TECHNICAL REPORT

PSYCHOMETRIC CHARACTERISTICS OF INDIVIDUAL GROWTH & DEVELOPMENT INDICATORS: PICTURE NAMING, RHYMING, AND ALLITERATION

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ABSTRACT

Three Individual Growth and Development Indicators are commonly used as indicators of children’s language and literacy development in preschool and early elementary programs. These three measures – Picture Naming assessment of expressive language development and Rhyming and Alliteration assessment of phonological analysis – were each developed by researchers at the University of Minnesota, under the auspices of the Early Childhood Research Institute on Measuring Growth and Development. To date, these three measures have been evaluated empirically in a series of studies (including Master’s and doctoral theses), with special attention to reliability and validity indices when used with preschool children.

This paper summarizes reliability (including test-retest and alternate forms) and validity (including concurrent and predictive relations) for the three measures, across independent studies. Available evidence suggests moderate to strong evidence for the reliability of all three measures when administered by trained examiners in a variety of preschool settings, and low to high relations across measures for analyses of validity.
From 1996 to 2001, three teams of researchers worked together to develop a set of general outcome measures of child growth and development, for use with children from birth to age 8. This project, the Early Childhood Research Institute on Measuring Growth and Development (ECRI-MGD; http://www.ici2.umn.edu/ecri), produced a list of desired developmental outcomes for all children, birth to age 8 (Priest et al., 2002), as well as sets of measures for infants and toddlers (Greenwood, Luze, & Carta, 2002), preschool-aged children (McConnell, Priest, Davis, & McEvoy, 2002), and elementary children (Good, Gruba, & Kaminski, 2002).

Our research team at the University of Minnesota focused specifically on the design, development, evaluation, and application of general outcome measures of early childhood development. General outcome measures (or GOMs) represent a class of measures and an approach to assessment that relies on direct assessment of child performance on a standard task, with a common growth metric of performance that can be collected across an extended period of time (Deno, 1985; Deno, 1997; Fuchs & Deno, 1991). Simply put, general outcome measures are “reliable, valid, and efficient procedures for obtaining [child] performance data to evaluate [intervention] programs…. the two most salient features of measuring general outcome indicators are (a) the assessment of proficiency on the global outcomes toward which the entire curriculum is directed, and (b) the reliance on a standardized, prescriptive measurement methodology that produces critical indicators of performance” (Fuchs & Deno, 1991, pp. 488-493).

Design standards for general outcome measures used for continuous progress monitoring were first articulated by Stanley Deno and his colleagues (Deno, Mirkin, & Chiang, 1982). While specific criteria have shifted somewhat and analytic procedures associated with these standards have matured, these design standards remain fairly robust today. Specifically, individual growth and development indicators (like other general outcome measures, including curriculum-based measures) should be evaluated along six broad features or characteristics, including the extent to which they: (a)
measure important outcomes for children; (b) can be used efficiently and economically; (c) are standardized and replicable; (d) rely on generalized or “authentic” child behaviors; (e) are technically adequate; and (f) are sensitive to growth and change over time and to effects of intervention.

For preschool-aged children, a series of approximately 10 measures were developed as potential individual growth and development indicators. Most promising tools emerged for the assessment of expressive language development (i.e., Picture Naming) and phonological analysis associated with early literacy development (i.e., Rhyming and Alliteration). These three measures were evaluated first in studies conducted by the ECRI-MGD research team, and subsequently in a variety of other investigations. In some instances, these investigations specifically intended to evaluate a measure’s psychometric characteristics. In other instances, evaluation of reliability or validity was embedded in a larger or differently-focused investigation.

Given the research team’s general satisfaction with the efficiency, reliability, and likely utility of these three measures, each was made available to researchers, teachers, and evaluators for use. Dissemination was conducted through professional presentations and workshops, print and journal descriptions, and on-line resources (www.getgotgo.net). Given the rather dispersed nature of the findings that might support use of these measures, this Technical Report has been prepared to summarize available evidence of reliability and validity for Picture Naming, Rhyming, and Alliteration in one location. In following sections, administration procedures are reviewed for each measure followed by a summary of available evaluations of reliability and validity.

