Stability of Maternal Reports of Lexical Comprehension in Very Young Children With Developmental Delays

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The MacArthur Communication Development Inventory: Infant Scale (CDI/I) is among the strongest measures of early lexical comprehension (Fenson et al., 1994). The present study examined the stability of CDI/I results over a 2-week period in a sample of 17 mothers of children with developmental delays. Test-retest stability was computed for total number of words understood (i.e., summary-level stability) and for word-by-word agreement (i.e., item-by-item stability) across a 2-week interval. Results indicated that although there was excellent summary level stability, there was, in many cases, inadequate item-by-item agreement between the two testing occasions. The degree to which mothers were consistent on an item-by-item basis varied as a function of the types of words they were reporting on, the occupational status and educational level of the mothers, and the extent to which mothers confidently interpret nonlinguistic child behavior. These data illustrate that the CDI/I can be used to identify overall vocabulary deficits and specific word classes that are under-represented, but not to identify specific words for remediation.

The present study examines two types of stability of a measure of early lexical comprehension, The MacArthur Communication Development Inventory: Infant Scale (CDI/I; Fenson et al., 1993). These two types of stability are summary level (stability of total number of words mothers report that their children comprehend) and item-by-item (stability of the specific words mothers report that their children comprehend). The presence or absence of such stability indicates the extent to which, and at what level of detail, it is possible for the CDI/I comprehension scale to be accurate.

Early lexical comprehension is notoriously difficult to measure (Tomasello & Mervis, 1994). One of the problems is that children's failure to respond to discrimination tests (e.g., "Point to the shoe" out of an array of stimuli) is ambiguous. Two-year-olds (or children who are developmentally 2 years old) frequently do not comply with our directives. Additionally, such tests are very time consuming, thus limiting the number of words we can test.

The CDI/I is among the strongest measures of early lexical comprehension (Fenson et al., 1994). The vocabulary checklist (section D) of the CDI/I contains 396 words that research indicates are used and understood by most typically developing 16-month-olds. The words on the checklist are organized into 19 categories, the largest of which are various types of nouns (including 10 subcategories), games and routines, action words, and descriptive words. By using mothers as informants, we may capitalize on the mothers' vast knowledge of their children's abilities. In the CDI/I, mothers indicate which words their children "understand" or "understand and say" on a checklist of words typically used by children 8 to 16 months old. The CDI/I was designed to screen children for vocabulary deficits and to identify under-represented word-classes in a child's vocabulary.

Although Fenson et al. (1993) specifically point out that parental reports should not be used alone to make clinical decisions about individual children for any of the items measured, in practice many clinicians may use specific words that mothers say their children understand as the primary basis for selecting target vocabulary in language targets. The practice of using CDI/I item responses as the basis for selecting specific words for vocabulary goals occurs for at least two reasons. First,

unlike most standardized tests, which sample a domain, some clinicians may consider the vocabulary on the CDI/I a large portion of the entire early lexicon of many U.S. children. The source of this assumption probably lies in the large number and well-researched selection of vocabulary on the CDI/I relative to the small vocabulary size of children at 8–16 months. Second, the absence of alternative tests of a large number of vocabulary items that can be given in the amount of time most clinicians have to spend on vocabulary assessment makes the CDI/I one of the only available options for vocabulary goal selection.

Given the number of nonlinguistic strategies young children use to guide their behavior before they learn to understand language (Chapman, 1978), Tomasello and Mervis (1994) have reasonably questioned whether mothers are accurate about the specific words they say their children understand. Chapman (1978) reports that children in the 8- to 12-month developmental stage give context-determined responses that have no dependence on the lexical content of their mothers' utterances. In the next stage of development (ages 12–18 months), children attend to the object mentioned and do what they would normally do in that situation (Chapman, 1978).

Even if one cannot determine whether the CDI/I is accurate on a word-by-word level, it is possible to determine whether mothers are reliable over time (i.e., stable) with the information they provide. An instrument cannot provide accurate information if it does not provide reliable information (Suen & Ary, 1989).

It is important to understand that instruments are stable for particular purposes and at particular levels of detail. For example, there are at least two types of stability: summary-level and item-by-item stability. Summary-level stability is estimated by determining whether a group of children generally rank in the same order on the summary-level score of the measured ability (e.g., total number of words understood) on both testings. Such information is important for identifying children who have vocabulary deficits and for identifying particular word classes that are under-represented in the child's vocabulary. Past work (Fenson et al., 1994) found very good (.87) summary-level stability in a sample of typically developing infants. No data exist on the summary-level stability of the CDI/I in a sample of children with known disabilities. This information is important because one of the most promising clinical purposes of the CDI/I is to screen children who may be delayed in their vocabulary development.

