Preschool Performance in the Rural Southeast:
Developing Speed DIAL Norms for a Local Head Start Population

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
May 9, 2011

Keywords: preschool assessment, local norms, theory vs empirically driven conceptualization, Speed DIAL

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Abstract

Preschool assessment has gained considerable attention in recent decades (Brassard & Boehm, 2007). Federal legislation, including the Individuals with Disabilities Education Act (IDEA, 1997) and the No Child Left Behind (NCLB) Act of 2001, has mandated accountability for student performance and free and appropriate education to all children with disabilities beginning in the preschool years. The Developmental Indicators for the Assessment of Learning—Third Edition (DIAL-3; Mardell-Czudnowski & Goldenberg, 1998) is one of few developmental screeners providing sufficient normative data and psychometric properties that covers multiple developmental domains. The present study explored the utility of this measure's short-form, the Speed DIAL, for a local Head Start program through development of local norms and exploratory factor analysis. Results indicated that the local Head Start sample differed from the Speed DIAL sample in terms of demographic characteristics and cutoff score ranges. Exploratory factor analysis yielded a two-factor model, contradicting the model presumed by the Speed DIAL authors. Implications for cutoff scores based on the local sample and the two-factor model are discussed.

Acknowledgements

I would like to thank Steve Shapiro for his guidance and support throughout the thesis process, especially during my moments of self-doubt. It is with his encouragement and mentorship that this project was able to come to fruition. I would also like to thank my committee members, Mike Steele and Adrian Thomas, for their valuable input and feedback. I thank team Shapisk for their thoughtful contribution to this project, especially Robert Butler and Melissa Cyperski. I look forward to our journey together through graduate school and beyond. To Bill Ferguson, I am privileged to have faced the challenges of the thesis process together and am ever grateful for your tutelage and generosity in friendship. I wish to thank all the undergrads who volunteered for Head Start for their assistance in data collection, specifically Lindsay Smith for the countless hours of data entry as well. Appreciation is particularly deserved to Janet Burns, ACHR, and the local Head Start agencies for their assistance and support in allowing our team to work with the children and gather data.

To my family, it is with your unconditional love and support that all my achievements are possible. Mom and Dad, your sacrifices and tireless work to provide the opportunities that have allowed to me to chase my dreams have not gone unnoticed or unappreciated. I cannot thank you enough for all that you have done for me and our family.

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Introduction

Preschool assessment has gained considerable attention in recent decades (Brassard & Boehm, 2007). Acknowledging the importance of preschool education in the foundation of later learning, increased federal and state involvement has focused on preschool development. Federal legislation, including the Individuals with Disabilities Education Act (IDEA, 1997) and the No Child Left Behind (NCLB) Act of 2001, has mandated accountability for student performance and free and appropriate education to all children with disabilities beginning in the preschool years.

Federal involvement in establishing educational program guidelines and increased funding has contributed significantly to the development of preschool assessment (Kelley & Surbeck, 2007). IDEA legislation mandates broad-scale developmental screening in five domains of development, specifically motoric, conceptual, linguistic, psychosocial, and self-help abilities, to identify all children with disabilities. Numerous screening measures have been developed recently; however, many lack adequate psychometric properties or do not inform appropriate educational programming (Brassard & Boehm, 2007).

The Developmental Indicators for the Assessment of Learning—Third Edition (DIAL-3; Mardell-Czudnowski & Goldenberg, 1998) is one of few developmental screeners providing sufficient normative data and psychometric properties that covers multiple developmental domains. The proposed study will explore the utility of this measure's short-form for a local Head Start program.

Development of the DIAL

In 1971, the state of Illinois passed legislation calling for the screening of potential learning problems in young children (Mardell & Goldenberg, 1972). The Illinois State Board of Education responded through the development and standardization of the Developmental Indicators for the Assessment of Learning (DIAL). Initially, an advisory board established ten criteria addressing content and characteristics upon which the DIAL should be based. The criteria specified that the test should be a brief, individually administered screening test that covers the age range of 2.5 to 5.5 years and is multidimensional.

The DIAL was based on a conceptual model that mapped onto the domains of development mandated in the Individuals with Disabilities Education Act (IDEA) – motoric, conceptual, linguistic, psychosocial, and self-help; and one additional domain (sensory). A literature review was conducted to determine developmental progression of behaviors in each domain of development and the related age norms. Item analysis suggested items seeming to provide developmental indicators of the learning process. These items were compiled by area of function and included in the preliminary battery. Preschool, kindergarten, and first-grade teachers, in addition to research findings on skill deficits related to learning difficulties influenced the content of the Motor, Concepts, and Language areas. From the preliminary battery, Mardell and Goldenberg (1972, 1974) derived 28 items spanning four areas (Gross Motor, Fine Motor, Concepts, and Communication). Pilot studies and field testing in Illinois assisted in developing preliminary evidence of the reliability and validity of the items.

The first revision of the DIAL (DIAL-R; Mardell-Czudnowski & Goldenberg, 1983, 1990) brought three major improvements. First, the standardization of the DIAL-R expanded from a state sample (DIAL) to a national sample. Second, the age range was broadened to include ages 2-0 through 5-11. Third, the Gross Motor and Fine Motor areas were combined to reduce the weight of the motoric items on the overall score and streamline the screening process by reducing the number of operators (technicians) needed.

The decision for a second revision of the DIAL (Mardell-Czudnowski & Goldenberg, 1983, 1990) was based on the need to provide updated norms to maintain validity and to include additional items shown in the literature to differentiate at-risk from typically developing preschool children. A review of the literature was conducted to assess for methods of increasing the predictive validity of the DIAL-R items. Additionally, tasks of greater difficulty were identified for each item to accommodate the expanded age range.