**Picture Naming Individual Growth and Development Indicator (Picture Naming IGDI; ECRI-MGD, 1998)**

Picture Naming administration is completed by presenting children with color pictures (photographs or line drawings) of objects found in natural environments, including home (e.g., cake, sink), classroom (e.g., glue, book) and community (e.g., rabbit, train). The children are told to name pictures as quickly as possible. The number of pictures named correctly in one minute is the child’s score. If the child does
not respond to any given picture within three seconds, the examiner gives a prompt by saying, “What’s that?” or “Do you know what this is?” and allows the child an additional two seconds to respond before moving to the next card.

Items are selected from a set of approximately 120 pictured objects. Examiners are instructed to use four standard sample cards (to demonstrate the task and confirm the child’s understanding of the task), and then to administer a randomly selected set of 1 to 50 cards. Current research by our group is exploring the possibility of “standard” sets of picture cards, but at this time each administration can be considered an alternate form or random sample of the 120 total cards.

**RELIABILITY**

Picture Naming scores appear to be relatively stable over time. One-month alternate form reliability coefficients range from $r = .44$ to $r = .78$ (McConnell et al., 2002) and test-retest reliability across three weeks is $r = .67$, $p < .01$ for a sample of 29 preschool children.

**VALIDITY**

Picture Naming correlates with other standardized measures of language development, and also with presumed correlates of the language domain (e.g., literacy). In our longitudinal investigation, with approximately 90 preschool children from 36 to 60 months of age (including children with disabilities and those living in poverty; Priest, Davis, McConnell, McEvoy, & Shin, 1999; Priest, McConnell, McEvoy, & Shin, 2000), Picture Naming IGDI was positively correlated with the *Peabody Picture Vocabulary Test – Third Edition* (PPVT-3; Dunn & Dunn, 1997; $r = .56$ to 75, $p < .001$) and with the *Preschool Language Scale – 3* (PLS-3; Zimmerman, Steiner, & Pond, 1992; $r = .63$ to .79, $p < .001$). In related research with children from 24 to 44 months of age, Picture Naming was positively correlated with the PLS-3 ($r = .74$ to .81).

Picture Naming also appears to be sensitive to preschoolers’ growing expressive language skills, with significant correlations between children’s scores and chronological age ($r = .41$ in our longitudinal study with 90 participants, and $r = .60$ in
a cross-sectional study with 39 participants), including typically developing children ($r = .63$, $p < .001$), children enrolled in Head Start ($r = .32$, $p < .05$), and children with disabilities receiving services in early childhood special education classrooms ($r = .48$, $p < .001$; McConnell, Priest, Davis, & McEvoy, 2002). In our longitudinal study of 90 preschoolers, estimated child performance levels centered at 66 months of age (using Hierarchical Linear Modeling [HLM]; Bryk & Raudenbush, 1992) yielded an average Picture Naming score (intercept) of 26.90 for typically developing children (slope = .44 pictures per month), 19.01 for low income children (slope = .28 pictures per month), and 16.88 for children with identified disabilities (slope = .36 pictures per month; Priest, McConnell, McEvoy, & Shin, 2000). In a different study of 69 preschoolers, estimated child performance levels centered at 59 months of age yielded an average Picture Naming score of 16.97 for typically developing children, 16.51 for children living in poverty, 14.13 for children with identified speech and language disabilities, and 2.64 for Spanish-speaking children learning English (Missall & McConnell, 2004).

Concurrent validity has also been established with the Dynamic Indicators of Basic Early Literacy Skills (DIBELS; Kaminski & Good, 1996) measures of Letter Naming Fluency (LNF; $r = .32$ to .37) and Onset Recognition Fluency ($r = .44$ to .49; McConnell et al., 2002; Missall, 2002) using a sample of 84 preschool-aged children.

