N=166)							
Factor 1 (4.006; 57.2%)	.93*	.94*	.94	.94*	.14	.22	.04
Factor 2 (1.716; 24.5%)	.11	.17	.15	.16	.87*	.77*	.83*
Adolescent (N=93)							
Factor 1 (4.614; 65.9%)	.94*	.93*	.93*	.95*	.38	.48*	-.03
Factor 2 (1.323; 18.9%)	.11	.24	.25	.23	.81*	.62*	.90*
Adult (N=182)							
Factor 1 (3.143; 44.9%)	.78*	.87*	.70*	.86*	-.00	.08	.24
Factor 2 (1.565; 22.4%)	.01	.14	.43*	.06	.80*	.82*	.72*
Retarded Childhood (N=72)							
Factor 1 (3.497; 50.0%)	.88*	.84*	.93*	.90*	.04	.36	-.09
Factor 2 (2.000; 28.6%)	-.09	.18	.06	.15	.89*	.74*	.88*
Retarded Adolescent/Adult (N=142)							
Factor 1 (3.645; 52.1%)	.94*	.95*	.97*	.95*	-.04	.01	.04
Factor 2 (1.745; 24.9%)	-.08	.01	.05	.05	.87*	.54*	.[illegible]*

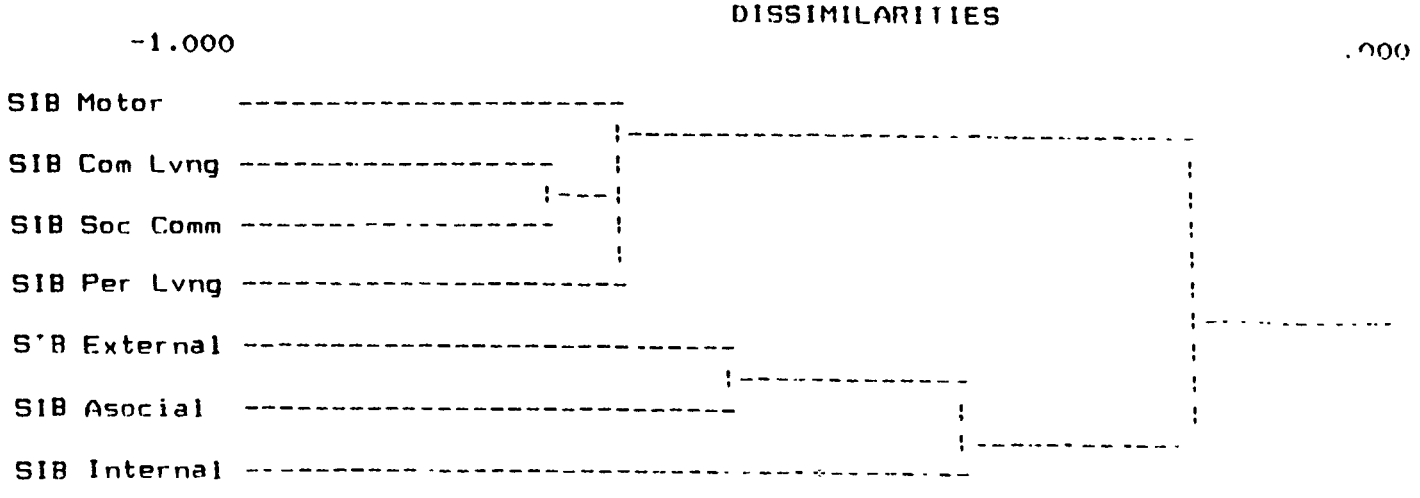
Note. Values in parentheses after each factor number are the unrotated eigenvalues and percentages of variance figures, respectively.
* Loadings of .40 or above.

Figure 2
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Preschool Nonretarded Sample (N=260)



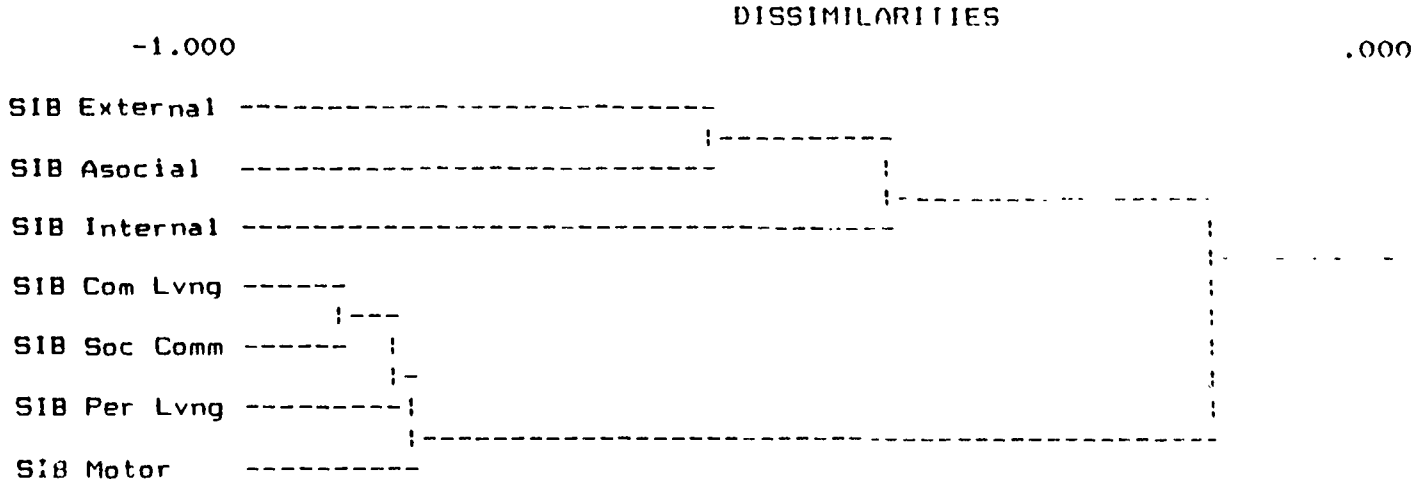
Note. SIB = *Scales of Independent Behavior;*
Internal = Internalized Maladaptive Index;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Per Lvng = Personal Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster.

Figure 3
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Early Childhood Nonretarded Sample (N=154)



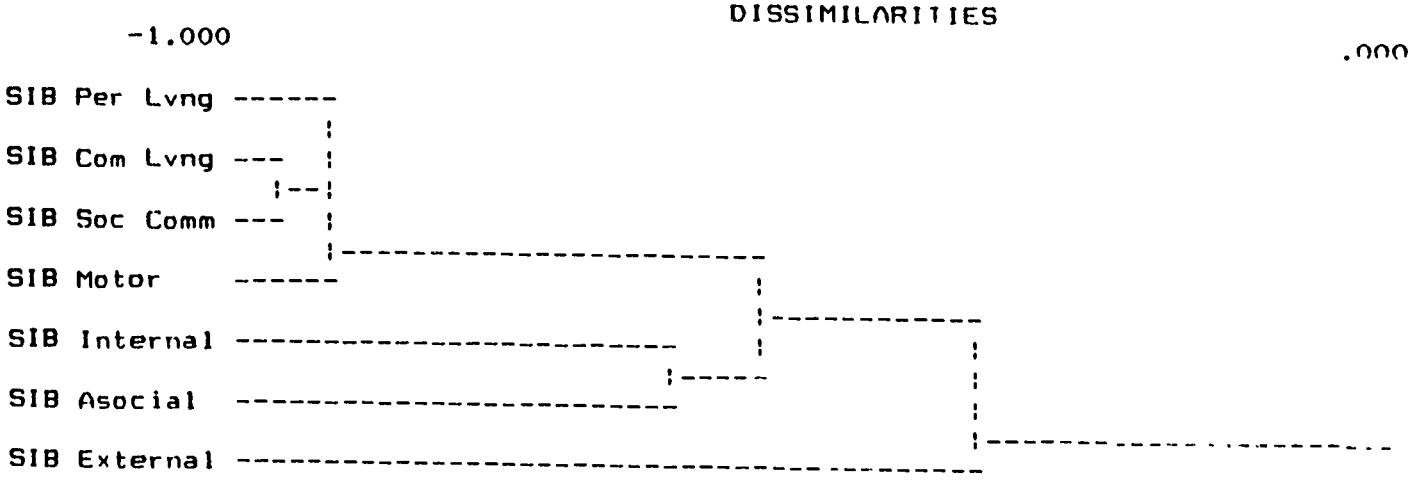
Note. SIB = *Scales of Independent Behavior;*
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index.