The third and current version, the DIAL-3 (Mardell-Czudnowski & Goldenberg, 1998), was normed on a nationally representative sample of 1,560 children ranging from 3 years to 6 years 11 months of age. The authors suggested that the DIAL-R was not widely used with 2-year-olds; however, items covering 6-year-olds were in great demand. Thus, the age range for the DIAL-3 was raised by one year. The standardization sample was stratified across a number of variables including chronological age, gender, geographic region, ethnicity, and parent education level. The standardization sample was grouped into 6-month chronological age groups of 110 to 297 children per group. Four racial groups were included in the standardization sample: African American, Hispanic, White, and Other. The proportion of each racial group included in the total sample was representative of the proportion found in the U.S. population as reported by the *Current Population Survey, March 1994*. However, Hispanic children were slightly underrepresented and White children were slightly overrepresented in the sample.

Items chosen for the DIAL-3, and subsequently the Speed DIAL, are based on theoretical and empirical support provided by the literature on the developmental progression of children, including age expectations as defined by the National Association for the Education of Young Children (NAEYC; Bredekamp & Copple, 1997). Determination of the scaled scores was based on the frequency distributions of the raw scores for each one year age group. The median raw score for each age group was assigned a scale score. A scaled score of 0 corresponds to a median score below 3 years, 1 to a median score at 3 years, 2 to a median score at 4 years, 3 to a median score at 5 years, and 6 to a median score at 6 years.

In order to designate children as having a potential delay, one of five cutoff levels can be chosen based on the targeted percentage (standard deviation (SD) from the mean) of children to be considered for this designation – 16 percent (1 SD), 10 percent (1.3 SD), 7 percent (1.5 SD), 5 percent (1.7 SD), and 2 percent (2.0 SD). Score ranges have been calculated for 2-month age intervals at each cutoff level. Given that individual communities are often not representative of the nation, it is advised that cutoff scores be determined based on the needs and characteristics of the community. Furthermore, the authors of the DIAL-3 note that it is the responsibility of screening coordinators or program officials to establish and closely adhere to specific guidelines for interpreting test scores and informing the resulting decisions.

Technical Characteristics of the DIAL-3

The median internal consistency coefficients of the DIAL-3 range from .66 (motor) to .87 (total). Based on the .80 standard established by Salvia and Ysseldyke (1998) for adequate reliability coefficients, with the exception of the Motor area, all area scores demonstrate adequate or near adequate reliability. Furthermore, the area scores and DIAL-3 Total score evidence adequate test-retest reliability, again with the exception of the Motor area. It should be noted that both the internal consistency and test-retest reliability are lower for older age groups.

The sensitivity of the DIAL-3 is measured by the proportion of children correctly identified as needing special education services or categorized as Potential Delay. Specificity refers to the proportion of children correctly identified as being in the OK category (typically developing). The authors of the DIAL-3 cite three samples used to estimate sensitivity and specificity coefficients: (1) children with physical problems, (2) children with cognitive problems, and (3) children tested on the Differential Ability Scales (DAS; Elliot, 1990). The DIAL-3 demonstrated lower sensitivity for children with physical problems (.54) and children with cognitive problems (.57), which the authors attributed to the heterogeneity of the samples. However, the DIAL-3 yielded a high sensitivity coefficient (.83) when compared with the DAS. The DIAL-3 yielded high specificity coefficients for all three samples (.96, 1.0, and .86, respectively). Additionally, the DIAL-3 demonstrated moderate to high overall diagnostic accuracy (.75, .78, and .86, respectively) for the three examples highlighted by the authors.

The DIAL-3 Total has moderate correlations with the Motor, Concepts, and Language areas (.76, .87, and .81, respectively). The intercorrelations between the Motor, Concepts, and Language areas range from low (.41) to moderate (.65). The relationship between the DIAL-3 and other well-known preschool assessment measures was examined to provide further support for its validity. The DIAL-3 Total score has moderately low to high corrected correlations with these measures, ranging from .38 to .78.

Development of the Speed DIAL

The Speed DIAL is a shortened version of the DIAL-3 designed for quick screening. It consists of ten items thought to represent the three performance areas and empirically supported as “most predictive of future problems” (p. 3). The total score of the Speed DIAL demonstrates adequate internal reliability (.80). The test-retest sample was divided into two groups based on age: 3-6 to 4-5 and 4-6 to 5-10. The Speed DIAL shows satisfactory test-retest reliability (.84 and .82, respectfully). Additionally, the Speed DIAL has a high corrected correlation with the DIAL-3 total score (.94) and moderate to moderately high correlations with the motor, concepts, and language area scores comprising the DIAL-3 total score (.67, .87, and .77, respectively). The Speed DIAL has moderately low to high corrected correlations with other well-known preschool assessment measures, ranging from .31 to .81.

Developers of the DIAL-3 recommend use of the total score yielded by the Speed DIAL rather than selecting subtest scores. The brevity of the Speed DIAL is intended to inform the operator within 15 minutes if a child is in need of further assessment, rather than highlight specific areas of potential delay. It is, however, informative to review the origin of the Speed DIAL items, particularly for the purpose of this study. Table 1 lists several measures that provide examples of items included in the Speed DIAL. The table is not meant to be an exhaustive reference of measures which incorporate the items in their battery but instead support for the use and history of such items in preschool assessment.

Motor . Coordinated movement is a key function of the nervous system. It allows for the exploration and processing of varied stimuli throughout one's environment, influencing brain development and perceptual functioning (Williams & Monsma, 2007). Motor development deficits in early childhood are associated with negative outcomes in social and emotional adjustment as well as academic achievement. In a 10 year longitudinal study, Cantell, Smyth, and Ahonen (1994) found that children diagnosed as having delayed motor development at age 5 had fewer social outlets, more negative views of their own physical and scholastic competence, and lower academic achievement at age 15 than did typically developing children. Motoric items included in the DIAL-3 were formatted to assess either fine or gross motor development

(Mardell-Czudnowski & Goldenberg, 2000). Three items are included in the Motor area of the Speed DIAL: Jump, Hop, & Skip; Building; and Copying. Jump, Hop, & Skip assesses gross motor development whereas the latter two items are both measures of fine motor development.

