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Scores on the MacArthur Communicative Development Inventory of children from low- and middle-income families

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ABSTRACT
This study compared the language skills in a group of very low-income toddlers with those of a middle-income sample matched on age and sex. The assessment instrument was the MacArthur Communicative Development Inventory (CDI) for toddlers, a parent report form. The scores for the low-income group were strikingly lower on the three key indices evaluated: size of expressive vocabulary, age of appearance of word combinations, and complexity of utterances. The entire low-income distribution was shifted about 30% toward the lower end of the middle-income distribution for both productive vocabulary and grammatical development. The magnitude of these income/social class effects was larger than reported in most prior reports for children in this age range. This finding underscores the cautionary note issued by the CDI developers, which states that the published CDI norms, based on a middle-class sample, may not be directly applicable to low-income samples.

A considerable body of evidence indicates that a moderate to strong negative relation exists between language skills and socioeconomic status (SES). The literature is much more complete and more definitive for children over 3 or 4 years of age: children from low-SES families perform at a lower level on both language tasks and a variety of cognitive tasks (Allen, Wasserman, & Seidman, 1990; Greenwood, Carta, Hart, Kamps, Terry, Arreaga-Mayer, Atwater, Walker, Risely, & Delquadri, 1992; Greenwood, Terry, Utley, & Montagna, 1993; Hess & Shipman, 1965; Lawrence & Shipley, 1996; Lesser, Fifer, & Clark, 1965; Morisset, Barnard, Greenberg, Booth, & Spieker, 1990; Snow, Blondis, & Brady, 1988; Walker, Greenwood, Hart, & Carta, 1994; Warren-Leubecker & Carter, 1988). In some instances, the magnitude of the differences between the skills of middle- and low-SES children has been quite large. For example, St.

Pierre, Swartz, Gamse, Murray, Deck, and Nickel (1995) reported that percentile scores on the Peabody Picture Vocabulary Test averaged 9% for a group of 200 4-year-old children upon entry into the Even Start program (St. Pierre & Swartz, 1995). SES level has been found to be of predictive significance in multiple regression analyses where an index of language development is the dependent variable (Diamond & le-Furgy, 1988; Largo, Graf, Kubdu, Hunziker, & Molinari, 1988; Mishra & Mishra, 1992; Wells, 1985).

A restricted range of available instruments and procedures for assessing language skills prior to about 3 years of age has limited the amount of information available on the relation between SES and language skills in younger children. The available studies generally parallel the findings for older children in finding a negative relation between SES and language skills, though most studies provide little indication of the size of the effects. Vohr, Garcia Coll, and Oh (1989) found higher SES to be associated with higher Peabody Picture Vocabulary Test scores at 2 and 3 years of age. Laosa (1984) found that low-SES children scored significantly lower than middle-SES children on the McCarthy Verbal Abilities Scale (McCarthy, 1978) at 2½ years of age. Using the Hollingshead SES index (Hollingshead, 1965), which includes a weighted index of parents' education and vocations, Siegel (1982) reported a significant positive relation between SES level and scores on the Reynell Language Comprehension measure at 3 years of age. A study by Rescorla (1989) is one of the few that provides some indication of the magnitude of SES effects. Across several samples of 24-month-old children, 16 to 23% of low-income, inner city minority children were identified as language delayed, compared with substantially lower percentages in middle-class samples, based on data stemming from a parent-completed vocabulary checklist.

Wells (1981, 1985) reported more qualified support for SES influences on language in his sample of 128 British children between 1 and 5 years of age. He found that SES differences between children on language measures resulted from a clustering of high scores for a subset of four high-SES children and a clustering of very low scores for a subset of five very low-SES children; when these children with extreme scores of either greater or less than two standard deviations from the mean were excluded, no SES effects were present.