Figure 4
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Middle Childhood Nonretarded Sample (N=166)



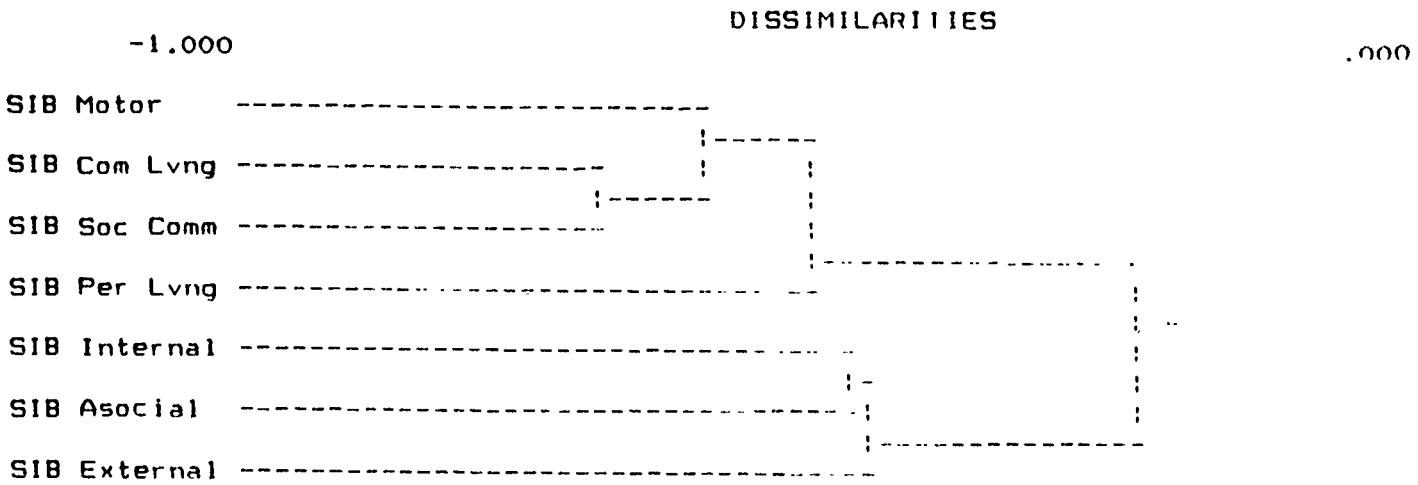
Note. SIB = *Scales of Independent Behavior;*
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
Motor = Motor Skills Cluster.

Figure 5
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Adolescent Nonretarded Sample (N=93)



Note. SIB = *Scales of Independent Behavior;*
Per Lvng = Personal Living Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Motor = Motor Skills Cluster;
Internal = Internalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
External = Externalized Maladaptive Index.

Figure 6
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Adult Nonretarded Sample (N=182)

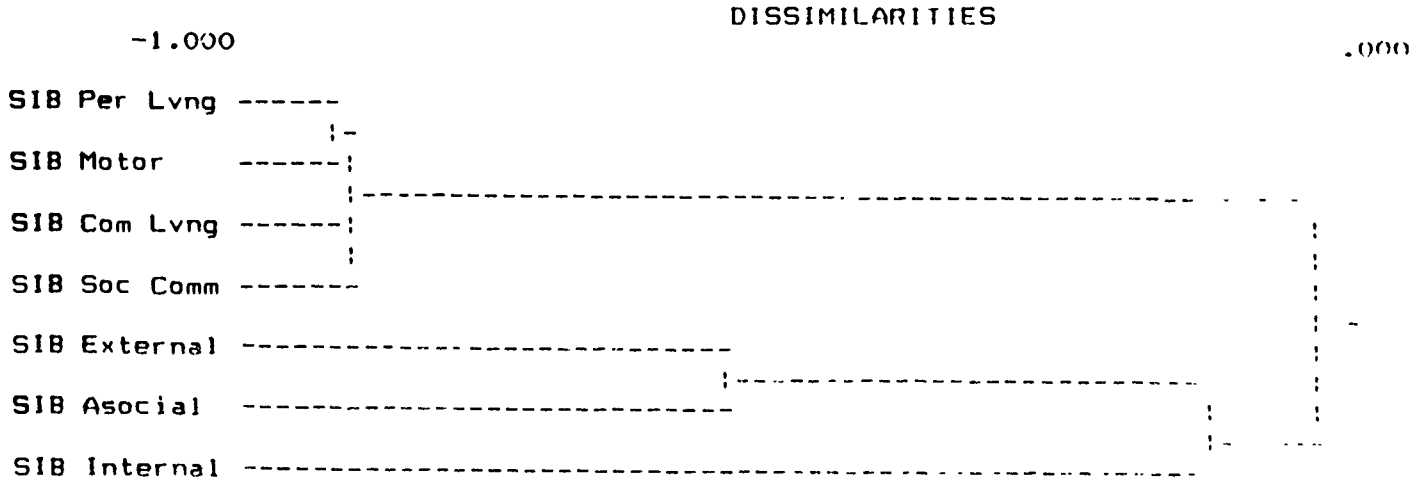


Note. SIB = *Scales of Independent Behavior;*
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
Internal = Internalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
External = Externalized Maladaptive Index.

Figure 7
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Childhood Mentally Retarded Sample (N=72)

Note. SIB = *Scales of Independent Behavior;*
Per Lvng = Personal Living Skills Cluster;
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index.

Figure 8
Cluster Analysis (Single Linkage) Dendogram of Adaptive and Maladaptive Behavior Domains in Adolescent/Adult Mentally Retarded Sample (N=142)



Note. SIB = *Scales of Independent Behavior;*
Per Lvng = Personal Living Skills Cluster;
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index.

Investigation of the combined intellectual, academic, adaptive, and maladaptive behavior domains

To assess the relationship between the intellectual, academic, adaptive, and maladaptive constructs, exploratory factor and cluster analyses were conducted in those samples which had scores for the measures of these constructs. Unfortunately, in the SIB/WJ equating studies (Bruininks et al., 1985) no samples existed where subjects had been administered all the intellectual (i.e., WJTCA Preschool cluster), academic (i.e., WJTA Skills and Knowledge clusters), adaptive (i.e., SIB adaptive clusters), and maladaptive (i.e., SIB maladaptive clusters) measures. Thus, a series of factor and cluster analyses were completed to "tease out" the interrelationship between these variables. The descriptive breakdown of the variables used in these analyses is presented in Table 20.

Tables 21 and 22 present the results for the factor analyses of the intellectual WJ Preschool, SIB adaptive behavior, and SIB maladaptive behavior clusters in the Early Childhood, Middle Childhood, Adolescent, and Adult nonretarded samples. In each sample two meaningful factors were identified, with the first representing a large (40.7 to 64.6% of the variance) general competence dimension defined by the WJ Preschool intellectual and SIB adaptive clusters. The smaller (17.7 to 23.8% of the variance) second factor was consistently defined by the SIB maladaptive indexes. These findings offered no additional insights beyond those previously derived from the factor analyses reported in Table 19. The only difference was the inclusion of an intellectual variable (viz., WJ Preschool) which was found to be more similar to the adaptive behavior variables than the maladaptive variables (i.e., the WJ Preschool cluster consistently loaded at moderate to high levels on the first factor with the SIB adaptive clusters). The failure of a third intellectual factor to emerge is due to the fact that only one intellectual variable was included in the analyses. At least three or more "indicators" of a factor would be necessary for a factor to emerge. Thus, the results in Tables 21 and 22 cannot be interpreted as meaning that intellectual ability and adaptive behavior are highly related. The results only suggested that, in the absence of other indicators, intellectual ability is more similar to adaptive than maladaptive behavior.