Three tasks comprise the Jump, Hop, and Skip item. The jumping task requires the child to jump to touch a bean bag held above his or her head. Williams and Monsma (2007) note that jumping progresses from stepping down with one foot to successfully landing long jumps that span nearly 44 inches. Most children are able to jump by age 3. The second task, hopping, requires the child to hop six times on each leg. Huttenlocher, Levine, Huttenlocher, and Gates (1990) found that hopping was one of three neurological tasks that distinguish between normal and at-risk 3- and 5-year-olds. Williams and Monsma (2007) suggest that hopping is one of the last locomotor skills to develop, typically appearing by age 6. The skipping task requires the child to skip after observing the operator. Skipping typically proceeds from a shuffled step to an alternating step-hop combination (Williams & Monsma, 2007).

Fine motor deficits can signal dysfunction in sensory and perceptual-motor integration (Bayley, 1993). The senses become integrated in stages throughout childhood development, with all five senses typically integrated by age 6 (Stepp-Gilbert, 1988). Fine motor movements such as building with blocks can be affected by sensory integration dysfunction as well as poor motor planning. The Building item on the Speed DIAL requires the child to model the building of increasingly difficult structures including a three-block tower, a three-block bridge, a six-block pyramid, and a six-block child figure. Similarly, a child's motor planning and motor control is assessed by his or her ability to copy a design (Bayley, 1993). Deficits in copying ability can be related to dyspraxia (inability to plan motor actions) or agnosia (inability to identify an object through use of senses). Furthermore, the perceptual-motor integration necessary for copying may be related to reading ability. Fletcher and Satz (1982) found that four measures, including the Developmental Test of Visual-Motor Integration, requiring children to copy geometric figures correctly, predicted 85% of kindergarten children who later demonstrated reading problems. The Copying item on the Speed DIAL requires the child to copy four geometric figures and four letters.

Concepts . Nelson and Warner (2007) explain that "basic concepts are involved whenever a child makes relational judgments among objects, persons, or situations, or in relation to some standard" (p. 384). Comprehension of basic concepts is important in the development of language and reasoning. Children who are delayed in the acquisition of basic concepts are at risk for difficulties in instructional settings as well as social impairments. Four items included on the Speed DIAL assess for concept attainment: Body Parts, Colors, Rapid Color Naming, and Concepts (Mardell-Czudnowski & Goldenberg, 1998).

The Body Parts item, intended as a measure of self-awareness, requests the child to identify ten body parts. The ability to identify body parts is often assessed for school readiness as this is a skill generally acquired during pre-kindergarten (Brassard & Boehm, 2007).

The Colors item requires children to identify colored blocks through verbalization or pointing if unable to expressively name the color. Findings from Andrick and Tager-Flusberg (1986) suggest that conceptual factors play an important role in the acquisition of color terms. Additionally, Berlin and Kay (1969) identified 11 colors used across all languages as descriptive concepts.

Rapid Color Naming is a rapid automatized naming (RAN) task that assesses the speed at which a child can sequentially identify colors. In a review of the literature, Denckla and Cutting (1999) concluded that RAN is a useful predictor of reading competence and taps into both visual-verbal and processing speed, which are necessary elements for reading. In an 8-year longitudinal study following the development of word reading fluency, Landerl and Wimmer (2008) found rapid automatized naming in early elementary to be the strongest predictor of later reading fluency. Color was chosen as the RAN category for the DIAL-3 due to the developmental appropriateness for younger children (Mardell-Czudnowski & Goldenberg, 1998).

The Concepts item requires the child identify one picture from a set of three depicting a superlative concept. The acquisition of basic concepts in preschool is predictive of later achievement in language, mathematics, and reading (Smith, 1986).

Language . Glascoe (1991) concluded that speech and language impairments are among the most common handicapping conditions in childhood. Seventy percent of children ages 3-5 identified with disabilities have speech and language problems (Brassard & Boehm, 2007). Without intervention, speech-language problems are strong predictors of school failure (Glascoe, 1991). The Speed DIAL includes three items intended to assess language skills: Actions, Letters and Sounds, and Problem Solving.

The Actions item assesses a child's ability to name actions or verbs expressively. Actions unable to be named expressively are then identified through pointing, measuring receptive language. Jansky (1973) found picture naming in kindergarten to be a strong predictor of later reading comprehension. Similarly, Scarborough (1990) found that dyslexic children demonstrated deficits in receptive vocabulary and object-naming as 3-year-olds.

Letters and Sounds is divided into three tasks. The first task assesses the child's letter recitation ability through the alphabet song. Most children learn the alphabet song before 4 years of age with many achieving this milestone before age 3 (Adams, 1990). Satz, Taylor, Friel, and

Fletcher (1978) found alphabet recitation in kindergarten to be one of the three best predictors of later reading achievement. The second task requires the child to name written letters presented in random order. Knowledge of letter names in preschool is widely held to be one of the best predictors of later reading achievement (Adams, 1990; Foulin, 2005). The third task assesses the child's ability to produce the sound of a letter when viewing the phoneme-grapheme association. Preschool deficit in phonological sensitivity is the most robust predictor of later reading impairment (Fluss, Ziegler, Warszawski, Ducot, Richard, & Billard, 2009).

Problem solving involves higher-order processing in which the child synthesizes information (Aylward, 1988). Complex processing is thought to be better predictive of a child's abilities, particularly for children demonstrating motor or neurological deficits. The Problem Solving item on the Speed DIAL requires the child to answer three questions. The questions assess the child's ability to understand "What to do when…" and "What should you do if …," which are significant skills (Johnson, 1994).

Factor Structure

Items for the DIAL-3 were evaluated through use of item response theory (IRT), however, the IRT analyses, "and factor analyses that helped determine unidimensionality," were conducted within area scores (Anthony, Assel, & Williams, 2007, p. 424). IRT suggests that each item has a characteristic curve that describes the probability of answering an item correctly or incorrectly given the ability of the examinee and the difficulty of the item (Kaplan & Saccuzzo, 1989). Internal consistency is demonstrated when responses to a set of items conform to the model (Kline, 1986). The goal of Mardell-Czudnowski and Goldenberg (1998) in utilizing IRT was to obtain a range of item difficulties while eliminating poorly discriminating items.