In contrast, item-by-item stability is estimated by determining the extent to which mothers agree with their previous report of their children's responses on an item-by-item basis. In the case of the CDI/I, item-by-item stability is measured by the extent to which mothers agree with their last report about the specific words their children understand. Item-by-item stability is necessary for clinicians to be able to use the CDI/I item results as the basis for vocabulary goal selection. It is quite possible for an instrument to have good summary-level stability, but poor item-by-item stability. For example, a mother may indicate that her child understands 100 words on both testing occasions, whereas the specific words that she reports he

understands vary across occasions. This item-by-item stability information is important to consider because without it, clinicians have no basis for confidence in mothers' reports of the specific words their children understand.

It should be noted that most psychometricians would not examine, or even expect, item-by-item stability in an instrument because most instruments are designed as a representative sample of a domain, not a nearly exhaustive record of one. Item-by-item stability of the CDI/I is relevant because our personal experience indicates that some clinicians are currently using the CDI/I as the basis for vocabulary goal selection. Currently, there are no data on the item-by-item stability of the CDI/I. Item-by-item stability is computed in the present study to demonstrate the extent to which current practice of using the CDI/I as the basis for vocabulary selection is justified.

It is possible that there are some word classes or parental characteristics that are associated with relatively high item-by-item stability on the CDI/I. Identifying such parental characteristics or word classes may help us identify the conditions under which the practice of using the CDI/I for vocabulary goal selection is most justified.

The degree to which CDI/I results have item-by-item stability may be related to the mothers' confidence in their judgment that their children understand a particular word. For example, a mother who is confident that her child understood "ball" on the first testing occasion is more likely to indicate that her child understands "ball" on the second testing than is a mother who was uncertain about her child's understanding of "ball" on either occasion.

Mothers' confidence in their judgments that their children understand a particular word may vary as a function of their tendency to confidently interpret children's nonlinguistic behavior as communicative and the degree of ambiguity of the behavioral evidence of comprehension. Tendency to confidently interpret children's behavior in general may be related to the mothers' tendency to interpret their own children's behavior as indicative of comprehension. Past research indicates that maternal tendency to interpret children's behavior as communicative is a stable characteristic that varies with the types of behavior they respond to in their own children (Yoder & Feagans, 1988). Tendency to confidently interpret children's nonlinguistic behavior as communicative may vary as a function of socioeconomic status (SES) of the mothers. It is posited that preoccupation with frequent stressors and inadequate resources to meet family needs results in less frequent or less confident interpretation of subtle, nonlinguistic behavior. Ambiguity of the evidence for comprehension may vary as a function of the word type. For example, the child's reaching for a red ball after the mother tells the child to get the ball is less ambiguous evidence of comprehension of "ball" than it is of either "red" or "get."

The current study examined the summary-level and item-by-item stability of the CDI/I in a sample of mothers with children who have identified disabilities. We examined whether individual differences in item-by-item stability varied as a function of (a) type of word class reported, (b) parental SES, (c) maternal perception of the

adequacy of family resources, and (d) extent to which mothers confidently interpret nonlinguistic child behavior.

Methods

Participants

Seventeen mothers and their children with an identified developmental disorder/delay participated in the study. The children were recruited from one of three early intervention centers for children under 3 years old. The selected children were those whose mothers agreed to come back a second time to take the CDI/I and who said that their children understood at least 5 words in each of the major word classes on the CDI/I (i.e., nouns, verbs, games and routines, and descriptives) on at least one testing occasion.

The children represented a large range of diagnoses. Developmental delay was the largest category represented (8 children) and is defined in our state, Tennessee, by a 60% delay in one domain or a 40% delay in at least two domains. Five children were diagnosed as language delayed, defined in Tennessee as at least a 40% delay in receptive or expressive language. One of these five children had a language delay associated with a repaired cleft palate, and another had an underdeveloped trachea. Because the children were not given a nonverbal intelligence test (only the Bayley was given), we cannot rule out the possibility that some of the children with developmental delay or language delay had specific language impairment or were "late talkers." However, all children passed a sound-field hearing screening that was administered by a pediatric audiologist. The following categories had one child in them: Down syndrome, autism, spastic hemiplegia, and visual impairment. This sample represents the wide variety of diagnoses of children in early intervention programs in Nashville, Tennessee.