Table 20
Means and Standard Deviations for SIB Adaptive and Maladaptive Clusters and Woodcock-Johnson Preschool, Knowledge and Skills Clusters

Cluster	Early Childhood	Middle Childhood	Adolescent	Adult	Combined samples: Childhood	Combined samples: Adolescent/ Adult
WJ Preschool						
M	465.6	500.9	511.6	526.6	489.1	524.4
SD	14.9	20.2	31.8	16.6	20.3	12.6
WJ Knowledge						
M	---	---	---	---	484.8	530.2
SD	---	---	---	---	23.2	17.5
WJ Skills						
M	---	---	---	---	484.8	541.4
SD	---	---	---	---	23.2	15.7
SIB Motor						
M	467.8	501.9	511.6	517.1	487.1	518.6
SD	19.2	18.8	21.6	11.6	20.8	10.7
SIB Social/ Communication						
M	471.4	503.8	523.8	543.2	486.2	523.9
SD	14.1	21.5	28.5	12.8	18.4	16.1
SIB Personal Living						
M	474.0	502.1	528.8	551.9	486.4	525.4
SD	14.9	18.4	22.2	9.1	18.0	14.7
SIB Community Living						
M	455.2	501.5	528.5	549.7	479.3	528.0
SD	20.1	22.1	31.3	9.1	24.9	15.0
Asocial						
M	.2	1.9	.5	.2	---	---
SD	9.9	10.7	9.2	5.0	---	---
Internalized						
M	.6	1.0	.2	.2	---	---
SD	8.0	8.2	7.9	6.4	---	---
Externalized						
M	.3	.8	1.2	1.0	---	---
SD	8.6	9.5	6.4	3.7	---	---

Table 21
Varimax Rotated Two-Factor Matrix of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Early Childhood and Middle Childhood Nonretarded Samples

Measure/Domain	Early Childhood (N=90) Factors 1	2	Middle Childhood (N=151) Factors 1	2
WJ Preschool	.58*	.02	.79*	.08
SIB Motor	.83*	.02	.78*	.24
SIB Social/Communication	.87*	.06	.89*	.19
SIB Personal Living	.81*	.11	.82*	.24
SIB Community Living	.89*	.08	.92*	.15
SIB Asocial Index	.04	.85*	.25	.84*
SIB Internalized Index	.13	.74*	.25	.74*
SIB Externalized Index	.04	.82*	.03	.86*
Eigenvalue (unrotated)	3.319	1.901	4.301	1.528
Percent of variance (unrotated)	41.5 %	23.8 %	53.8 %	19.1 %

Note. * Indicates loadings of .40 or above

The possibility that the WJ Preschool cluster may differ from the adaptive behavior factor is suggested in the supplementary cluster analyses presented in Figures 9 through 12. In each of the cluster solutions, the WJ Preschool cluster was the last variable to merge into the general competence cluster. In Figures 9 through 12, the difference between the intellectual WJ Preschool and the SIB adaptive clusters is suggested by the point at which the WJ Preschool cluster joins this general competence cluster. It joins the general competence cluster particularly late in the Early Childhood and Adult

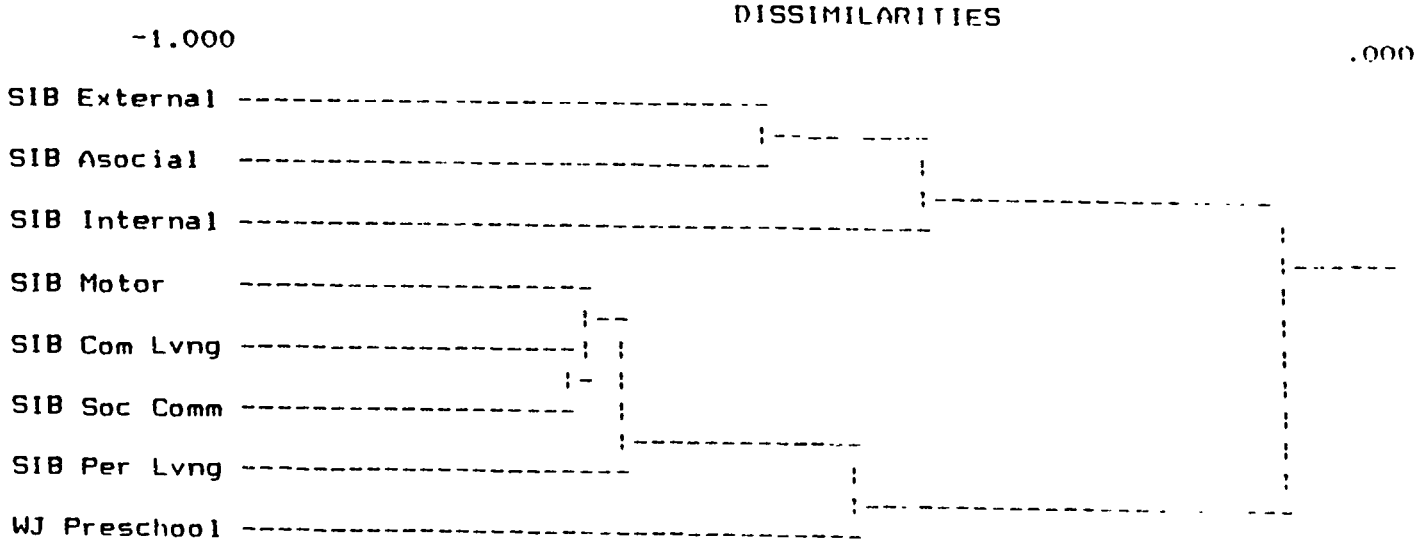
Varimax Rotated Two-Factor Matrix of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Adolescent and Adult Nonretarded Samples

Measure/Domain	Adolescent (N=84) Factors 1	2	Adult (N=124) Factors 1	2
WJ Preschool	.89*	.17	.54*	.10
SIB Motor	.92*	.09	.78*	.10
SIB Social/Communication	.93*	.22	.94*	.11
SIB Personal Living	.87*	.28	.70*	.39
SIB Community Living	.95*	.23	.87*	.07
SIB Asocial Index	.28	.87*	-.03	.74*
SIB Internalized Index	.50*	.60*	.11	.79*
SIB Externalized Index	.01	.88*	.10	.77*
Eigenvalue (unrotated)	5.165	1.415	3.258	1.682
Percent of variance (unrotated)	64.6 %	17.7 %	40.7 %	21.0 %

Note. * Indicates loadings of .40 or above

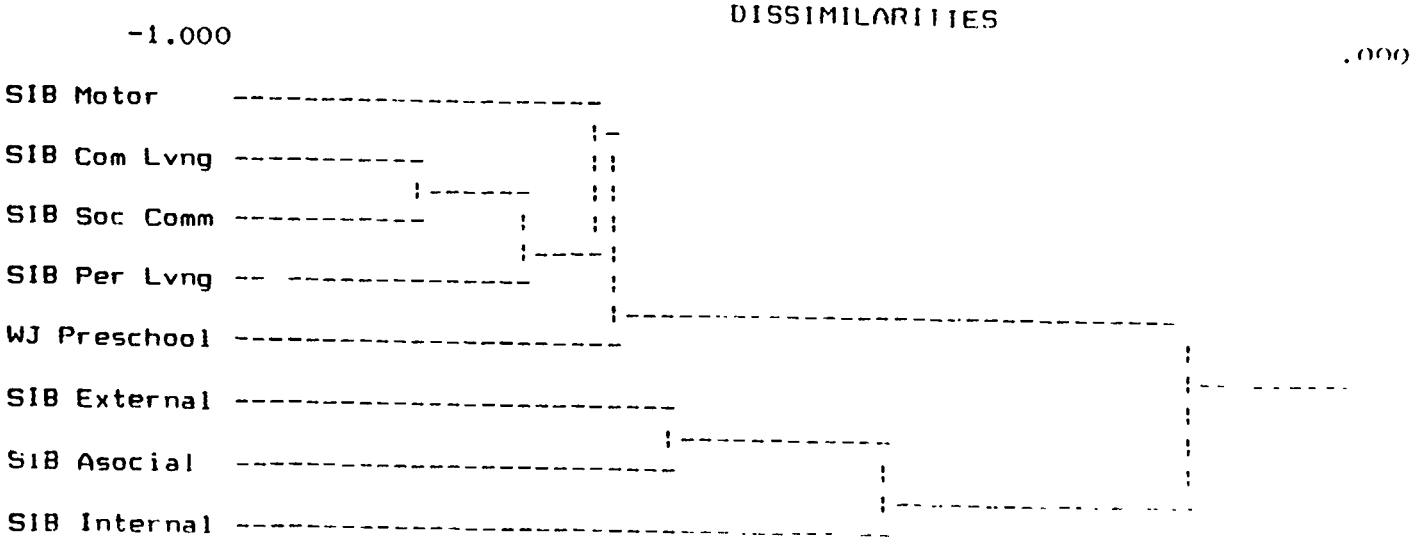
samples, Figures 9 and 12, respectively. Although the factor analyses solutions found the WJ Preschool cluster joining with the SIB adaptive behavior clusters in a general competence dimension, the cluster analyses results suggested that the intellectual and adaptive behavior variables may differ. The distinctness of the intellectual and adaptive behavior dimensions became clear in the subsequent analyses where the academic measures (i.e., WJTA Skills and Knowledge clusters) were jointly analyzed with the intellectual WJ Preschool and SIB adaptive behavior clusters.