**Rhyming Individual Growth and Development Indicator (RHYMING IGDI; ECRI-MGD, 2000)**

Rhyming administration is completed by presenting a child with a series of cards. Each card shows four pictures: at the top is a picture depicting the stimulus word (e.g., bees) and under the stimulus picture is a row of three other pictures (e.g., house, pants, cheese) with one correct and two incorrect responses. For each card the examiner points to and says the name of each picture and tells the child to, "Point to the picture that sounds the same as the top picture." After demonstration (two standard cards) and practice items (four randomly selected cards), the examiner shows a random selection of cards for two minutes. A child's score is the number of correctly-identified rhymes in two minutes.
RELIABILITY

Rhyming scores tend to be quite stable over time. Test-retest reliability over three weeks is $r = .83$ to $.89$, $p < .01$ for a sample of 42 preschoolers.

VALIDITY

Rhyming correlates with other standardized measures of phonological awareness and early literacy development. In our longitudinal research with 90 children (including children with disabilities and those living in poverty; McConnell, Priest, Davis, & McEvoy, 2002) the Rhyming IGDI was positively correlated with the PPVT-3 ($r = .56$ to $.62$, $p < .05$), Concepts About Print (CAP; Clay, 1985; $r = .54$ to $.64$, $p < .01$) and Test of Phonological Awareness (TOPA; Torgeson & Bryant, 1994; $r = .44$ to $.62$). With this same sample, examination of concurrent validity indicated moderate to high correlations with Picture Naming IGDI ($r = .46$ to $.63$, $p < .01$) and Alliteration IGDI ($r = .43$; Missall, 2002).

Rhyming also appears to be sensitive to preschoolers’ growing phonological skills, with significant correlations between children’s scores and chronological age ($r = .46$, $p < .01$) in our longitudinal study of 90 preschoolers. In this same study, estimated child performance levels centered at 53 months of age using HLM yielded an average Rhyming score of 7.61 for typically developing children (slope = .38 rhymes per month), and a score of 6.5 for low income children (slope = .95 rhymes per month) and 5.07 for children with identified disabilities (slope = .40 rhymes per month; Priest, Silberglitt, Hall, & Estrem, 2000). In a different study of 69 preschoolers estimated child performance levels at 59 months of age yielded an average Rhyming score of 6.29 for typically developing children, 1.66 for children living in poverty, 1.68 for children with identified speech and language disabilities, and .79 for Spanish-speaking children learning English (Missall & McConnell, 2004).

Concurrent validity has also been established with DIBELS Letter Naming Fluency ($r = .48$ to $.59$) and Onset Recognition Fluency ($r = .44$ to $.68$; McConnell et al., 2002; Missall, 2002) for children in preschool.
ALLITERATION INDIVIDUAL GROWTH AND DEVELOPMENT INDICATOR (ALLITERATION IGDI; ECRI-MGD, 2000)

Alliteration is similar to the other two IGDI’s in that it uses stimulus cards and the child’s score is the number correct during a timed administration. The Alliteration cards depict four pictures: at the top is a picture depicting the stimulus word (e.g., cake) and under the stimulus picture is a row of three other pictures (e.g., cat, sink, bear) with one correct and two incorrect responses. The child is told to, “Look at the pictures and find the ones that start with the same sound.” For each card the examiner names all the pictures for the child. After demonstration (two standard cards) and practice items (four randomly selected cards), the examiner shows a random selection of cards for two minutes, counting the number correct in that time as the child’s score.

RELIABILITY

Alliteration scores appear to be stable over time. Test-retest reliability over three weeks is \( r = .46 \) to \( .80 \), \( p < .01 \) for a sample of 42 preschool-aged children.

VALIDITY

Alliteration correlates with other standardized measures of phonological awareness and early literacy development. In our longitudinal research (see McConnell, Priest, Davis, & McEvoy, 2002) Alliteration was correlated with the PPVT-3 (\( r = .40 \) to \( .57 \), \( p < .01 \)), TOPA (\( r = .75 \) to \( .79 \), \( p < .01 \)), and CAP (\( r = .34 \) to \( .55 \), \( p < .05 \)).

Studies have found Alliteration to be positively correlated with age (\( r = .61 \)). In a longitudinal study of 90 preschoolers, HLM centered at 53 months of age yielded an average Alliteration score of 5.23 for typically developing children (slope = \( .38 \) alliterations per month), and 4.28 for low income children (slope = \( .25 \) alliterations per month) and 4.43 for children with identified disabilities (slope = \( .36 \) alliterations per month; Priest, Silberglitt, Hall, & Estrem, 2000). In a similar study of 69 preschoolers estimated child performance levels at 59 months of age yielded an average Alliteration score of 5.19 for typically developing children, 1.09 for children living in poverty, \( .94 \).