The children who participated in the study were, on average, 25 months (*SD* = 4.6 months; range = 18–33 months). Their average mental quotient as determined by the Bayley Infant Scales of Mental Development (Bayley, 1969; The Psychological Corporation, 1993) was 54.6 (*SD* = 13; range = 35 [using extrapolated norms] to 82). Their mental age averaged 15 months (*SD* = 1.9 months, range = 13–20 months). The average number of words the mothers said their children understood was 150 (*SD* = 95 words, range = 28–329). Because the children's chronological ages were all above 16 months, we cannot compute age equivalencies or percentile rankings on the CDI/I. However, it is clear that all children would be considered well below the 10th percentile in vocabulary development for their age.

The parent who participated in the study was the one who reportedly spent the most time with the child. All parent participants happened to be mothers. The mothers had about average occupational status (mean = 34.94; *SD* = 18.91, range = 10–76.71; U.S. mean = 34.5; *SD* = 18 (Stevens & Cho, 1985)). The modal educational level of the mothers was a high school diploma. However, one mother had 3 years of graduate school, three had 4 years of college, six had between 1 and 3 years of college or technical school education, three had been in school 10–11

years, two had 7–9 years of formal education, and one had 1–6 years of formal education. Sixty-four percent (11) of the sample were Caucasian, 29% (5) were African American, and 6 percent (1) was Asian.

Procedure

Overview. The mothers were asked to fill out a CDI/I, a demographic form measuring child date of birth and maternal education and occupational status, and an instrument that measures the extent to which mothers' confidently interpret children's prelinguistic behaviors (General Tendency to Attribute Communication (GTAC), Yoder & Feagans, 1988). The children were given the Bayley Infant Scales of Mental Development (Bayley, 1969; The Psychological Corporation, 1993).

Communication Development Inventory: Infant Scales (CDI/I). The mother filled out the CDI/I (Fenson et al., 1993). This instrument is a vocabulary checklist containing 396 words that research indicates are used and understood by most typically developing 16-month-olds in the United States. Mothers were asked to indicate whether their children "understand only" or "understand and say" (or sign) each word. All 17 mothers filled out the CDI/I twice, 2 weeks apart. The CDI/I was divided into four subcategories that contained more than 20 words to allow examination of stability of reports on different types of words. These subcategories were nouns, action words, games and routines, and descriptive words. The total score includes the primary four subcategories plus pronouns, prepositions and locations, sound effects and animal sounds, question words, words about time, and quantifiers.

Measures of Familial Occupational Status and Maternal Educational Level. We used the following four questions from the International Standard Classification of Occupations (1986) questionnaire to determine the mothers' and fathers' occupations: (a) "Are you presently employed?" (b) "If yes, what is your job title?" (c) "If yes, what are your job duties?" and (d) "If yes, what type of industry do you work in, that is, what does your company produce or what service does your company provide?" Stevens and Cho's (1985) system was used to assign an occupational status score (total socioeconomic index) for each parent. We selected the highest of the two scores to represent the family in the analyses.

The mothers were asked which grades they passed in formal educational settings (e.g., school, college, technical school). The responses were scaled as follows to allow quantitative analysis: (a) 0 grades = 1, (b) 1st–6th grades = 2, (c) 7th–9th grades = 3, (d) 10th–11th grades = 4, (e) high school diploma = 5, (f) 1–3 years college or technical school = 6, (g) graduate from college with a baccalaureate degree = 7, (h) 1–2 years graduate or professional school = 8, and (i) 3 or more years of graduate or professional school = 9.

Family Resource Scale (FRS). The mothers were administered the FRS (Dunst & Leet, 1987) to measure their perception of the adequacy of their family resources. The FRS is a questionnaire in which mothers rate the adequacy of their resources to meet 30 different needs. The

average score was used as the index of the mothers' perception of the adequacy of their family resources. This summary score has been found to correlate with parental well-being, with self-reported commitment to the child's intervention program (Dunst & Leet, 1987), and with parental stress (Crowley, 1995).

General Tendency to Attribute Communication (GTAC). This instrument measures the extent to which mothers confidently attribute communicative value to infant behaviors. Mothers are shown 20 videotaped scenes that depict an infant communicating to an adult using prespeech behaviors that range widely in clarity of communication (Yoder & Feagans, 1988). After viewing each scene, the mother indicated whether she considered the behavior communicative and how confident she is of her judgment. The summary score across all 20 items ranges from 20 to 120. The GTAC summary score has been found to correlate with children's severity of disability, with the types of behaviors mothers consider communicative in their own children, and with the degree to which mothers are responsive to their own babies' behavior (Yoder & Feagans, 1988).