Whether based on differential distributions for extreme scores or more pervasive effects, the causes of lower overall scores on language measures for low-SES populations are probably quite varied, ranging from a higher proportion of premature births (Smith, Ulvund, & Lindemann, 1994) to less opportunity for social and verbal interactions between parent and child to bilingualism in the household (Bradley, Caldwell, & Lock, 1988; Garcia Coll, 1990; Hart & Risley, 1992; Laosa, 1984). Some of these factors (e.g., premature birth) would be expected to have an impact on language acquisition from the outset; other factors (e.g., reduced exposure to printed materials) may operate through cumulative effects that manifest themselves much more slowly. Because different factors exercise their effects at different rates, inconsistencies are inevitable in the literature for younger as well as older children. Additionally, many inconsistencies are no doubt attributable to variations in criteria for assigning SES levels, the measures used, and variability in level of the samples being compared.

This study compared the language profiles of very low-income children with those of middle-class children in the 16- to 30-month age range using the MacArthur Communicative Development Inventory (CDI), Word and Sentences (Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994). This form, commonly referred to as the CDI toddler form, is a parent report instrument designed for 16- to 30-month-old children. Normative data permits the computation of percentile scores for each of the major scales (Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick, & Reilly, 1993).

The developers of the CDI reported only a very small negative correlation between vocabulary production and SES for 16- to 30-month-olds. They noted, however, that the general absence of a relation between SES and language development may have reflected the limited SES range of their sample, which was composed mostly of middle-class to upper middle-class respondents, a high proportion of whom were college educated. They cautioned that the norms may not be representative of low-SES groups. This article focuses on the toddler version of the CDI, which assesses expressive vocabulary as well as several major aspects of early grammatical development. In the present study, a sample of children drawn from the CDI normative data was compared with an independent group of toddlers from very low-income families, allowing a more adequate test of the extent to which income level is related to CDI scores than was possible with the CDI normative data.

Because the CDI is a parent-completed instrument, it makes feasible the collection of data on a large number of children, a desirable feature for studies investigating the influence of a variable as complex as SES. The availability of normative data including percentile scores for the CDI also increases its utility in studying the possible effects of SES. This information permits an appraisal of the entire distribution of scores for a population and of measures of central tendencies such as mean and median scores. Consequently, it becomes possible to test the generality of Well's finding (1981, 1985) that SES differences in language skills are principally due to a higher proportion of middle-income children at the upper end of the distribution and a higher proportion of lower income children at the lower end, rather than resulting from a more pervasive downward shift of the entire low-income distribution.

METHOD

Subjects

A total of 103 younger siblings (59 males, 44 females) of Head Start children composed the low-income sample. These children were participants in a literacy intervention project (Cronan, Walen, & Cruz, 1994). In order to compare the low-income sample with the CDI middle-income norms, three independent samples were drawn from the normative study ($N = 1,130$) of the CDI (Fenson et al., 1993). Three samples were assembled because we were not certain how representative a given sample of 103 children would be. Previous analyses of the CDI normative sample had revealed extensive variability in these measures (Fenson et al., 1994). Each of the three middle-class samples was constructed

Table 1. *Annual salaries for the low-income families*

Income ($)	Sample (%)
Less than 10,000	35.42
10,001 to 15,000	50.23
15,001 to 20,000	11.34
20,001 to 25,000	3.01

Table 2. *Demographic profiles of the low- and middle-income samples*

	U.S. 1990 census (%)	Middle-income sample (%)	Low-income sample (%)
Ethnicity			
Asian	2.8	3.2	4.1
Black	11.8	2.6	25.7
Mexican American/Latin	9.0	4.5	43.2
White	75.6	87.1	24.3
All others	0.8	2.6	2.7
Parent education			
Some high school or less	23.2	4.5	36.5
High school diploma	42.0	17.9	37.7
Some college education	16.9	24.3	21.7
College diploma	17.9	53.3	4.1

in the following manner: (a) for each low-income child, all of the children in the normative sample of the same age and sex were identified; (b) three children were randomly drawn from this pool, one for each of the three middle-class samples. The normative data were collected in three different cities (New Haven, Seattle, and San Diego) using university subject pools at each location (see Fenson et al., 1993). Each of the four samples contained 44 females and 59 males, with a mean age of 23.49 months ($SD = 4.23$).