Concurrent validity with DIBELS Letter Naming Fluency is moderate to high ($r = .39$ to .71, $p < .05$; McConnell et al., 2002; Missall, 2002).
REFERENCES


Gibbons, K., Howe, K., Phanuef, R., Silberglitt, B. (2003, February). Creating and implementing a general outcome measurement system from preschool to grade three: One education district’s experience. Presentation at the Pacific Coast Research Conference, La Jolla, CA.

Sample:
Size: N = 68 [Phase 1]; N = 35 - 48 [Phase 2]
Ages: Preschoolers (3 to 5 years old)
Demographics: Caucasian = 58, Native American = 10; Early Childhood Special Education (ECSE) = 7

Measures:
Picture Naming (PN)
Rhyming (R)
Alliteration (A)

Procedure:
Assessed every 2 months for 6 months (3 waves over 2 months)

Results:
Reliability:
PN: Jan - Mar (r = .30*); Mar - May (r = .49*); Jan - May (r = .17)
R: Jan - Mar (r = .57**); Mar - May (r = .77**); Jan - May (r = .68**) 
A: Jan - Mar (r = .26); Mar - May (r = .46**); Jan - May (r = .25)

HLM:
PN: Overall growth rate of .62 pictures per month
R: Overall growth rate of .50 rhymes per month
A: Overall growth rate of .06 alliterations per month

Samples:
Two descriptive studies:
Cross-sectional:
Size: N = 39
Ages: 35 - 69 months
Demographics: Childcare Center (CC; all English speaking and children without identified disabilities)

Longitudinal:
Size: N=58
Ages: 32 - 66 months (M = 50.60; SD = 10.25)
Demographics: Early Childhood Special Education (ECSE) = 10; Head Start (HS) = 14; Childcare Center (CC) = 34; girls = 33

One intervention study:
Size: N = 3
Ages: 4-11 to 5-1
Demographics: ECSE = 3

Measures:
Picture Naming (PN)
Rhyming (R)
Alliteration (A)
Peabody Picture and Vocabulary Test-Third Edition (PPVT-3)
Preschool Language Scale-3 (PLS-3)
Concepts About Print (CAP)
Test of Phonological Awareness (TO PA)
DIBELS Letter Naming Fluency (LNF)
Procedures:

? Summary of psychometric information from cross-sectional and longitudinal IGDI studies.

? Children in the intervention study were identified by flat or decreasing Picture Naming slopes after 10 assessments. Children received a peer-mediated language intervention with typically developing peers in 20-minute play groups three times per week. Intervention continued for 2 months and Picture Naming data were collected twice a week.

Results:

Descriptive Statistics:

PN & Age:  
- $r = .41$ (longitudinal study)
- $r = .60$ (cross-sectional study)
- $r = .63$ (CC)
- $r = .32$ (HS)
- $r = .48$ (ECSE)

A & Age:  
- 35-45 months: $M = 3.5$
- 45-56 months: $M = 5.8$
- 57-69 months: $M = 8.3$

Validity:

PN with PPVT-3 & PLS-3:  $r = .47 - .69$

R:  
- PPVT-3:  $r = .56^*$
- CAP:  $r = .54^*$
- TOPA:  $r = .62$
- LNF:  $r = .59^*$
- Age:  $r = .44^*$

A:  
- PPVT-3:  $r = .57^*$
- CAP:  $r = .55^*$
- TOPA:  $r = .75^*$
- LNF:  $r = .71^*$
- Age:  $r = .61^*$
Reliability:
PN: \( r = .44 - .78 \) [1-month alternate forms]

HLM: \( (B = \text{intercept or score}, B_1 = \text{slope or growth}) \)
PN: \( B_1 = .34^{***} \)

Intervention study:
Picture Naming score and slope increased as a function of intervention for two of three children.