Figure 9
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Early Childhood Nonretarded Sample (N=90)



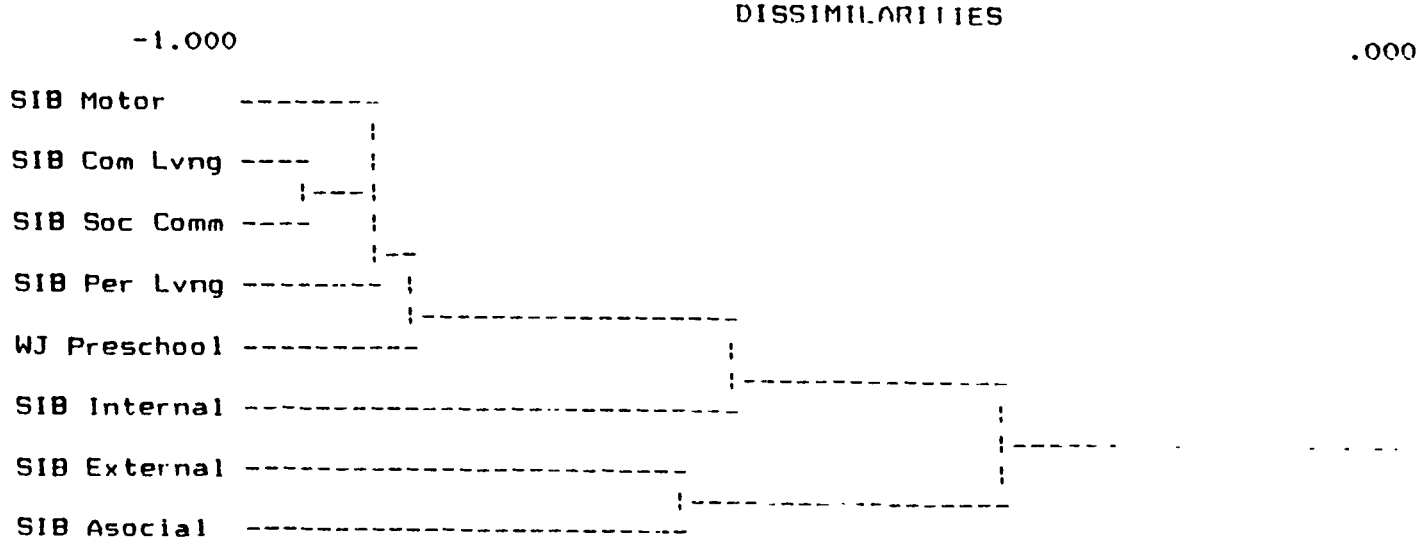
Note. SIB = *Scales of Independent Behavior;*
Externaal = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index;
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability. Cluster.

Figure 10
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Middle Childhood Nonretarded Sample (N=151)



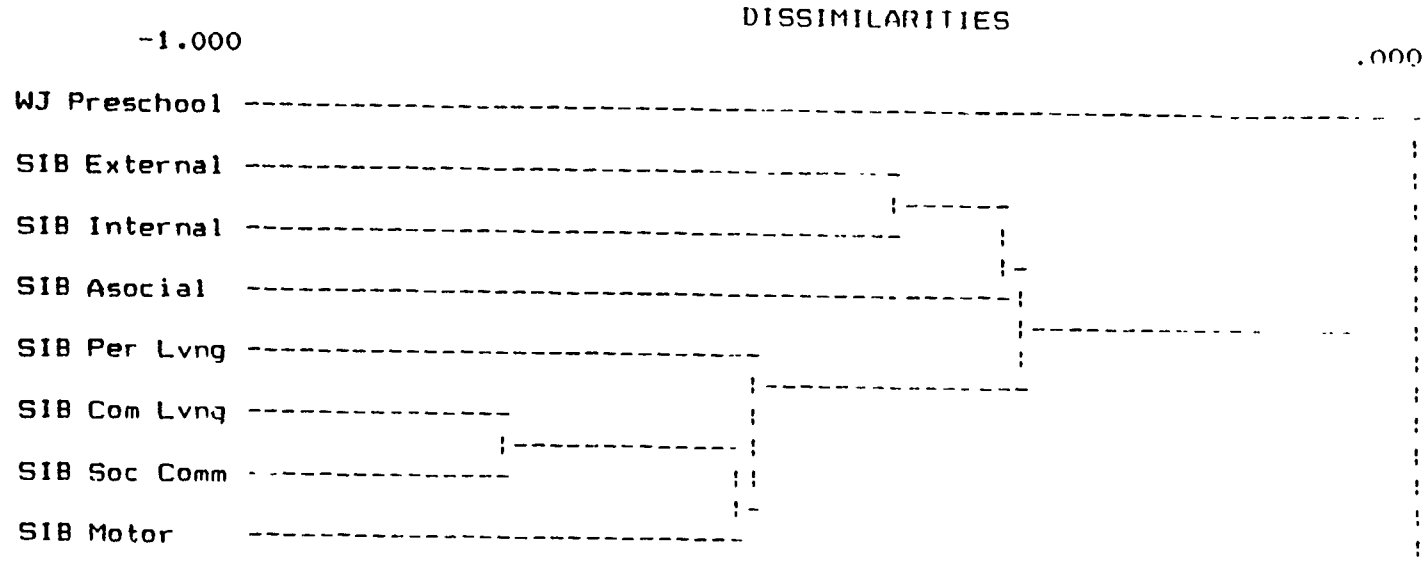
Note. SIB = *Scales of Independent Behavior;*
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Internal = Internalized Maladaptive Index.

Figure 11
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Adolescent Nonretarded Sample (N=84)



Note. SIB = *Scales of Independent Behavior;*
Motor = Motor Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability Cluster;
Internal = Internalized Maladaptive Index;
External = Externalized Maladaptive Index;
Asocial = Asocial Maladaptive Index.

Figure 12
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Adaptive Behavior, and Maladaptive Behavior Domains in Adult Nonretarded Sample (N=124)



Note. WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability;
SIB = *Scales of Independent Behavior;*
External = Externalized Maladaptive Index;
Internal = Internalized Maladaptive Index;
Asocial = Asocial Maladaptive Index;
Per Lvng = Personal Living Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Soc Comm = Social and Communication Skills Cluster;
Motor = Motor Skills Cluster.

Since the number of subjects who had been administered all intellectual, academic, and adaptive behavior measures in the SIB/WJ equating studies was small (a situation which threatens the stability of multivariate statistical results), four of the samples were combined into two samples (i.e., Early and Middle Childhood combined as Childhood/Adolescent; and Adult combined as Adolescent/Adult). Employing the commonly used 10:1 subject-to-variable multivariate rule-of-thumb, the new Childhood sample was judged adequate, while the Adolescent/Adult sample was somewhat limited. The smallness of these two samples (the Adolescent/Adult, in particular) argues for significant caution in the interpretation of the results. Since the current investigation was exploratory in nature, the investigators considered the analyses worthwhile to pursue in order to provide preliminary findings that would guide future research.

With the above caveats in mind, inspection of Table 23 revealed two distinct factors. Although the order of factor extraction varied between samples (possibly due to sampling error in these small samples), consistent intellectual/academic (Factor 2 in Childhood sample; Factor 1 in Adolescent/Adult sample) and adaptive behavior (Factor 1 in Childhood sample; Factor 2 in Adolescent/Adult sample) factors emerged. These findings suggested that the domains of intellectual/academic ability and adaptive behavior represent separate constructs. The crisp delineation of the two factors in Table 23, when combined with the results presented in Tables 21 and 22, and in Figures 9 through 12, suggested that if a factor analysis including all intellectual, academic, adaptive, and maladaptive measures had been possible, three distinct factors (viz., intellectual/academic, adaptive, and maladaptive) would probably have emerged.

The supplementary cluster analyses reported in Figures 13 and 14 reinforced the factor analysis results presented in Table 23. Inspection of the cluster dendograms in Figures 13 and 14 found the adaptive measures clustering together, the intellectual/academic measures clustering together, and the two domains joining together relatively late in