In a critique of the DIAL-3 development, Anthony, Assel, and Williams (2007) note that "no factor analyses of all subtests were conducted to evaluate whether or not the subtests empirically clustered into the three rationally derived scales" (p. 424). Therefore, it is possible that certain DIAL-3 subtests may reflect different developmental domains than intended and that multiple area scores may measure the same developmental domains. Based on a sample of 2012 children attending Head Start, exploratory factor analysis suggested a three factor empirically-derived model different than the conceptually-derived model offered by the DIAL-3 authors, accounting for 42.5%, 8.5%, and 6% of the variance.

Factor 1 demonstrated unique associations with naming Actions, naming Body Parts, naming Objects, Personal information, Problem Solving, Positions, Basic Concepts, Articulation, and identifying colors. Due to the verbal demands required of these tasks, the authors labeled Factor 1 as Verbal Ability. Factor 2 demonstrated unique associations with Copying, Cutting, playing with Thumbs and Fingers, Building, identifying Shapes, Catching, Counting, identifying Colors, and gross motor coordination (i.e., Jump, Hop, and Skip). Factor 2 was labeled Nonverbal Ability as the subtests reflected visual-spatial integration abilities. Factor 3 demonstrated unique associations with naming Letters, identifying Colors, and Counting. Factor 3 reflected scholastic achievement and thus was labeled Achievement.

Confirmatory factor analysis revealed that this empirically-derived 3-factor model better accounted for the variance in children's performances; however, neither model characterized the data very well. Anthony et al. (2007) examined standard indices of fit to determine the goodness of fit for each model. The empirically-derived model yielded a Comparative Fit Index (CFI) of .90, Tucker Lewis Index (TLI) of .88, and a Root Mean-Square Error of Approximation (RMSEA) of .08 whereas the conceptually-derived model yielded a CFI of .85, TLI of .82, and

RMSEA of .10. The authors note that the empirically-derived model meets only liberal criteria for a good-fitting model according to the fit index proposed by Bentler and Bonett (1980). Hu and Bentler (1999) provide conservative criteria for a good-fitting model as CFIs and TLIs of .95 or greater and RMSEAs of .06 or less.

Assel and Anthony (2009) replicated the comparison of the empirically-derived 3-factor model suggested by Anthony et al. (2007) and the conceptually-derived model suggested by Mardell-Czudnowski and Goldenberg (1998) through confirmatory factor analysis using data from the standardization sample of the DIAL-3. Assel and Anthony (2009) found the two models to yield equivalent standardized fits for younger children, older children, and the overall sample (CFIs .93, .93, and .96, respectively), characterizing performances reasonably well.

Rationale for the Current Study

Mehrens and Lehmann (1973) suggest that an appropriate norm group must be recent, representative, and relevant. National norms are representative of the general population and are relevant to the general uses of a given assessments. However, community samples are likely to differ from nationally representative samples and test scores in a community may be used for different purposes than for the general population. Therefore, local norms are more appropriate in regard to community samples. Cronbach (1984) asserts that local norms are essential in educational assessment as it is more useful to compare a student's performance to the performance of other students sharing the same local school setting and to predict future academic performance within the context of the local milieu. The primary aim of the current study is to develop stratified norms for the Speed DIAL for children attending Head Start in the rural Southeast as the current national norms are outdated and do not reflect the characteristics of this population. Furthermore, anecdotal information suggests that the scaled scores are inappropriate for the local population as the Total scores of many children appear elevated due to frequently observed competence in gross motor skills despite underperformance in other seemingly more developmentally crucial subtests. This profile is problematic given that the subtests related to the Concepts and Language areas, rather than the Motor area, are more predictive of future school success (Vacc, Vacc, & Fogleman, 1987).

Although it is important to assess the validity of an instrument by determining its ability to predict a criterion, it is also necessary to assess the internal structure of an instrument to ascertain its reliability and accuracy in measuring constructs of interest (Kline, 2005). Analyzing the factor structure of a measure can help to determine if the items that rationally map onto the conceptual model are empirically supported, thereby validating the purpose of the measure. Exploratory factor analysis of the DIAL-3 revealed that the conceptual model purported by Mardell-Czudnowski and Goldenberg (1998) was not empirically supported suggesting that the scales created by the DIAL-3 authors were not actually measuring their intended constructs (Anthony et al., 2007). Furthermore, CFA revealed that the empirically-derived model better accounted for the performances of Head Start students. Given the sample of the current study, a secondary aim is to determine the factor structure of the Speed DIAL to aid in its predictive utility. Because the Speed DIAL is a short form consisting of relatively few items, factor analysis must be limited to determining if the Speed DIAL items map onto a one-factor model. Although the loading of all items onto a single common factor supports the validity of the Speed DIAL, failure of items to converge to a one-factor model also informs the utility of the measures as well as suggests the need for different interpretations of the Speed DIAL Total score.

Hypothesis for the Current Study

This study will test three hypotheses:

1) Differences in sample characteristics between the national standardization sample of the DIAL-3 and the local sample will be considered. It is expected that the local sample will differ in terms of minority race representation and parent education level.
2) The local sample will differ in terms of the age-based cutoff criteria for identifying potential delays.
3) The factor structure of the Speed DIAL will be explored. It is hypothesized that all subtests will not load onto a one-factor model, specifically the gross motor skills domain.

Method

Participants

The Head Start program is a preschool program providing services for children ages 3 to 5 whose families are considered economically disadvantaged. Data for the current study consists of screening scores for two consecutive years (2008-2009; 2009-2010) of a Head Start Child Development Program (CDP). This preschool component of the CDP serves five sites in and around a small city in rural East Central Alabama and provides services for approximately 400 children in a given year.

Measures

Speed DIAL. The Speed DIAL consists of ten subtests from the three scales of the DIAL-3 battery (Motor, Concepts, and Language). The ten subtests include Jump, Hop, & Skip; Body Parts; Building; Copying; Colors; Rapid Color Naming; Concepts; Actions; Letters & Sounds; and Problem Solving. Each subtest consists of multiple items ranging from 4 to 26 items. The scaled scores for each subtest are added to yield an overall score, the Scaled Score Total (max. = 39).