Table 1 shows the income levels of the Head Start families. The mean income of these families was about $13,000. Just over 85% of these families reported annual incomes of $15,000 or less. Table 2 presents other pertinent demographic measures for the U.S. population, the middle-income sample drawn from the normative sample originally reported in the CDI technical manual (Fenson et al., 1993), and the low-income sample.

The low- and middle-income samples also differed sharply in ethnic composition, education, and linguistic environment. The middle-income sample was composed mostly of white parents, while the low-income sample was principally nonwhite. The low-income sample had less formal schooling than the general U.S. population, whereas the CDI sample had more schooling; more than 36% of the low-income parents had not received their high school diploma. A higher proportion of the low-income sample (28.4%) was exposed to a second language, relative to the middle-class sample (14.0%).

Measures

The three CDI toddler form measures offering the broadest sampling of young children's language skills were examined. Each child's expressive vocabulary was assessed by means of the 680-item productive vocabulary checklist. A second measure was based on the parent's response to a question about how frequently the child combined words, the options being "not yet," "sometimes," and "often." The CDI sentence complexity scale served as our index of the children's grammatical skills. This scale offers a broader sampling of grammatical abilities than the other CDI measures and also yields percentile scores. The scale employs a forced-choice recognition format in which parents are asked to choose a member from each of 37 pairs of sentences which best exemplifies the child's present language. The second item of a given pair is the more sophisticated form of a specified utterance. The child's score for this scale is obtained by summing the number of pairs in which the parent selects the more complex response; thus, the scores can range from 0 to 37. Scores on both the vocabulary production and sentence complexity scales were converted to percentiles, using the normative tables furnished in the CDI technical manual (Fenson et al., 1993).

Procedure

The CDIs on the low-income sample were collected within the context of a literacy intervention project. The forms were completed at the outset of the study, prior to intervention. Details of this study are described elsewhere (Cronan et al., 1994). The CDI was given to the family on the first of two visits. At that time, the instructions for completing the CDI were read to the parent. The instructions urged parents to mark only those items they had heard the child utter spontaneously (versus prompting the child to say a given word). The CDI was picked up on the second assessment visit, a day or two later. These visits preceded the initiation of intervention activities.

RESULTS

The three middle-income samples presented quite similar profiles for each of the three CDI measures. Thus, to maximize stability and representativeness, the three samples were combined for the statistical comparisons with the low-income sample.

Expressive vocabulary

Table 3 presents the expressive vocabulary raw scores for the low- and middle-income children. The raw score for each child was converted to percentiles, based on the normative tables in the CDI technical manual (Fenson et al., 1993). These scores are shown in Table 4. A two-way ANOVA of the percentile scores confirmed that the mean percentile score for the low-income group (29.74) was significantly lower than the mean for the aggregate CDI normative sample (50.04), $F(1, 404) = 44.36$, $p < .001$. There was no main effect for sex, $F(1, 404)$

Table 3. *Vocabulary raw scores for the low- and middle-income samples*

	N	Mean	*SD*	Median	Range
Low income					
Girls	44	212.50	172.89	183	3–671
Boys	59	210.07	176.21	175	1–679
Combined	103	211.11	173.95	182	1–679
Middle income					
Girls	132	359.31	200.03	399	6–667
Boys	177	276.37	191.86	255	6–662
Combined	309	311.80	199.35	314	6–667

Table 4. *Vocabulary percentile scores for the low- and middle-income samples*

	N	Mean	*SD*	Median	Range
Low income					
Girls	44	22.82	20.67	15	5–99
Boys	59	34.90	28.71	30	5–99
Combined	103	29.74	26.17	25	5–99
Middle income					
Girls	132	50.83	27.90	55	5–99
Boys	177	49.45	26.51	50	5–99
Combined	309	50.04	27.08	50	5–99

= .38, n.s. An interaction was found between income level and sex, $F(1, 404) = 4.97$, $p < .05$. A follow-up one-way ANOVA indicated that scores for middle-class males ($M = 49.45$) and females ($M = 50.83$) were equivalent $F(1, 307) = 1.96$, n.s.; however, in the low-income sample, the mean for females (22.82) was significantly lower than the mean for males (34.90), $F(1, 102) = 5.61$, $p < .05$.