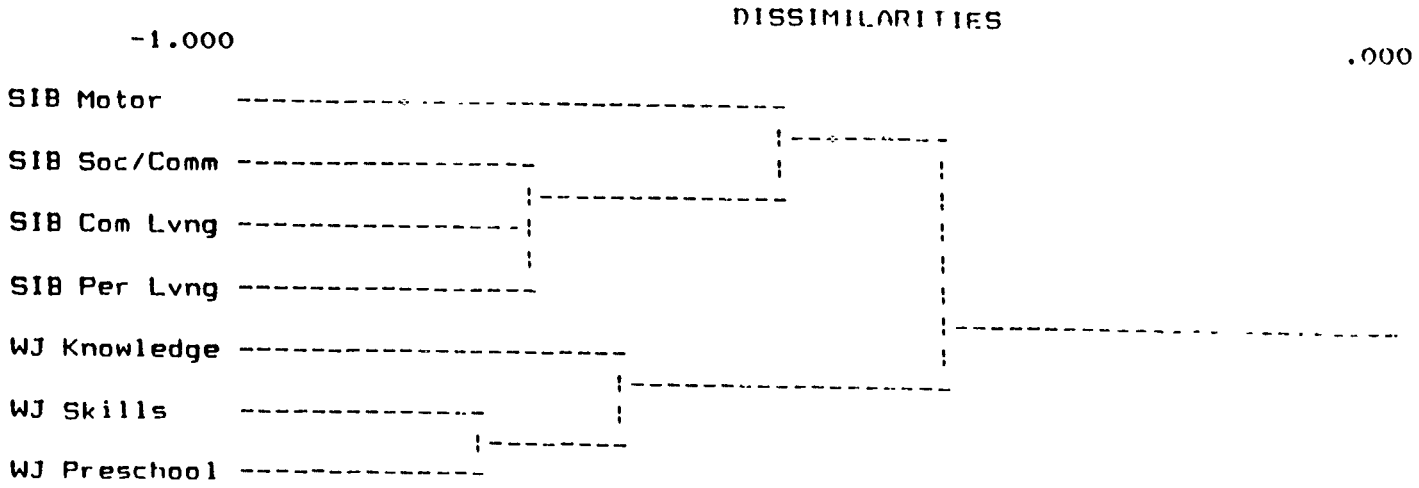
Table 23
Varimax Rotated Two-Factor Matrix of Cognitive, Academic, and Adaptive Behavior Domains in Childhood and Adolescent/Adult Nonretarded Samples

Measure/Domain	Childhood (N=104) Factors 1	2	Adolescent/Adult (N=42) Factors 1	2
WJ Preschool	.13	.88*	.86*	.21
WJ Skills	.17	.85*	.90*	.03
WJ Knowledge	.04	.86*	.90*	.13
SIB Motor	.71*	.12	.38	.26
SIB Social/Communication	.77*	.32	.29	.90*
SIB Personal Living	.84*	.01	-.00	.93*
SIB Community Living	.80*	.34	.21	.89*
Eigenvalue (unrotated)	3.123	1.821	3.477	1.748
Percent of variance	44.6 %	26.0 %	49.7 %	25.0 %

Note. * Indicates loadings of .40 or above

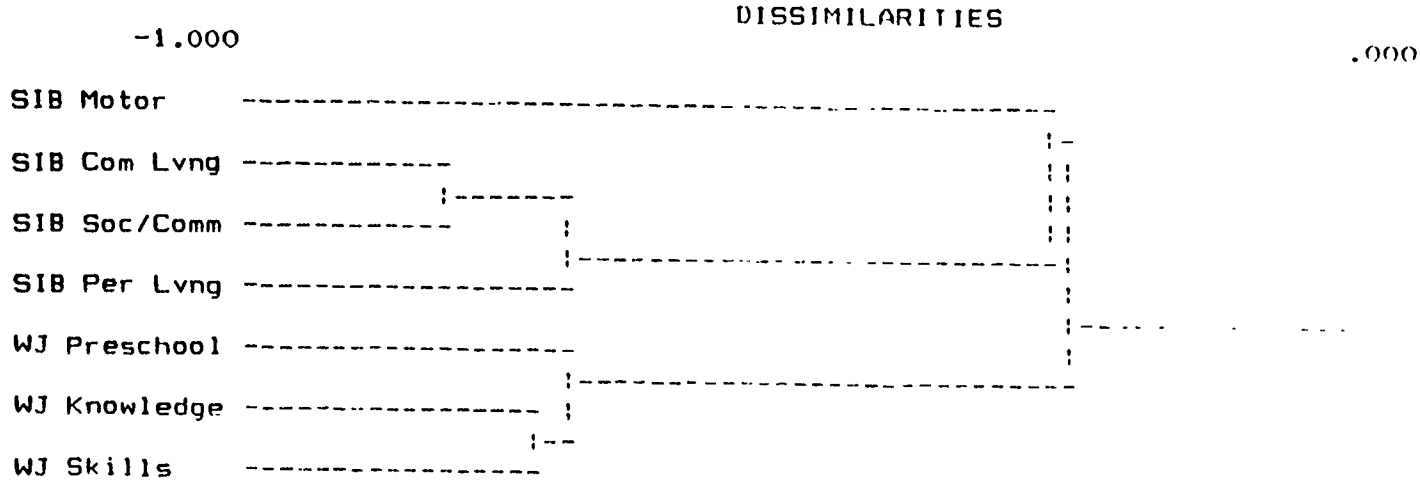
the amalgamation process. This pattern reinforced the conclusion that the intellectual/academic and adaptive behavior factors reported in Table 23 represent distinct dimensions. It is interesting to note that in these analyses (which were the only analyses to include all adaptive and intellectual/academic variables) the SIB Motor cluster was weakly related to the other three SIB adaptive behavior clusters. Furthermore, this trend was most significant in the Adolescent/Adult sample. Although possibly a function of sampling error, this suggested that motor skills may reflect a different dimension of functioning separate from adaptive behavior, particulary with increasing age.

Figure 13
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Academic, and Adaptive Behavior Domains in Childhood Nonretarded Sample (N=104)



Note. SIB = *Scales of Independent Behavior;*
Soc Comm = Social and Communication Skills Cluster;
Com Lvng = Community Living Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
WJ Knowledge = *Woodcock-Johnson Tests of Achievement* - Knowledge Cluster;
WJ Skills = *Woodcock-Johnson Tests of Achievement* - Skills Cluster;
WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability Cluster.

Figure 14
Cluster Analysis (Single Linkage) Dendogram of Cognitive, Academic, and Adaptive Behavior domains in Adolescent/Adult Nonretarded Sample (N=42)



Note. SIB = *Scales of Independent Behavior;*
Com Lvng = Community Living Skills Cluster;
Per Lvng = Personal Living Skills Cluster;
WJ Preschool = *Woodcock-Johnson Tests of Cognitive Ability* - Preschool Broad Cognitive Ability;
WJ Knowledge = *Woodcock-Johnson Tests of Achievement* - Knowledge Cluster;
WJ Skills = *Woodcock Johnson Tests of Achievement* - Skills Cluster.

Finally, the domains of intellectual/academic ability and adaptive behavior as measured by the K-ABC and VABS (Keith et al.'s sample) were subjected to exploratory factor analysis. The result is presented in Table 24. Similar to the SIB/WJ analysis, distinct intellectual/academic (Factor 1) and adaptive behavior (Factor 2) factors emerged. These results, in a larger sample with alternative intellectual/academic and adaptive behavior measures, reinforced the conclusion that intellectual/academic ability and adaptive behavior represent separate dimensions.

Table 24
Varimax Rotated Two-Factor Matrix of K-ABC
Cognitive/Academic and Vineland Adaptive Behavior Scale
Domains in Keith et al.'s (1987)
Grades 1-8 Childhood Sample (N=556)

	Factors	
Measure	1	2
K-ABC Verbal Memory	.76*	.15
K-ABC Nonverbal Reasoning	.84*	.06
K-ABC Verbal Reasoning	.87*	.14
Vineland Daily Living Skills	.03	.86*
Vineland Communication	.40*	.71*
Vineland Socialization	.07	.85*
Eigenvalue (unrotated)	2.769	1.463
Percent of variance	46.15 %	24.38 %

Note. * = Indicates loadings of .40 or above.

Investigation of the redundancy between adaptive behavior and intellectual/academic ability

Three separate canonical correlation analyses explored the redundancy between the domains of adaptive behavior and intellectual/academic ability. Table 25 presents the summary results for the canonical analysis in the Childhood SIB/WJ sample (n=104).

Table 25
Summary of Canonical Correlation of Cognitive and Academic with Adaptive Behavior Domains in Childhood Nonretarded Sample (N=104)

Variate	Canonical Correlation	Eigenvalue (R Squared)	Chi-Square	df	Significance
1	.515	.265	41.636	12	<.001*
2	.322	.104	11.132	6	.084
3	.055	.003	.298	2	.862

Note. * Significant at .05 level

Canonical loadings and related statistics for significant variate

	Variate 1		Variate 2
WJ Preschool	.748*	SIB Motor	.056
WJ Skills	.991*	SIB Social/Communication	.715*
WJ Knowledge	.667*	SIB Personal Living	.167
		SIB Community Living	.811*
Variance extracted	66.22%		30.00%
Total redundancy	17.55%		7.95%

Note. * Loadings of .40 or above

Inspection of Table 25 revealed one significant canonical correlation (.515) which accounted for approximately 26.5% of the variance between the linear intellectual/academic (i.e., WJ clusters) and adaptive behavior (i.e., SIB clusters) composites. The total proportion of variance extracted by the pair of variates was 66.2% for the WJ intellectual/academic domain and 30.0% for the SIB adaptive behavior domain. Inspection of the total redundancy figures indicated that 17.6% of the WJ intellectual/academic variance was predictable from the linear combination of the SIB adaptive behavior measures. In comparison, approximately 8.0% of the SIB adaptive behavior variance was predictable from the linear combination of the WJ intellectual/academic measures.