Sample:
Size: \( N = 89 \)
Ages: 54 - 66 months (at start of study)
Demographics: boys = 46; girls = 43; Early Childhood Special Education (ECSE) = 8; ethnic minority = 14

Measures:
Picture Naming (PN)
Rhyming (R)
DIBELS Letter Naming Fluency (LNF)
DIBELS Onset Recognition Fluency (OnRF)
Scale of Social Competence and School Adjustment– Preschool Version (SSCSA-PS)
Scale of Early School Adjustment (SESA)

Procedures:
Children assessed fall (Oct/Nov) & winter (Jan/ Feb) for one school year

Results:
Validity:
PN: LNF: \( r = .26 - .37^{**} \)
OnRF: \( r = .32 - .49^{**} \)
SSCSA-PS: \( r = .42 - .60^{**} \)
Descriptive and Experimental Analyses

SESA: \( r = .43 - .57^{**} \)

R: LNF: \( r = .48 - .58^{**} \)
OnRF: \( r = .44 - .68^{**} \)
SSCSA-PS: \( r = .37 - .69^{**} \)
SESA: \( r = .39 - .68^{**} \)


Sample:
Size: \( N = 69 \)
Ages: 44 – 69 months
Demographics: Childcare Center (CC) = 12; Early Childhood Special Education (ECSE) = 26; Head Start (HS) = 12; Spanish-speaking (SS) = 19

Measures:
Picture Naming (PN)
Rhyming (R)
Alliteration (A)
Ecobehavioral System for Complex Assessments of Preschool Environments (ESCAPE)

Procedures:
Children were assessed with IGDIs three times in the preschool year prior to kindergarten: in the fall, winter, and spring. ESCAPE observations were conducted in the fall and spring. Data presented represent spring ESCAPE observations.

Results:
**HLM for Picture Naming**: (B = intercept or score; centered at median age [59 months] for sample)
CC: \( B = 16.97 \)
HS: \( B = 16.51 \)
ECSE: $B = 14.31$

SS: $B = 2.64^*$
**HLM for Rhyming:** (\(B = \) intercept or score; centered at median age [59 months] for sample)

- **CC:** \(B = 6.29\)
- **HS:** \(B = 1.68^*\)
- **ECSE:** \(B = 1.66^*\)
- **SS:** \(B = .79^*\)

**HLM for Alliteration:** (\(B = \) intercept or score; centered at median age [59 months] for sample)

- **CC:** \(B = 5.19\)
- **HS:** \(B = 1.09^*\)
- **ECSE:** \(B = .94^*\)
- **SS:** \(B = .71^*\)

**Relations between IGDIs and ESCAPE:**

**HS:**
- R & Verbal Behavior \(\bar{r} = .57^*\)
- PN & Pre-Academic Behavior \(\bar{r} = .54\)
- PN & Instructional Materials \(\bar{r} = .54\)

**SS:**
- PN & Verbal Behavior \(\bar{r} = .56 - .71^{**}\)

**ECSE:**
- A & Story Activities \(\bar{r} = .47^*\)
- A & Instructional Materials \(\bar{r} = .46^*\)

**CC:**
- PN & Play Activities \(\bar{r} = -.61^*\)
- A & Play Activities \(\bar{r} = -.60^*\)
- R & Play Activities \(\bar{r} = .48\)

Sample:
Size: N = 42
Ages: 5 to 7 years old
Demographics: English Language Learners (ELL) = 29 (Hmong = 23); Primary Language is English (PLE) = 13

Measures:
Picture Naming (PN)
Peabody Picture and Vocabulary Test - Third Edition (PPVT-3)

Procedures:
IGDI's administered once per week for 13 weeks; PPVT-3 administered one time at start of study

Results:
Descriptive Statistics for Picture Naming:
All: M = 19.1; SD = 5.0
PLE: M = 25.2; SD = 2.8
All ELL: M = 16.4; SD = 2.9
Hmong: M = 16.1; SD = 3.0

Validity:
PN * PPVT-3: r = .78**

HLM: (B = intercept or score, B1 = slope or growth)
PN scores and rate of growth per week by group:
ALL: B = 14.97
B1 = .71