The Speed DIAL demonstrates adequate internal consistency for 3-to 5-year-olds with alphas ranging from .76 to .85. The Speed DIAL yields good test-retest reliability (rs=. 82-. 84). Moderate correlations with other developmental screening instruments including the Bracken Screening Test (Bracken, 1984), Brigance Preschool Screen (Brigance, 1985), Battelle Screening

Test (Newborg et al., 1984), and Early Screening Profiles (Harrison et al., 1990) support the validity of the Speed DIAL.

Procedure

Consistent with federal mandate, the participants were screened within the first 45 days of entering the Head Start program. The Speed DIAL was individually administered in a quiet setting temporarily assigned for the purposes of screening. Each administration was completed within approximately 30 minutes.

Examiners consisted of undergraduate psychology students earning course credit. Examiners were carefully trained by graduate students over a two week period through a variety of modalities including video, didactic, large, and small group training. Examiners were required to demonstrate a proper understanding of administration and scoring by passing a paper and pencil test and through several observed mock administrations of the Speed DIAL. Examiners consistently received corrective feedback and assistance by the graduate students during actual administration of the Speed DIAL. Each protocol was checked for accuracy upon completion of the administration. If needed, more extensive feedback was given to examiners in order to maintain administration and scoring integrity.

Data for the current study were de-identified by the Alabama Council on Human Relations, Inc. (ACHR), which oversees the Head Start sites, before being received by the author.

Results

Preanalysis data inspection

Data were inspected prior to analysis to examine missing data and distribution characteristics. Approximately less than 5% of children enrolled in the local Head Start problem were not included in the sample due to missing data as a result of being absent, not responsive, or demonstrating behavioral problems that prevented screening. The Speed DIAL requires that children be able to expressively identify five of the colors in the Identifying Colors subtest in order to continue with the Rapid Color Naming subtest. Consequently, 70% of the sample was missing data on the Rapid Color Naming subtest.

A criterion z-score of 3.4, equivalent to a probability of .001, was used to identify outliers. Six outliers were found for the Copying subtest and 7 for Letters and Sounds. Inspection of the data revealed that these outliers performed exceptionally well on all the subtests. Given that the outliers varied systematically from the data with generally high performance, their data were considered valid and therefore retained. Subsequent analysis was based on a sample size of 397.

Local Norms

Tables 2.1 through 2.3 display frequencies and percentages of the sample divided into six-month age groups for gender, race, and parents' education level in accordance with the DIAL-3 standardization sample. Chi-square tests were conducted to determine if the demographic characteristics of the local sample differed significantly from expected frequencies based on the characteristics of the standardization sample. Results indicated that the local sample differed from the standardization sample for race, $\chi^2(3, N = 370) = 1766.87$, $p < .001$, and parent education level, $\chi^2(3, N = 333) = 133.78$, $p < .001$, supporting Hypothesis 1. African American children comprised the majority of the local sample (78.6 %) whereas the national standardization sample consists mostly of Caucasian children (70.3 %). Additionally, the majority of parents in the local sample had education levels of high school graduation or below (77.1 %) whereas 50.1% of parents in the national standardization sample had attained education levels of high school graduate or below. Thus, 22.9% of the local sample had acquired one to four or more years of college, compared to 49.6% of the standardization sample. Furthermore, the local sample differed from the standardization sample in terms of age distribution, $\chi^2(4, N = 397) = 313.34$, $p < .001$. The majority of the local sample were distributed in the 3-0 to 3-5 (27.7%) and 3-6 to 3-11 (36.0%) age groups. The national standardization sample had higher percentages of children in the oldest three age groups: 4-0 to 4-5 (21.0%), 4-6 to 4-11 (26.7%), and 5-0 to 5-5 (24.6%), respectively.

Age-based cutoff criteria were developed in accordance with DIAL-3 standardization and development. The cutoff scores for each two-month age-group based on selected standard deviations are displayed in Table 3.1 and percentile rank scores in Table 3.2. Because the data did not follow a normal distribution, cutoff scores were calculated based on mean and median scores to ensure that the cutoff scores were not affected by the skewed distribution. Visual examination of the cutoff scores revealed a direct relationship between age and the differences between cutoff scores for the two samples. The cutoff scores obtained for the local sample does not differ from the national sample for 3-year-olds 2% cutoff range and across cutoff ranges for 3-0 to 3-1 due to floor effects. However, the criteria for identifying the 5-16% lowest performing 3-year-olds and 2-16% lowest performing 4-year-olds is lower in the local sample compared to the national standardization sample. Differences in cutoff scores between the local and national sample appeared to increase with age. This pattern holds true when examining corresponding percentiles, supporting hypothesis 2.

Scale Intercorrelation and Exploratory Factor Analysis

To determine the factor structure of the Speed DIAL, exploratory factor analysis was conducted. Data for the Rapid Color Naming subtest was excluded due the large proportion of missing data. Reliable correlations were found between the subtests and the Total score ranging from .25-.82, $ps<.01$ (Table 4). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is an index that indicates the proportion of variance that might be caused by new factors or when the partial correlations among subtests are small. KMO values over .7 suggest that factor analysis is appropriate. A KMO value of .875 was yielded for the current study, supporting the use of the factor model. Exploratory factor analysis was conducted using principal component analysis with Promax rotation, a commonly used oblique rotation. An oblique rotation was chosen to allow for correlations among the variables. Exploratory factor analysis yielded two factors with eigenvalues greater than 1.0 and meeting the parallel analysis method criteria referred by Lautenschlager (1989). The scree plot was also consistent with a two-factor solution. Furthermore, the two-factor solution accounted for variance above and beyond that of a one-factor solution, 60.02% compared to 47.69%. Factor 1 accounted for 47.7% of the variance with Factor 2 accounting for an additional 12.2% of the variance.