Inspection of the significant canonical loadings on the variate suggested the presence of a general ability or competence dimension defined by the WJ Preschool, WJ Skills, WJ Knowledge, SIB Social/Communication, and SIB Community Living clusters. Since the SIB Social/Communication and Community Living clusters contain subscales with academic/intellectual characteristics (viz., Language Comprehension, Language Expression, Time and Punctuality, and Money and Value), an intellectual/academic interpretation for this general ability variate appeared appropriate.

The canonical correlation results for the SIB/WJ Adolescent/Adult sample (Table 26) are generally similar to those for the Childhood sample. Only one significant canonical correlation (.595) was identified, which accounted for approximately 35.4% of the variance between the linear WJ intellectual/academic and the SIB adaptive behavior composites. With the exception of a moderate .451 loading for the SIB Motor cluster, the variables with significant canonical loadings on the variate were identical to those in the Childhood sample. Although the small adolescent/adult sample size argues for significant caution in interpretation, the presence of a large general ability dimension with intellectual/academic characteristics was noted. The total redundancy figures indicated that 25.6% of the WJ intellectual/academic domain was predictable from the SIB adaptive

Table 26
Summary of Canonical Correlation of Cognitive and Academic Abilities with Adaptive Behavior Domains in Adolescent/Adult Nonretarded Sample (N=42)

Variate	Canonical Correlation	Eigenvalue (R Squared)	Chi-Square	df	Significance
1	.595	.354	22.248	12	.026*
2	.402	.162	7.060	6	.315
3	.122	.015	.554	2	.758

Note. * Significant at .05 level

Canonical loadings and related statistics for significant variate

	Variate 1		Variate 2
WJ Preschool	.724*	SIB Motor	.451*
WJ Skills	.809*	SIB Social/Communication	.684*
WJ Knowledge	.994*	SIB Personal Living	.151
		SIB Community Living	.491*
Variance extracted	72.22%		23.38%
Total redundancy	25.57%		8.28%

Note. * Loadings of .40 or above

behavior measures. In contrast, only 8.3% of the SIB adaptive behavior variance was found to be predictable from the WJ intellectual/academic measures.

Similar to the canonical analyses with the SIB adaptive behavior and WJ intellectual/academic variables, only one significant VABS/K-ABC canonical correlation (.460) was identified in Keith et al.'s (1987) sample of 566 children (Table 27). This

canonical correlation accounted for approximately 21.2% of the variance between the linear K-ABC intellectual/academic and the VABS adaptive behavior composites. The total proportion of variance extracted by the significant variate was 63.5% and 43.8% for the K-ABC intellectual/academic and the VABS adaptive behavior domains, respectively. Approximately 13.5% and 9.3% of the respective K-ABC intellectual/academic and VABS adaptive behavior domain variance was redundant with the other domain. As in the preceding two SIB, WJ canonical analyses, the significant canonical loadings on the single variate suggested a general ability dimension with intellectual/academic characteristics.

Table 27
Summary of Canonical Correlation of K-ABC Cognitive and Academic Skills, with Vineland Adaptive Behavior Domains in Keith et al.'s (1987) Grades 1-8 Childhood Sample (N=566)

Variate	Canonical Correlation	Eigenvalue (R Squared)	Chi-Square	df	Significance
1	.460	.212	134.667	9	<.001*
2	.060	.004	3.762	4	.439
3	.056	.003	1.756	1	.185

Note. * Significant at .05 level

Canonical Loadings and related statistics for significant variate

	Variate 1		Variate 2
K-ABC Verbal Memory	.780*	Vineland Daily Living	.383
K-ABC Nonverbal Reasoning	.633*	Vineland Communication	.992*
K-ABC Verbal Reasoning	.947*	Vineland Socialization	.428*
Variance extracted	63.53%		43.80%
Total redundancy	13.47%		9.29%

Note. * Loadings of .40 or above

All K-ABC intellectual/academic variables loaded highly on the variate. The highest loading VABS measure was Communication (the VABS Social domain loading was only at a moderate level .428). The common dimension reflected by the highest loading VABS/K-ABC variables was interpreted as intellectual/academic ability.

Although the three canonical analyses were conducted with different intellectual-/academic and adaptive behavior measures, and although two of the samples were small in size, significant commonalities were detected. First, only one significant moderate canonical correlation was identified in each analysis (.515, .595, .460). Second, the significant variate identified in each analysis was characterized by highest loadings for the intellectual/academic domain variables, as well as for those adaptive behavior variables with strong intellectual/academic characteristics. In many respects, this general intellectual/academic dimension is analogous to the general intellectual or "g" factor identified in intelligence research. Third, the degree of shared redundancy between the respective intellectual/academic and adaptive behavior measures was relatively small, with the intellectual/academic measures demonstrating 13.5% to 25.6% redundancy, and the adaptive behavior measures demonstrating 8.0% to 9.3% redundancy. The combined canonical correlation analyses suggested that the domains of intellectual/academic ability and adaptive behavior have much less in common in comparison to what they do share in common. Total redundancy figures of 8.0% to 25.6% suggested that the intellectual/academic and adaptive behavior domains represent marginally related, but separate constructs.

DISCUSSION OF STUDIES

A synthesis of the three studies presented in this report produces a number of substantive and methodological conclusions regarding the structure of adaptive behavior, its relationship to the domains of maladaptive behavior and cognitive/academic ability, and the status of research on the construct of adaptive behavior.

Research Study I

Resear h Study I explored the structure of adaptive behavior in retarded and nonretarded samples across the entire age range. In exploring the structure of adaptive behavior skills, a variety of procedures were used to correct for possible sampling and statistical bias. Analyses were conducted on a variety of retarded and nonretarded samples at different age levels, with the effect of age statistically removed from the intercorrelations prior to all factor analysis procedures.

In the exploratory factor analysis of the Scales of Independent Behavior (SIB) (Bruininks et al., 1984) subscales and items, a large general adaptive behavior dimension was consistently identified across all age ranges and retarded/nonretarded samples. The presence of a large general factor reinforces Meyers et al.'s (1979) conclusion that a substantial portion of the adaptive behavior construct (as measured by available adaptive behavior scales) is represented by a general adaptive behavior factor. In contrast, the presence of only one responsibility factor in the SIB (i.e., personal responsibility in the nonretarded sample) differed from Meyers et al.'s (1979) conclusion that the adaptive behavior construct contains a second "responsibility" dimension. Also discrepant from Meyers et al.'s (1979) review was the presence of an academically oriented factor in the nonretarded preschool and retarded childhood samples. Similar academic dimensions were not reported in Meyers et al.'s (1979) authoritative review of the adaptive behavior

factor analytic research. The presence of a community-vocational factor in the nonretarded adult sample is also unique to the current research study. Since community and work adjustment may be the single most important adaptive behavior criterion in defining mental retardation along with subaverage intelligence in late adolescence and adulthood (Grossman, 1983; Reschly, 1986), the presence of a community/vocational dimension is a positive finding. When integrated with Meyers et al.'s (1979) review, the identification of quantitative and community-vocational factors, as well as the failure to consistently identify a responsibility factor, suggests possible scale differences in the assessment of adaptive behavior. Although the presence of a large general factor suggests the SIB is similar to most other adaptive behavior instruments, the presence of unique second or third SIB factors does suggest at least slight differences in the operationalized measurement of adaptive behavior by different adaptive behavior scales.

Closer inspection of the SIB exploratory factor analysis results suggested possible developmental differences in the construct of adaptive behavior. A review of the number of factors identified in the five nonretarded samples found two- or three-factor solutions in the extreme age samples (i.e., preschool and adult). In contrast, only single-factor solutions were present between these extreme age samples. The occurrence of single-factor solutions during the years of formal education suggests that schooling provides a possible homogenizing influence. Individuals at the preschool and adult age levels typically do not share similar educational experiences. These observations suggest the hypothesis that adaptive behavior may be more multi-dimensional during those years where individuals do not share a common set of experiences (i.e., school). The influence of a standard set of educational experiences may reduce the dimensionality of adaptive functioning during the formal school years. There is also some prospect, however, that the nature of skills achieved may differ during these developmental periods. During the preschool period, items on adaptive behavior scales assess early maturational skills and

the results of learning to master self-help, mobility, community and personal care skills. During adolescence and adulthood, adaptive behavior skills typically require increasing mastery of social interactions, use of community resources, economic transactions and employment related behaviors. The combination of differences in skills mastered at various stages of the life cycle and along with the varying effects of environment, may differentially influence the structure of adaptive behavior skills by age. This hypothesis, as well as the alternative hypothesis that this trend may be reflective of developmental changes in adaptive behavior, warrants future research.