PLE: B = 22.78*
B1 = .387*

ELL: B = 11.64*
B1 = .84*

Sample:
Size: N = 60
Ages: 30 - 68 months
Demographics: Girls = 29, Boys = 31; Primary Language is English (PLE) = 55; Early Childhood Special Education (ECSE) = 16; Head Start (HS) = 14; Childcare Center (CC) = 30

Measures:
Picture Naming (PN)
Peabody Picture and Vocabulary Test-Third Edition (PPVT-3)
Preschool Language Scale-3 (PLS-3)

Procedure:
IGDIs administered once a month for seven months (e.g., cycles 1-7); PPVT-3 and PLS-3 administered during cycle 1 and during cycle 4

Results:

Descriptive Statistics:
Mean Picture Naming Score
? boys: M = 15.5, girls: M = 17; t = .62 (not significant)

Validity:
Age: All: \( r = .41^{***} \)
CC: \( r = .63^{***} \)
HS: \( r = .32^{*} \)
ECSE: \( r = .48^{***} \)
PN: PPVT-3: \( r = .69^{***} \)
PLS-3: \( r = .63^{***} \)
**HLM**: \( B = \) intercept or score, \( B_1 = \) slope or growth

- **ALL**: \( B = 17.27 \quad B_1 = .32^* \)
- **CC**: \( B = 26.9 \quad B_1 = .44/\text{month} \)
- **HS**: \( B = 19.01 \quad B_1 = .28/\text{month} \)
- **ECSE**: \( B = 16.88 \quad B_1 = .36/\text{month} \)


**Sample:**
- Size: \( N = 58 \)
- Ages: 32 - 66 months (\( M = 50.60; \text{SD} = 10.25 \))
- Demographics: Early Childhood Special Education (ECSE) = 10; Head Start (HS) = 14; Childcare Center (CC) = 34; girls = 33; boys = 25

**Measures:**
- Picture Naming (PN)
- Rhyming (R)
- Alliteration (A)
- DIBELS Letter Naming Fluency (LNF)
- Peabody Picture Vocabulary Test – Third Edition (PPVT-3)
- Test of Phonological Awareness (TO PA)
- Concepts About Print (CAP)

**Procedures:**
- IGDIs administered seven times: once per month in seven consecutive months

**Results:**

**Descriptive Statistics:**

- Rhyming:
  - 35-45 mo: \( M = 4.0 \)
  - 45-56 mo: \( M = 7.5 \)
  - 57-69 mo: \( M = 9.2 \)

- Alliteration:
Mean = 4.16, SD = 2.28

**Reliability:**
R: age: $r = .46^{**}$
R: (across 2.5 - 4 weeks) $r = .83-89^{**}$
R: (waves next to each other) mean $r = .75 (.59 - .89)$

A: 
A: (2.5 - 4 weeks) $r = .62 - .78^{**}$
A: (waves next to each other) mean $r = .65 (.46 - .80)$

**Validity:**
R: A: $r = .43^{**}$
PPVT-3: $r = .62^{*}$
TOPA: $r = .44$
CAP: $r = .64^{**}$
LNF: $r = .49^{**}$
PN: $r = .54^{**}$

A: PPVT-3: $r = .40^{**}$
TOPA: $r = .79^{**}$
CAP: $r = .34^{**}$
LNF: $r = .39^{**}$
PN: $r = .40^{*}$

**HLM for Rhyming:** (B = intercept or score, $B_1$ = slope or growth per month; (centered at median age [53 months] for sample)
ALL: $B = 6.79^{**}$ $B_1 = 0.47^{**}$
CC: $B = 7.61$ $B_1 = .38$
HS: $B = -1.09$ $B_1 = .57$
ECSE: $B = -2.54^{*}$ $B_1 = .01$

**HLM for Alliteration:** (B = intercept or score, $B_1$ = slope or growth per month; (centered at median age [53 months] for sample)
ALL: $B = 4.84^{**}$ $B_1 = 0.35^{**}$
CC: $B = 5.23$ $B_1 = .38$
HS: \( B = -0.95 \quad B_1 = -0.15 \)
ECSE: \( B = -0.80 \quad B_1 = -0.02 \)