Factor 1 demonstrated unique associations with Body Parts, Colors, Concepts, Actions, and Problem Solving (see Table 5.1) suggesting verbal ability. Factor 2 demonstrated unique associations with Jump, Hop, and Skip, Building, Copying, and Letters and Sounds. Jump, Hop, and Skip, Building, and Copying clearly suggest nonverbal abilities such as motor and visuospatial skills. Intuitively, it would seem that Letters and Sounds would reflect verbal abilities. However, a strong correlation between Copying and Letters and Sounds ($r=.60$) indicates a relationship between the orthographic skills of writing letters (Copying) and identifying the symbols from which letters are constructed (Letters and sounds). The relationship is further accounted for in that only children 5 years and older are required to produce the sound that corresponds to the letter (1.0% of the local sample).

Discussion

Local Norms

As hypothesized, the local sample differed from the national standardization sample of the DIAL-3/Speed DIAL in terms of minority race representation and parent education level. The differences in the demographic characteristics between samples are likely attributable to differences in socioeconomic status (SES). Given that education level is commonly used as an indicator for SES (Bradley & Corwyn, 2002), it is to be expected that the local sample would have larger percentages of lower parent education level as the purpose of Head Start is to serve children from economically disadvantaged families. Similarly, differences in minority race representation between the local sample and the national standardization sample are likely accounted for by SES status (U.S. Census Bureau, 2000)

Demographic characteristics are important when considering the appropriateness of norms provided by assessment measures. Specifically, variables related to SES can determine availability of educational resources as well as potential health and nutritional concerns, which can affect cognitive functioning and academic performance (Bradley & Corwyn, 2002). Children from low-SES families tend to have fewer books and other educational materials than children from high-SES families (Bradley & Corwyn, 2002; Constantino, 2005). Furthermore, children from low-SES families are less likely to visit local libraries or museums or other education centers in the community. In a review of the literature, Bradley and Corwyn (2002) found that research demonstrating the lack of access to cognitively stimulating material for children from low-SES families and its subsequent limitations on cognitive development and academic achievement dates back over 50 years. Limited access to nutritional resources is another commonly cited link between SES and cognitive development (Klerman, 1991; Pollitt et al., 1996). Research indicates that poor nutrition is related to stunted brain growth (Pollitt et al., 1996), increased neural tube defects (Wasserman, Shaw, Selvin, Gould, & Syme, 1998) iron deficiency (Oski, 1993), and poor long-term memory (Korenman & Miller, 1997). Because the norms developed for the DIAL-3 can be used to determine the percentage of children referred for special services, it is necessary to ensure that the local sample fits the demographic characteristics of the national standardization sample. Therefore, the national standardization sample is not appropriate for the local Head Start population.

The cutoff scores represent extreme areas in the distribution of Speed DIAL scores, specifically the lowest scoring children. Children are designated as having a potential delay based on one of five cutoff levels indicating a targeted percentage of children to be considered for this designation. Because communities may not be representative of the nation, cutoff scores should be determined based on the needs and characteristics of the community. Anecdotal information further supports the development of cutoff scores based on the local sample.

The hypothesis that the age-based cutoff criteria defining the potential delay range for the local sample would differ from the DIAL-3 sample was generally supported. Overall, the cutoff values based on targeted percentages to be identified as potentially delayed for the local sample was lower than the national standardization sample, in some instances as much as 1 standard deviation. The differences between the cutoff scores for the local and national sample appeared to indicate a direct relationship with age such that the differences increased as the age of the child increased. This finding suggests that the cutoff scores may be particularly inappropriate for older preschool children. Interestingly, children in the 3-0 to 3-1 and 3-2 to 3-3 age groups for the local sample appeared to perform at or above children of the same age groups in the national sample. Therefore, the cutoff scores established by the Speed DIAL may be appropriate for younger preschool children in the local sample. Similarly, the cutoff criteria did not differ for the lowest scoring 2% of the 3-year-olds. This finding is likely related to a floor effect and may indicate a need for more sensitive items in order to more accurately identify younger children in need of referral for special services, as both the local sample and national sample do not provide cutoff scores for identifying the lowest scoring 2% as potentially delayed and in need of referral for special services. A raw score of 1 that is at least 2 standard deviations (2SDs) below the mean is considered most acceptable as a floor (Ford & Dahinten, 2005).

Finding differences between the local Head Start sample and the DIAL-3 national standardization sample have major implications for referral of special services. Based on the national standardization sample, the local Head Start agencies are using the 2% cutoff criteria to identify children as potentially delay. However, norms based on the local sample suggest that in fact 2% of the lowest scoring children are not being identified. As a result, children who demonstrate developmental delays in relation to peers in the same educational setting are not being identified through the Speed DIAL and therefore potentially are not receiving the necessary services. Given that children who demonstrate difficulties early in their academic career are likely to continue on a trajectory of poor performance without appropriate intervention (Hooper, Roberts, Sideris, Burchinal, & Zeisel, 2010), the finding that children are not being accurately identified for referral for special services is concerning. It is advisable that local norms be developed and utilized for populations that appear to differ from the national standardization sample when using the Speed DIAL as a screener for identifying developmental delays to ensure that children in need of services are recognized. However, a limitation of this study is the lack of outcome data to determine if the use of the cutoff criteria based on the local sample more appropriately identifies children in need of special services. Future research should compare outcome data from children actually referred for special services to those identified by both the DIAL-3 and local samples to determine if the local sample does better capture potential delays. This type of predictive utility work is essential when establishing the validity of cutoff scores.

Exploratory Factor Analysis

Findings from the exploratory factor analysis support the hypothesis that the Speed DIAL items do not fit a one-factor model. The authors of the DIAL-3 advise use of an overall score for the Speed DIAL due to the limited number of items. However, the findings from the present study suggest that the use of one score to characterize Speed DIAL performance may be inappropriate. Through exploratory factor analysis, two factors were identified that collectively accounted for 60% of the variance, 12.2% more variance than the one-factor model. These results are consistent with the Anthony et al.'s (2007) findings that the conceptually-derived scale structure of the DIAL-3 is not supported by empirical evidence. In the current study, the two factors are labeled Verbal Ability and Nonverbal Ability due to the clear differentiation between the nature of the tasks that comprise each factor.