The other substantive finding of significance was the lack of any systematic difference between the nonretarded and retarded samples in the structure of adaptive behavior. This issue was important to explore, since most previously reported factor structure studies used samples of adults with mental retardation (cf. Meyers et al., 1979). Both single-factor and two-factor solutions were identified in each type of sample. Also, similar personal independence and academic factors were present in both the nonretarded and retarded samples. Although a different number of factors were extracted from the comparable age groups (i.e., retarded childhood = 2, nonretarded childhood = 1, retarded adolescent/adult = 1, nonretarded adult = 2), these differences where not systematically related to type of sample (i.e., retarded vs. nonretarded). Research Study I generally suggests no systematic difference in the structure of adaptive behavior for nonretarded and retarded populations.

Finally, problems were encountered when attempting to factor analyze the adaptive behavior test items. More specifically, factor analysis of the item Pearson-Product Moment intercorrelation matrices produced large item difficulty factors. A review of prior item-based adaptive behavior factor analytic research indicated that most of this research may suffer from results which are confounded by item difficulty. This common problem has been noted previously by Thorndike (1982). Even after employing the

recommended method of factoring item tetrachoric intercorrelation matrices (Kim & Mueller, 1978b; Thorndike, 1982), the difficulty or developmental factors still remained. Although the derivation of theoretically important information was difficult to obtain from the item factor analyses, the results highlight a methodological problem that must be recognized in item-based factor analytic research. The failure of researchers to recognize the confounding influence of item difficulty in factor analysis studies may result in the formation of inaccurate conclusions concerning the structure of adaptive behavior.

Research Study II

In this study a quantitative and qualitative analysis was conducted of factor analysis studies of adaptive behavior scales. Nine additional research sources not available at the time of Meyers et al.'s (1979) authoritative review, were combined with prior studies to provide a broader synthesis of the adaptive factor analytic research. The integration of the SIB factor analysis results (Research Study I) with the studies reviewed by Meyers et al. (1979), plus the adaptive behavior factor analytic research published since Meyers et al.'s (1979) review, produced a pool of 52 samples for research synthesis. A number of significant substantive and methodological findings were identified by subjecting the adaptive behavior factor analytic research published since 1965 to quantitative research synthesis procedures (Light & Pillemer, 1984).

Analysis of the factor analytic research revealed variability in the number of adaptive factors that have been identified and, more importantly, the finding that this variability may be attributable to methodological variables. Item-based studies identified a larger number of adaptive factors (typically 8-10). In contrast, item parcel and subscale-based studies typically identified 3-4 and 1-2 adaptive behavior factors, respectively. This finding suggested that when attempting to analyze the construct of adaptive

behavior from a review of factor analytic research studies, researchers must consider the level of the variables that are factored (i.e., items, item parcels, or subscales). This finding should sensitize researchers to the possibility that the dimensionality of adaptive behavior is a function of level or measurement detail. Failure to recognize this finding when evaluating the research could lead to inaccurate conclusions concerning the structure of adaptive behavior.

A number of problems with item and item parcel factor analytic research argues against the inclusion of these studies in theoretical conceptualizations of the structure of adaptive behavior. First, item and item parcel research studies factor variables which typically suffer from poor reliability. Second, the factoring of items initially scaled on difficulty introduces problems with difficulty factors (see Research Study I in this report). This methodological problem has typically gone unrecognized in published item-based adaptive behavior factor analytic research reports. As a result, it is argued that subscale factor analytic research currently provides the most useful information concerning the structure of adaptive behavior. Future research at the item level needs to be designed with a full recognition of the methodological issues specific to this level of analysis.

A review of 21 subscale level adaptive behavior research samples suggested that adaptive behavior, as measured by existing scales, is either a one- or two-dimensional construct. The relatively greater frequency of single-factor solutions is at variance with Meyers et al.'s (1979) conclusion that adaptive behavior is a two-dimensional construct, a finding that "would universally be determined in any competent studies employing the usual broad-ranged AB scale," (p. 464). Analysis of the research suggested that the number of adaptive behaviors identified in research studies is not related to the study characteristics of publication date, number of factored variables, domains that are factored, sample size, age characteristics of the samples, type of samples (i.e.,

retarded/nonretarded; placement setting; degree of retardation), or certain factor method characteristics (viz., type of factor rotation and salience criteria). However, there did appear to be a relationship between the number of identified adaptive behavior factors and the scale which was factored, and/or the type of factoring method which was employed. It was impossible to disentangle these two variables to determine if the differences in the number of identified factors is due to different scales, and/or the use of different factor extraction procedures.

Inspection of the type of factors identified in research studies suggested that in all studies, regardless of whether they produced a one-factor or a two-factor structure, a large general adaptive behavior factor was present. Although labeled with different terms by different investigators, this large general factor appears to represent a functional autonomy or personal independence dimension. When a second or third factor was present, its size (as represented by amount of variance accounted for by the factors) relatively small. Although some form of responsibility dimension (most often, social responsibility) was the most frequent second or third factor identified in adaptive behavior research studies, it appears that the specific nature of these secondary factors depend on the specific adaptive behavior scale being investigated. The conclusion of Meyers et al. (1979) that adaptive behavior is characterized by two dimensions, with the second representing social responsibility, is not as clearly supported in the current review. The discrepancy between the two reviews is probably related to the fact that most adaptive behavior research available at the time of Meyers et al.'s (1979) review was conducted primarily with one scale (i.e., AAMD Adaptive Behavior Scale - ABS [Lambert et al., 1975; Nihira et al., 1969]). The current review includes seven additional years of research and, as a result, a greater variety of adaptive behavior scales and samples. The current review suggests that the derivation of one- or two-factor solutions may be a function of certain methodological variables, specifically, factor extraction

procedures and/or the specific scale that was investigated. If adaptive behavior is more than a single dimensional construct, the ability to consistently identify and study these secondary dimensions may be hindered by inclusion of only current adaptive behavior scales. Advances in our understanding of the theoretical structure of adaptive behavior will probably require a variety of measures to assess adaptive behavior, as well as studies which also include measures of intellectual functioning, achievement, maladaptive behavior, and other affective measures.

Analysis of the maladaptive behavior domain was less complex than that for adaptive behavior. With only one exception (Nihira, 1969b), all samples produced a two-factor solution. In the absence of much additional research since Meyers et al.'s (1979) original review, the conclusion that maladaptive behavior is a two-dimensional construct still appears appropriate. Meyers et al. (1979) considered these two factors to be analogous to the extra-intra personality or adjustment dimensions frequently described in psychology, and were labeled social and personal maladaption.

Research Study III

Research Study III investigated the nature of adaptive behavior in the context of measures of intellectual/academic and maladaptive functioning. Combined factor and cluster analyses in three nonretarded samples consistently suggested that the domains of intellectual/academic ability, adaptive behavior, and maladaptive behavior represent three distinct constructs. These findings were consistent across three nonretarded research samples and assessment instruments (i.e., SIB/WJ or VABS/K-ABC). More importantly, the canonical correlation analyses suggest that adaptive behavior and intellectual/academic ability are weakly related constructs. Although both domains were found to share a common general competence ability (analogous to general ability or "g"), total redundancy figures only ranged from 8.0% to 25.6%. The canonical correlation analyses suggested

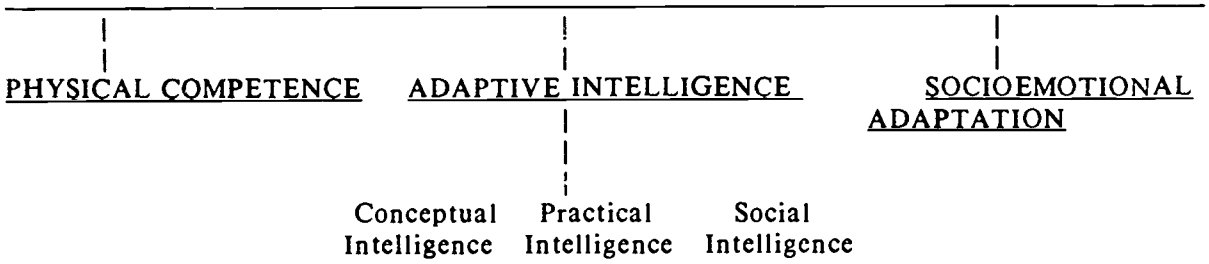
that the intellectual/academic and adaptive behavior domains represent weakly related, but distinct, constructs. The presence of a common intellectual dimension is consistent with the viewpoint that competent adaptive functioning requires certain basic intellectual abilities (Reschly, 1986). Although using different analytic procedures (viz., confirmatory factor analyses), Keith et al. (1987) reported similar levels of association between adaptive behavior and intellectual/academic ability, from which they reached a similar conclusion. The current results, as well as those of Keith et al. (1987), more accurately reflect the overlap between adaptive behavior and intellectual/academic ability than do simple correlational studies. Shared variance estimates based on squared simple correlations fail to simultaneously account for the variance within each measure within each domain.