Figure 1 contrasts the distributions of vocabulary scores for the low- and middle-income samples. A total of 82.5% of the low-income group received vocabulary scores that fell below the median score for middle-class children (based on CDI norms). This contrasts with 51.1% of the middle-income sample.

Table 5 permits a finer grained appraisal of these two distributions. The table shows the percentage of children in each group who fell below the middle-class normative values for the 10th, 20th, 50th, 75th, and 90th percentile scores, as reported in the CDI manual (Fenson et al., 1993). A total of 55.3% of the low-income sample fell below the 25th CDI percentile mark. Similarly, 35.9% of the low-income sample fell below the 10th CDI percentile level, compared with only 11.7% of the middle-income sample.

In contrast to Well's (1985) findings, the low mean and median scores for the low-income group were not simply a function of a disproportionate number

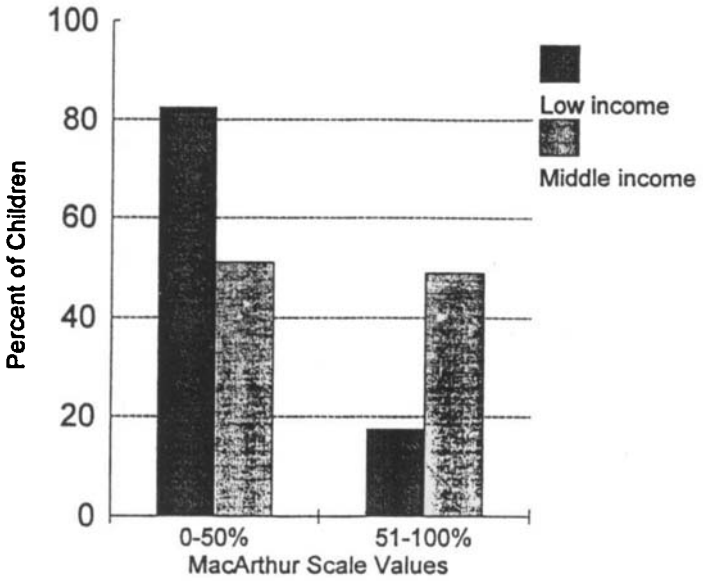

Figure 1. Distribution of scores on the CDI expressive vocabulary scale, relative to the MacArthur norms.

Table 5. *Comparison of the distribution of the low- and middle-income vocabulary scores to the MacArthur norms*

		Percentile scores				
	N	10th	25th	50th	75th	90th
Low income						
Girls	44	40.90	65.90	93.20	98.08	99.23
Boys	59	32.20	47.50	74.60	88.67	94.90
Combined	103	35.90	55.30	82.50	92.75	96.10
Middle income						
Girls	132	12.90	24.20	49.20	81.10	93.90
Boys	177	10.70	24.90	52.50	83.60	94.90
Combined	309	11.70	24.60	51.10	82.50	94.50

of very low scores for that group and a disproportionate number of very high scores for the middle-income children. Rather, the effect was quite pervasive among these children; the entire low-income distribution had shifted in the negative direction by about 25%. Despite this fact, the range of scores for the low-income sample encompassed the entire middle-class distribution. The contrast between the middle- and low-income groups was even larger for females than for males: for example, 93.2% of the low-income females scored at or below the median, while 74.6% of males were at this mark.