Reliability of Proposed Parent and Child Covariates of CDI/I Stability

Generalizability coefficients (G), not percentage agreement, were used to estimate the reliability of the GTAC and FRS, because this index controls for inflated agreement due to restricted variance in the sample (Cronbach, Gleser, Norda, & Rajaratnam, 1972). Because the FRS and GTAC are maternal questionnaires, and thus do not require the judgment of an independent observer, test-retest stability over a 2-week interval was measured. Percentage agreement can be high due to chance when the range of scores is restricted, because there are fewer possible values than when the range is broad. A G-coefficient is the ratio of variance due to true differences between subjects divided by the total variance in scores. Total variance in the present study is variance between subjects (across coders or testing occasions) plus variance between coders (or testing occasions) across subjects plus variance due to error. Therefore, the G-coefficient conceptually represents the proportion of total variance in the scores that results from true between-subject variability, and not different coders or testing occasions or other sources of "measurement error" (Cronbach et al., 1972). The G-coefficient for the FRS summary score for 10 mothers (59% of the sample) was .81. The G-coefficient for the GTAC summary score for 14 mothers (82% of the sample) was .96.

Results

Summary-Level Stability of the CDI/I

The G-coefficients for the summary-level stability of the total number of words are summarized in Table 1. As expected, the number of words mothers reported that their children comprehended on the total scale and in the primary subcategories of the CDI/I was found to be highly stable.

Item-by-Item Stability of the CDI/I

Cohen's (1960) kappa was used to quantify item-by-item stability for each dyad for each major word class for the total number of words understood. Kappa controls for expected agreement due to chance by estimating the extent to which one would expect chance agreement and subtracting it from observed agreement. For example, one mother reported that her child understood 338/394 words at the first testing and 333/394 words at the second. Because such a high proportion of the words on the checklist were marked on both occasions, one would expect relatively high agreement across occasions by chance. The observed percentage agreement was .87, whereas the expected percentage agreement by chance was .73. The kappa was .51, which represents observed agreement after controlling for chance agreement. Controlling for chance allowed us to examine individual differences in item-by-item stability of mothers who had different amounts of chance agreement due to different total numbers of words marked. The means and standard deviations for the individual kappas for the four subcategories and the total scale of the CDI/I are presented in Table 1.

For research purposes, many researchers consider a kappa of .60 to .75 to be "good" (Fleiss, 1981). However, for the purposes of selecting target vocabulary, a more stringent criterion (e.g., .80–.90) is probably necessary (Salvia & Ysseldyke, 1978). Three categories had mean kappas at or above .60: nouns, action words, and games and routines. The mean kappas for two categories (i.e., descriptive words and total words) fell below .60. No category had a mean kappa above .70.

In the analyses that examined the conditions and dyads that varied with individual differences in item-by-item stability, kappa was computed on each mother-child dyad and for each of the major word categories, as well on total words comprehended. Then individual kappas were used as scores in the appropriate statistical analysis. For example, to examine whether mothers were more stable in reporting comprehension of some types of words over others, paired *t* tests on the kappas from the different categories for each dyad were conducted. Additionally, to find predictors of those mothers who tended to have relatively high item-by-item stability, Pearson Product Moment Correlation analyses were conducted to correlate the maternal/familial characteristic with the kappas from each mother. As this is

TABLE 1. Summary-level G-coefficients and item-by-item kappas means, standard deviations, and ranges by category.

	Total	Nouns	Action Words	Games & Routines	Descriptive Words
Summary-level g-coefficient	.93	.95	.94	.80	.87
Item-by-item Kappas					
Means	.47	.65	.62	.62	.51
SD	.27	.22	.29	.32	.32
Range	-.27–.80	-.03–.89	0–.99	0–1.0	0–.91

a relatively novel use of kappa, it is important to note that all distributions of individual kappas met the assumption of normality.

Covariates of Item-by-Item Stability

Item-by-item stability of reports on the comprehension of nouns was greater than that for total comprehension [$t(16) = -3.15$, $p = .01$] and greater than that for comprehension of descriptive words ($t = 2.20$, $p = .04$). The stability among all other categories was nonsignificantly different.

The results of correlational analyses are in Table 2. As expected, all four maternal/familial variables (occupational status, education level, GTAC, and FRS) were positively correlated to item-by-item stability of reported comprehension of nouns. Occupational status was also correlated with item-by-item stability of reported comprehension of action words and games and routines. These correlation coefficients and corresponding p values are presented in Table 2. All other correlations were nonsignificant.

To examine the possible interrelatedness of the four maternal/familial variables, intercorrelation coefficients among these variables were examined. Occupational status was correlated with mothers' education level ($r = .74$, $p = .001$) and with the GTAC score ($r = .51$, $p = .036$). In addition, education level and GTAC also were correlated ($r = .69$, $p = .003$). It should be noted that our measure of maternal perception of the adequacy of their family resources (FRS) was nonsignificantly related to measures of SES (i.e., occupational status and maternal education level).