The Verbal Ability factor of the Speed DIAL consists of the Body Parts, Colors, Concepts, Actions, and Problem Solving subtests. With the exception of identifying Colors, all the subtests included in the Verbal Ability factor match the Verbal Ability factor of the DIAL-3 as delineated by Anthony et al. Furthermore, these subtests are consistent with verbal reasoning subtests from empirically supported measures such as subtests in the Verbal Fluid Reasoning

Domain of the Stanford-Binet V (Roid, 2003). The Color subtest nearly loaded onto the Nonverbal Ability factor based on .40 loadings. This cross loading suggests that identifying colors measures aspects of verbal ability (i.e., expressive language) as well as nonverbal abilities (i.e., visual spatial processing).

The Nonverbal Ability factor of the Speed DIAL consists of the Jump, Hop, & Skip, Building, Copying, and Letters and Sounds subtests. With the exception of Letters and Sounds, all subtests included in the Nonverbal Ability factor are consistent with the Nonverbal Ability factor of the DIAL-3 as identified by Anthony et al. Tasks comprising the Nonverbal Ability factor are consistent with subtests in other well-known measures used to assess visual spatial perceptual abilities such as the Beery's test of Visual-Motor Integration (Beery, Buktenica, & Beery, 2004) and Wechsler series. The Letters and Sounds subtest require preschoolers under five years of age to identify letters whereas children five years of age and older are required to also identify the sound that corresponds with the letter. Given that only 1% of the local sample was 5 years or older, the vast majority were required to only identify the letter. Therefore, it makes conceptual sense that the Letters and Sounds subtest would load onto the Nonverbal Ability factor as it is closely related to the Copying subtest in that children are using visual spatial processing to identify symbols.

The finding of a two-factor model to characterize preschool performance on the Speed DIAL has significant implications for identifying children with potential delays. Given that the two-factor model accounts more variance than the one-factor model, it is necessary to further examine the impact of utilizing one score versus two when deciding to refer children for special services. When utilizing an overall score, it is possible that children who are experiencing delays in nonverbal areas are being overlooked. Instead, it may be preferential to utilize both a verbal and nonverbal score to develop a profile of the preschooler's performance. This profile could better inform the referral process so that the child receives interventions that will best address the potential delay.

Unfortunately, outcome data regarding the types of special services required for children referred was limited for this sample. Future research should address the utility of considering both a verbal and nonverbal score when identifying a child as potentially delayed in relation to the types of services provided. Furthermore, future research should examine the use of confirmatory factor analysis to evaluate the two-factor model yielded by exploratory factor analysis and the one-factor model presumed by the authors of the Speed DIAL. Future research should also evaluate the generalizability of this finding as the sample was predominantly minority children from economically disadvantaged families, which is not nationally representative. Additionally, the local sample was skewed toward a predominance of younger preschool aged children compared to the national sample. The significant differences in the characteristics between the local sample and national standardization sample may help to explain why the current findings contradict the model assumed by the authors of the Speed DIAL. Future research should further explore the impact of demographic characteristics on children's performance.

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Table 1

Measures Including Speed DIAL Items

	Jump	Hop	Skip	Building	Copying	Body Parts	Colors	Rapid Color Naming	Concepts	Actions	Letters and Sounds	Problem Solving
BDI-2									X			
Bayley Scales of Infant Development	X	X		X	X							X
Boehm-3: Preschool									X			
BBCS-R							X		X		X	
Brigance K and I Screen—Revised						X	X					
CTOPP								X			X	
Denver II	X	X		X	X	X	X					X
Developmental Diagnosis	X	X	X	X	X					X		X
K-SEALS										X	X	
Measurement of Intelligence of Infants and Young Children				X	X	X						
Merrill Palmer Scales				X	X					X		
Preschool Attainment Record	X	X	X	X	X							
Quick Screening Scale of Mental Development	X		X	X	X	X						
Stanford-Binet Intelligence Scale				X	X	X						
Tests of Mental Development				X	X							
WJ III-ACH										X		

Table 2.1

Representation of the Local Head Start Sample, by Gender and Age

	Female			Male			Total	
Age	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample	N	DIAL-3 Sample
Under 3 years	5	100.0		0	0.0		5	-
3-0 to 3-5	55	50.0	43.6	55	50.0	56.4	110	110
3-6 to 3-11	67	46.9	51.3	76	53.1	48.7	143	197
4-0 to 4-5	37	49.3	48.7	38	50.7	51.3	75	234
4-6 to 4-11	30	50.0	43.4	30	50.0	56.6	60	297
5-0 to 5-5	2	50.0	47.1	2	50.0	52.9	4	274
Total	196	49.4	46.9	201	50.6	53.1	397	1,112

Table 2.2

Representation of the Local Head Start Sample, by Race/Ethnicity and Age

	African American			Hispanic			White			Other		
Age	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample
Under 3 years	4	80.0		0	0.0		1	20.0		0	0.0	
3-0 to 3-5	86	80.4	17.3	2	1.9	6.4	18	16.8	73.6	1	.9	2.7
3-6 to 3-11	96	71.6	20.3	12	9.0	6.1	21	15.7	68.5	5	3.7	5.1
4-0 to 4-5	59	85.5	21.8	1	1.4	8.5	6	8.7	63.2	3	4.3	6.4
4-6 to 4-11	45	86.5	19.2	2	3.8	15.8	2	3.8	58.6	3	5.8	6.4
5-0 to 5-5	1	33.3	7.3	1	33.3	12.0	0	0.0	72.3	1	33.3	8.4
Total	291	78.6	14.7	18	4.9	9.6	48	13.0	70.3	13	3.5	5.5