Table 6. *Percentage of children in the low- and middle-income samples reported to be combining words* (Ns *in parentheses*)

Month	Low income (%)	Middle income (%)
16	0 (4)	25 (12)
17	33 (6)	50 (18)
18	0 (5)	40 (15)
19	29 (7)	75 (20)
20	71 (7)	81 (21)
21	33 (9)	85 (27)
22	57 (7)	81 (21)
23	86 (7)	86 (21)
24	80 (5)	93 (15)
25	89 (9)	96 (26)
26	100 (4)	92 (12)
27	70 (10)	100 (30)
28	100 (8)	100 (24)
29	100 (6)	100 (18)
30	100 (9)	100 (26)

Combining words

Table 6 shows the percentage of children reported to be combining words. Children were classified as combining if the parent checked either the "sometimes" or "often" category. The wider month-to-month fluctuations in the low-income sample were probably due to the smaller *N*s. For the low-income sample, combining words increased irregularly, from a mean of 0% at 16 months to nearly 100% by 26 to 28 months. The pattern appeared to accelerate in the middle-income sample by 4 or 5 months.

Sentence complexity

Table 7 shows the sentence complexity raw score data for all the low- and middle-income children who were 22 months of age or older. The sentence complexity scores for the younger children were excluded because many of them (particularly in the low-income sample) were not yet combining words; this applied to 68% of the low-income sample and 36% of the aggregate middle-income sample in the 16- to 21-month range. The inclusion of the younger children would, therefore, have distorted the data.

Table 8 shows the sentence complexity scores after conversion to percentile values. A two-way ANOVA was performed on the percentile scores, with income level and sex as the factors. The analysis yielded a significant main effect of income level, $F(1, 256) = 35.34$, $p < .001$. The main effect was qualified by an interaction between sex and income level, $F(1, 256) = 16.91$, $p < .001$. An analysis of the interaction showed that the gender effect was limited to the low-income group; in this group, the mean percentile score for boys (42.71) was

Table 7. *Sentence complexity raw scores for the 22- to 30-month-old children in the low- and middle-income samples*

	N	Mean	*SD*	Median	Range
Low income					
Girls	30	5.43	6.94	2	0–27
Boys	35	9.49	10.03	4	0–36
Combined	65	7.62	8.91	4	0–36
Middle income					
Girls	90	18.92	11.73	19	0–37
Boys	105	12.66	11.99	9	0–37
Combined	195	15.55	12.24	14	0–37

Table 8. *Sentence complexity percentile scores for the 22- to 30-month-old children in the low- and middle-income samples*

	N	Mean	*SD*	Median	Range
Low income					
Girls	30	17.67	15.52	15	0–60
Boys	35	42.71	27.21	35	5–95
Combined	65	31.15	25.71	25	0–95
Middle income					
Girls	90	54.36	27.47	55	5–99
Boys	105	49.40	25.16	50	5–99
Combined	195	51.69	26.30	50	5–99

significantly higher than that for girls (17.67), $F(1, 63) = 19.86$, $p < .001$. In the middle-income sample, the mean percentile scores for girls (54.36) and for boys (49.40) were equivalent, $F(1, 193) = 1.73$, n.s.

Figure 2 illustrates the differences between the distributions of the sentence complexity percentile scores of the low- and middle-income samples, relative to the norms reported in the CDI manual. The shift of the low-SES distribution toward the lower end of the normative sample is slightly less for vocabulary (as shown in Figure 1), but it is still substantial.

More detail on the distributions of the low- and middle-income scores for the grammatical measure is provided in Table 9. For the sexes combined, 78.5% of the children in the low-income sample fell below the 50th percentile mark (based on the CDI normative sample), compared with 82.5% of the low-income sample who fell below the 50th percentile for vocabulary.

DISCUSSION

This study compared the language skills of a group of very low-income 16- to 30-month-old children with those of three middle- to upper middle-class samples matched on age and sex. The children's language skills were assessed with