Discussion

This study was conducted to examine the summary-level and item-by-item stability of the CDI/I. However, because this study was conducted on a small sample of mothers and children, replication of the results is necessary before generalization to other samples is reasonable.

With this caveat in mind, the present results provide support for the summary-level stability of the CDI/I comprehension scale with a sample of children who are at high risk for language delays. These results extend those of Fenson et al. (1994), who also found quite high summary-level stability of the CDI/I in a sample of mothers with

TABLE 2. Correlations between parental variables with item-by-item stability of reported comprehension by selected word categories.

	Occupational Status	Mothers' Education Level	GTAC	FRS
Nouns	.57	.59	.50	.56
Action Words	.50			
Games & Routines	.55			

Reported correlations significant at the .05 level.

typically developing infants. The current data support the hypothesis that the total number of reported words comprehended is stable. This means that the total number of words comprehended is a score that can be used to compare a particular child with his or her age peers to determine whether a child has a vocabulary delay.

The present study showed that the average item-by-item stability reached an acceptable standard for some research purposes (i.e., .60; Fleiss, 1981) in three out of five word classes (nouns, games and routines, and action words). However, individual clinicians should ask themselves whether .60 stability across testings that are separated by only 2 weeks is sufficient for selecting individual vocabulary targets. Salvia and Ysseldyke (1978) suggest that instruments used for decision-making at the individual level must be higher than that used for groups of children. Their suggestion of .80–.90 for clinical decision-making is widely accepted. In no category did the average item-by-item stability exceed even .70. Therefore, the results of this study suggest that both researchers and clinicians should use caution in interpreting maternal reports of young children's comprehension at the word level.

The low mean item-by-item stability does not mean that the CDI/I will never elicit maternal responses that have sufficient item-by-item stability to aid in the selection of specific words children understand. To the contrary, the findings indicated that mothers' reports tend to be more stable for nouns than for descriptive words and for the total scale. The total scale includes the four primary subcategories (including descriptive words) and prepositions, quantifiers, and temporal terms. It is highly likely that nouns are included in many of the naturally occurring directives and activities in which the mother asks the children to provide labels for various objects (e.g., picture book "reading"). In contrast, it is unlikely that mothers of such developmentally young children have many opportunities to see their children respond to directives that include descriptives (e.g., put that *red* ball over there), prepositions (e.g., put that *in* the box), quantifiers (e.g., get *two* balls), or temporal words (e.g., take a bath *after* we go to the store) without the guidance of maternal gestures (e.g., pointing).

The relationship of the GTAC to item-by-item stability of nouns and to parental SES measures suggests a possible explanation for the relationship between SES and item-by-item stability of the CDI/I. It is possible that mothers who have a lower educational level and occupational status are more preoccupied with other concerns than with noticing the possible communicative meaning in their children's behavior. Because they are less practiced in interpreting nonlinguistic behavior as communicative, these mothers may be less confident in their judgments about the communicative value of nonlinguistic child behavior. This lack of confidence may lead to inconsistent responding to CDI/I items across test occasions. The relationships between (a) occupational status and item-by-item stability of action words and games and routines and (b) perception of the adequacy of family resources and item-by-item stability of nouns may be explained using a similar argument. However, there is less complete empirical support for this

explanation of these latter two relationships.

It is important to remember that stability is not synonymous with accuracy. However, a measure cannot be accurate if it does not evoke stable responses at the level of detail for which the information is to be used (Suen & Ary, 1989). Therefore, we cannot be confident that maternal reports with low item-by-item stability are accurate at an item-by-item level.

So how is the clinician to select individual vocabulary goals? When the client's mother is from a middle or high SES level, especially when dealing with nouns, we recommend using the CDI/I item responses as a means to reduce the number of words the clinician needs to probe. However, probing (i.e., setting up controlled situations in which the child must use lexical, not nonlinguistic, information to respond accurately to directives) is still necessary to identify which words the child understands.

In summary, the CDI/I evokes very stable responses in terms of the total number of words across a brief temporal interval. Information on total number of words is useful for screening children to determine if there is evidence of a vocabulary delay. However, if the clinician wishes to know specifically which words the child understands, the CDI/I is not likely to yield results that are stable, much less accurate, at the word level. This caveat may be particularly applicable to mothers with a low SES and for descriptive words. Information on the CDI/I may be useful as a starting place for further probing the child's comprehension of specific words.

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