Table 2.3

Representation of the Local Head Start Sample, by Parent Education Level and Age

	Grade 11 or Less			High School Graduate			One to Three Years of College or Tech School			Four or More Years of College		
Age	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample	N	%	DIAL-3 Sample
Under 3 years	1	20.0		3	60.0		1	20.0		0	0.0	
3-0 to 3-5	30	33.3	7.3	37	41.1	27.3	20	22.2	44.5	3	3.3	20.9
3-6 to 3-11	42	34.4	10.2	54	44.2	33.5	20	16.4	36.5	6	4.9	19.8
4-0 to 4-5	26	42.6	17.9	22	36.1	35.5	11	18.0	33.3	2	3.3	13.2
4-6 to 4-11	15	28.8	19.2	24	46.2	35.7	12	23.1	35.7	1	1.9	9.4
5-0 to 5-5	3	100.0	17.5	0	0.0	36.5	0	0.0	33.2	0	0.0	12.8
Total	117	35.1	15.9	140	42.0	34.6	64	19.2	35.4	12	3.6	14.2

Table 3.1

Scaled Score Ranges Corresponding to Five Cutoff Levels based on Mean and Standard Deviation, by Age

Age	1.0 SD (16%)		1.3 SD (10%)		1.5 SD (7%)		1.7 SD (5%)		2.0 SD (2%)		N	Mean	SD
	Local	Speed DIAL	Local	Speed DIAL	Local	Speed DIAL	Local	Speed DIAL	Local	Speed DIAL			
3-0 to 3-1	4	0-2	3	0-1	2	-	2	-	1	-	27	7.19	3.16
3-2 to 3-3	5	0-4	2	0-2	1	0-1	0	0	0	-	46	7.00	4.14
3-4 to 3-5	6	0-5	2	0-4	1	0-2	0	0-1	0	-	37	8.38	4.63
3-6 to 3-7	6	0-7	4	0-5	3	0-3	2	0-3	0	0	43	9.95	4.76
3-8 to 3-9	4	0-8	4	0-6	3	0-5	3	0-4	2	0-1	50	8.72	3.58
3-10 to 3-11	6	0-9	5	0-8	4	0-6	3	0-6	1	0-3	50	11.18	4.99
4-0 to 4-1	9	0-11	4	0-9	3	0-8	2	0-7	0	0-4	33	13.03	6.67
4-2 to 4-3	7	0-12	5	0-11	4	0-9	3	0-8	1	0-5	12	11.33	5.07
4-4 to 4-5	9	0-13	6	0-12	5	0-10	4	0-10	2	0-7	30	15.67	7.05
4-6 to 4-7	8	0-15	10	0-13	8	0-12	7	0-11	6	0-8	26	17.42	5.94
4-8 to 4-9	9	0-16	10	0-15	9	0-13	7	0-12	5	0-9	19	18.68	6.68
4-10 to 4-11	8	0-18	9	0-16	8	0-14	7	0-13	5	0-10	15	16.60	5.78

Table 3.2

Scaled Score Ranges Corresponding to Five Cutoff Levels based on Percentile Rank, by Age

Age	16%ile	10%ile	7%ile	5%ile	2%ile	N	Median	IQR
3-0 to 3-1	4	4	4	3	3	27	6	4
3-2 to 3-3	4	3	2	2	2	46	6	4
3-4 to 3-5	4	4	3	3	2	37	7	6
3-6 to 3-7	5	4	4	4	3	43	8	8
3-8 to 3-9	4	4	4	3	2	50	10	6
3-10 to 3-11	7	5	4	4	0	50	11	6
4-0 to 4-1	6	4	3	3	2	33	14	10
4-2 to 4-3	6	5	5	5	5	12	10	8
4-4 to 4-5	8	6	5	4	2	30	15	10
4-6 to 4-7	10	8	8	6	5	26	17.5	8
4-8 to 4-9	10	10	8	7	7	19	20	12
4-10 to 4-11	10	8	7	7	7	15	17	11

Table 4

Intercorrelations of the Speed DIAL subtests and Speed DIAL Total

	Jump, Hop, & Skip	Body Parts	Building	Copying	Colors	Concepts	Actions	Letters & Sounds	Problem Solving	Total
JHS	-	.33	.34	.38	.33	.41	.41	.43	.31	.62
Body Parts	-	-	.24	.25	.54	.51	.58	.39	.42	.64
Building	-	-	-	.46	.36	.34	.33	.31	.26	.52
Copying	-	-	-	-	.48	.39	.34	.60	.26	.67
Colors	-	-	-	-	-	.54	.52	.51	.36	.83
Concepts	-	-	-	-	-	-	.60	.41	.45	.71
Actions	-	-	-	-	-	-	-	.39	.56	.70
L & S	-	-	-	-	-	-	-	-	.31	.70
PS	-	-	-	-	-	-	-	-	-	.54
Mean	5.95	4.93	2.14	1.34	7.04	5.97	7.67	1.74	1.75	42.8
SD	4.11	1.91	1.31	2.36	4.75	2.67	3.72	3.84	1.67	23.03

Table 5.1

Factor loadings of the Speed DIAL subtests on verbal ability and nonverbal ability factors

Speed DIAL subtest	Pattern matrix	
	Verbal ability	Nonverbal ability
Jump, hop, and skip	.20	**.51**
Body parts	**.84**	-.07
Building	-.05	**.71**
Copying	-.17	**.95**
Colors	**.47**	.38
Concepts	**.68**	.16
Actions	**.85**	-.00
Letters and sounds	.07	**.74**
Problem solving	**.81**	-.12

Note. Loadings of .40 and above are in bold type. The pattern matrix reflects partial correlations of observed variables with factors after controlling for shared variance among the factors.

Table 5.2

Factor loadings of the Speed DIAL subtests on verbal ability and nonverbal ability factors

Speed DIAL subtest	Structure matrix	
	Verbal ability	Nonverbal ability
Jump, hop, and skip	**.49**	**.63**
Body parts	**.80**	**.40**
Building	.36	**.69**
Copying	.37	**.86**
Colors	**.69**	**.65**
Concepts	**.78**	**.55**
Actions	**.85**	**.48**
Letters and sounds	**.49**	**.79**
Problem solving	**.74**	.33

Note. Loadings of .40 and above are in bold type. The structure matrix reflects zero-order correlations of observed variables with factors.