Implications

As noted in the introductory section of this report, many of the problems encountered in the definition and assessment of adaptive behavior may stem from a void in the development of theories of adaptive behavior (Greenspan, 1979; Reschly, 1982; Witt & Martens, 1984). As a result, most current adaptive behavior instruments were developed in a theoretical vacuum as "researchers rushed into the void to develop assessment instruments before there was a clear and valid formulation of what the construct was supposed to measure" (Greenspan, 1979, p. 517). Because of this theoretical vacuum, it was judged useful to interpret the results from the current research project within a theoretical framework, specifically, Greenspan's model of personal competence (1979).

Figure 15 presents a modified schematic of Greenspan's model as originally defined in the introduction section of this report. Of relevance to the current research project are the higher-order domains of adaptive intelligence and socioemotional adaptation. Interpretation of the current project results within the context of Greenspan's model reveals a number of parallels. First, the maladaptive factor identified in the current

Figure 15
Top Tiers of Greenspan's Model of Personal Competence



Source: Adapted from Greenspan, S. Social intelligence in the retarded. In: N.R. Ellis (ed.), *Handbook of mental deficiency: Psychological theory and research.* Hillsdale, NJ: Lawrence Erlbaum Associates, 1979.

research resembles the socioemotional adaptation domain. Greenspan (1979) considers the socioemotional domain to represent a variety of character and temperament variables similar to items contained in most maladaptive behavior measures. Under the adaptive intelligence umbrella there are three intellectual subdomains. Conceptual intelligence, as defined by emphasis on abstract thinking and symbolic or semantic content, closely parallels the traditional notions of intelligence. The intellectual/academic factor identified in the current research project closely approximates the conceptual intelligence component of Greenspan's model. Practical intelligence, which "represents the ability to deal with physical and mechanical aspects of life, including both self-maintenance and vocational activities" (Greenspan, 1979, p. 510), corresponds to the general adaptive behavior or personal independence factor reported in the current research project. The close correspondence between Greenspan's definitions of socioemotional adaptation, conceptual intelligence, and practical intelligence, and the three primary factors identified in the current research project (viz., maladaptive behavior, intellectual/academic ability, adaptive behavior), provides theoretical support for the conclusions of this research, as well as partial support for Greenspan's model.

Greenspan's model also suggests voids in current approaches to the definition and assessment of personal competence. Physical competence, which includes variables such as strength, size, and coordination, is a dimension which did not consistently surface as a separate factor in measures used in the current research project. The lack of variables that tap this dimension in the current research project or, perhaps, the possibility that this component is part of a general developmental factor may account for this omission. However, there is some indication from the adaptive behavior research literature that this separate dimension exists. First, in the cluster analyses which included all adaptive and intellectual/academic variables, the SIB Motor cluster demonstrated a weak relationship between adaptive behavior and intellectual/academic ability.

This trend was most significant in the adolescent/adult samples. The SIB Motor cluster measures a "range of motor proficiency tasks involving mobility, fitness, coordination, eye-hand coordination, and precise movements" (Bruininks et al., 1985, p. 11). Reschly (1986) suggests that the motor domain included in many adaptive behavior scales might be interpreted as representing Greenspan's physical competence dimension. Thus, the relatively weak association of the SIB Motor cluster with the other variables in the current series of studies could be interpreted as some support for a physical competence dimension. Second, the review of other factor analytic research studies revealed a number of factors conceptually similar to the physical competence dimension. Owens and Bowling's (1970) physical developmental and Song et al.'s (1984) psychomotor factors bear a resemblance to the physical competence domain. Although still only weak indicators, these findings provide tentative support for the physical competence component of Greenspan's model.

Greenspan's social intelligence component failed to surface as a distinct factor in the current research project. As defined by Greenspan (1979, p. 483), social intelligence is "a person's ability to understand and to deal effectively with social and interpersonal objects and events." Although one could consider the social responsibility factors identified in the research as reflecting social aspects of intelligence rather than adaptive intelligence, the current research project provides little evidence for the presence of a separate social intelligence dimension in current adaptive behavior scales. The absence of a social intelligence factor in the adaptive behavior factor analytic research should not be viewed as evidence that this construct does not exist. The absence of the social intelligence construct is consistent with the criticisms of Greenspan (1979) and Meyers et al. (1979) that this dimension is not adequately represented in most measures of adaptive or intellectual functioning.

In summary, this report explored a number of important conceptual and methodological issues in defining the construct of adaptive behavior. The following major conclusions were extracted across three research studies:

1. Adaptive behavior appears to be a unique construct with minimal overlap or redundancy with the construct of intellectual and academic ability. Furthermore, maladaptive behavior appears to represent a construct distinct from that of adaptive behavior and intellectual and academic ability. Thus, adaptive and maladaptive behavior scales add important information to intelligence and achievement tests in assessing personal competence.

2. The structure of adaptive behavior, as measured by available measurement scales, appears best represented by one to two dimensions. There is consistent evidence across scales and populations for the presence of a large general adaptive behavior factor. The consistency of research findings breaks down when one moves beyond this large general adaptive behavior factor. Although evidence does exist for the presence of a second, and in some cases a third factor, this dimension is relatively small and appears to vary with adaptive behavior scales and the developmental characteristics of the samples. A variety of secondary dimensions have been identified which include social responsibility and academic, physical developmental, and community-vocational functioning.

3. When the structure of adaptive behavior has been systematically studied with the same scale across the entire life span, as well as in retarded

and nonretarded samples (i.e., Research Study I), possible developmental differences in the construct of adaptive behavior are suggested. A more multidimensional representation of adaptive behavior at the preschool and adult age ranges, with a unidimensional structure during the school-aged years, suggests possible developmental and/or differential environmental influences in the development of adaptive behavior.

4. Exploration of the nature of the adaptive behavior construct requires researchers to be cognizant of a number of significant methodological issues. First, the interpretation of factor analysis of adaptive behavior scale items can be confounded by item "difficulty" factors. Second, the number of adaptive behavior factors identified by different researchers appears to be systematically 'related to the level-of-measurement detail (i.e., whether one is analyzing individual items, item parcels, or subscales). Because of the number of problems inherent in item-based factor analytic research (e.g., difficulty factors, reliability of items), which appears to have been largely ignored in most of the research, it is concluded that subscale-level research currently provides the most solid base from which to evaluate the theoretical structure of adaptive behavior.

5. The construct of maladaptive behavior has been studied less extensively than adaptive behavior. The extant literature suggests that maladaptive behavior, as measured by available measurement scales, is primarily a two-dimensional construct. Social (externally directed) and personal (internally directed) maladaptive dimensions have been identified in the literature.

6. Research provides important support for a number of components of Greenspan's (1979) model of personal competence. Available factor analytic research studies support the conceptualization of adaptive intelligence as having a substructure of conceptual (i.e., intellectual/academic ability) and practical (i.e., adaptive behavior) intelligence. A separate socioemotional adaptation dimension (i.e., maladaptive behavior) is also supported by the available research. In contrast, as measured by available scales, minimal or no evidence exists to support the presence of separate physical competence and social intelligence dimensions. The degree of correspondence between the research and Greenspan's model reinforces attempts to utilize theoretical models in research efforts on human competence and points out as well, limited coverage of selected areas in currently available intelligence, achievement and adaptive behavior measurement scales.

7. Much additional research is needed. First, research in this area should include a broader range of samples (e.g., different placement/living settings; different degrees of retardation) and instruments (e.g., motor, adaptive behavior, maladaptive behavior, intelligence, achievement, and affective behaviors). Studies similar to Research Study III in this monograph and the work of Keith et al. (1987), where indicators of more than one construct are analyzed simultaneously, are needed. Second, the exploration of adaptive behavior in the context of other constructs needs to utilize a variety of sound research methods and analytical procedures. The development and testing of theoretical models (e.g., Greenspan's model) through confirmatory factor and covariance structure modeling procedures could be particularly helpful. Third, additional research needs

to focus on exploring the structure of the maladaptive behavior construct. Exploratory research in this domain has been limited to a handful of studies which have used a small number of scales. Fourth, efforts should be made to explore and develop assessment scales which measure those dimensions of personal competence which have been suggested to be lacking in current scales (e.g., physical competence, social intelligence) or which appear to be important (e.g., community/vocational dimension during adulthood; personal responsibility), but are typically scale-dependent. Through such research, it is likely that improvements can be achieved in our understanding and assessment of personal competence in educational and service programs for individuals with disabilities.

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