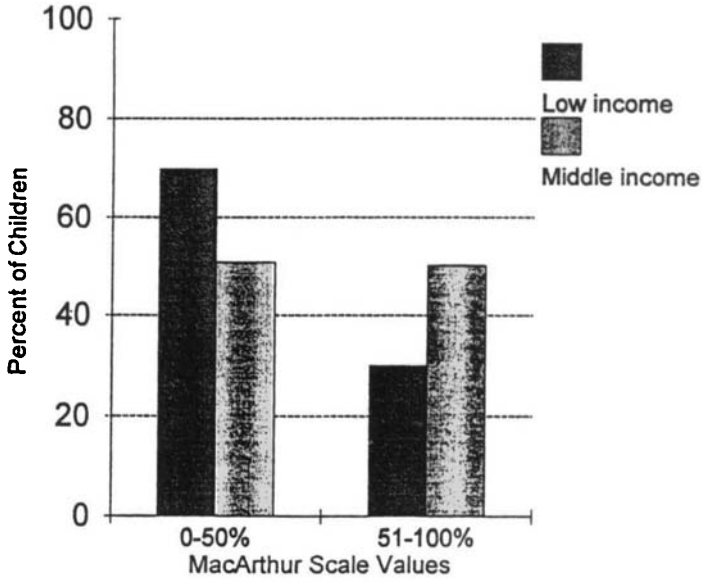

Figure 2. Distribution of scores on the CDI sentence complexity scale, relative to the MacArthur norms.

Table 9. *Comparison of the distribution of the low- and middle-income sentence complexity scores to the MacArthur norms*

		Percentile scores				
	N	10th	25th	50th	75th	90th
Low income						
Girls	30	43.30	60.00	83.30	100.00	100.00
Boys	35	8.60	37.10	65.70	85.70	94.30
Combined	65	24.60	58.50	78.50	92.30	96.90
Middle income						
Girls	90	6.70	23.30	46.70	77.80	90.00
Boys	105	9.50	25.70	53.30	84.80	96.20
Combined	195	8.20	24.60	50.30	81.50	93.30

the MacArthur CDI toddler form, a parent-report instrument (Fenson et al., 1993). The middle-class samples were drawn from the CDI normative study. The developers of the CDI reported a very small negative correlation between vocabulary production and SES for 16- to 30-month-olds on the MacArthur CDI toddler form. They noted that their ability to test for social class effects was limited by the restricted range of their sample and cited the need for more definitive studies on SES using the MacArthur scales.

Our results indicated that, as a group, the low-income toddlers scored strikingly lower than the middle-class normative sample on the three major features of language ability we assessed: vocabulary production, combining words, and sentence complexity. These effects are among the largest that have been reported in the literature in children under 3 years of age. The difference between the low- and middle-income samples was not restricted to an overrepresentation of middle-income children at the upper end of the distribution and an overrepresentation of low-income children at the lower end (i.e., the pattern reported by Wells, 1985). Rather, the entire low-income distribution was shifted toward the lower end, even though scores for this group spanned the entire range from 5 to 99% for each sample. These findings underscore the CDI authors' caution that the published CDI norms may not be directly applicable to children from low-education/low-income families.

What factors account for the notably lower scores of the low-income children, relative to their middle-class counterparts? One possibility is that the low-income children are developing linguistically (and possibly cognitively) at a slower rate, perhaps due to a lower level of adult verbal input and interaction and/or other opportunities to develop language skills. Support does exist in the literature for an environmental deficiency hypothesis. Researchers have found that low-SES parents differ from middle-SES parents in the quality and/or quantity of verbal input and interaction with their young children (Barnes, Gutfreund, Satterly, & Wells, 1983; Snow, Arlman-Rupp, Hassing, Jobse, Joosten, & Vorster, 1976). The lower level of interaction has often been suggested as the source of SES effects on language acquisition (Bradley et al., 1988; Clarke-Stewart, 1973; Gottfried, 1984; Greenwood et al., 1992; Hart & Risley, 1992; Walker et al., 1994).

If the rate of language development is strongly influenced by sociocultural factors, the effects of SES would be expected to increase with age, at least during periods when language development is most rapid; that is, environmental influences should be progressive and cumulative (Klineberg, 1963). SES effects on language and cognition are generally more apparent after ages 3 or 4 than earlier in development. Morisset et al. (1990) offered two explanations that could account for this often-reported age-related increase in SES effects. One is based on the assumption that development is highly canalized during stages of rapid growth such as infancy; under such constraints, children might be biologically buffered from all but extreme deviations in environmental input (McCall, 1981; Rutter, 1985; see also Bertenthal, 1991). Another possibility is that tests such as the Bayley may not be sufficiently sensitive at ages 2 or 3 to adequately tap individual differences in cognitive and linguistic growth.

Our findings with the CDI indicate that a middle-income advantage was present for each of the three scales well before 3 years of age. The early presence of these effects calls into question the canalization hypothesis and is more consistent with the position that the insensitivity of the measuring instruments may have obscured SES effects in very young children in some studies. To attribute these differences to environmental deficiency, one must be willing to assume that sociocultural effects begin quite early in development – earlier than the age at which most studies have first noted SES effects on language skills.

The parent-report format on which the present study was based requires the consideration of parental misjudgment hypothesis for explaining why the average scores of the low-income children in the present study were so much lower than those of middle-income children. A child's score on the CDI is a product of the parent's ability to appraise the child's language and the child's language skills per se. The misjudgment hypothesis could take either of two forms. One possibility is that lower income parents might underestimate their children's verbal abilities, perhaps because they are less verbally interactive with them (Garcia Coll, 1990). If this is the case, the strikingly lower scores for the low-income group may be, partly or largely, a product of the parents' underappraisals rather than lower abilities of the children. Another possibility is that the social desirability of advanced language might lead middle-SES parents to overestimate their children's linguistic abilities.

A limited amount of data is available on the relation between parent appraisal and experimental measures of children's language skills. Judging from these studies, neither low- nor middle-SES parents seem prone to underestimating or overestimating their children's performance. Arriaga, Hicks, Cronan, and Fenson (1992) reported that lower SES parents tend to underestimate the verbal comprehension of children with low expressive vocabularies, but Fenson, Sweet, and Jimerson (1996) found exactly the same pattern with middle-class parents. Cross (1977) reported that middle-class parents were more attuned to what children say than to what they understand and were as likely to underestimate as to overestimate language comprehension. Gullo (1988) found no differences in the ability of low- and middle-SES mothers of 1-year-olds to predict the time of emergence of second-year developmental milestones (including linguistic skills); moreover, under- and overestimation were equally likely in both groups.

In the present study, boys from low-income families scored higher than girls from low-income families on both the vocabulary and sentence complexity measures. No sex differences occurred in the middle-income groups. Reznick (1990) reported a related pattern for word comprehension based on a vocabulary checklist completed by parents: that is, a negative correlation between comprehension scores and SES for boys, but not for girls. He speculated that many low-SES parents may have higher expectations or aspirations for their sons than for their daughters, and that those views (or hopes) may be reflected in their estimates or comprehension.

The environmental deficiency and parental misjudgment hypotheses are not mutually exclusive. Differentiating between these two sources of influence in middle- and low-SES children would require a comparison of parent-report measures with child language indices that were independent of parents' judgments. Based on the evidence to date, however, the present findings suggest that the many negative factors associated with poverty begin to create impediments to communicative development well before 2 years of age, but that our measuring devices often fail to detect these differences until some later time.

The implications of the present findings for the use of the CDI norms with low-SES children are largely dependent upon the source of the differences. If the lower scores of the low-income children in the present study are principally

a function of differences in the reporting style and/or the accuracy of the parents, resulting in a systematic tendency to underestimate their children's language skills, then the use of the CDI norms with this population is not appropriate. If, on the other hand, low-SES children as a group acquire language skills more slowly than middle-SES children, then the CDI norms may have some relevance. Clearly, if the CDI normative sample had been more demographically balanced, lower raw scores would be associated with any given percentile score (i.e., the low-SES children would score higher than in the present tables). That is the conventional manner in which normative tables are constructed and used. However, the present middle-class based norms may have some use for low-SES samples, in that they permit the assessment of language status of a child from a low-income or low-education family, compared with that of children from middle-class families. Given that, by school-age (if not earlier), middle-class developmental-academic standards are those to which all children are expected to measure up, a low-SES child's standing with respect to those standards may provide a measure of how far the child is from the level of performance to which he or she will ultimately be expected to conform. That is, regardless of the source of the gap (if it is, indeed, real), the low-SES child's standing relative to middle-class norms conveys information of significance.

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