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Home Environment and Cognitive Development in the First 3 Years of Life: A Collaborative Study Involving Six Sites and Three Ethnic Groups in North America

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Attempted to examine the generalizability of environment/development relationships among 3 ethnic groups across the first 3 years of life. Social status did not show a consistent relationship to either quality of home environment or children's developmental status across the various groups. Results indicated a fairly consistent relationship between HOME scores and children's developmental status, although there were some ethnic and social status differences in the relationship. Measures of specific aspects of the child's home environment, such as parental responsivity and availability of stimulating play materials, were more strongly related to child developmental status than global measures of environmental quality such as SES. When the child's early developmental status *and* early home environment were both very low, the likelihood of poor developmental outcomes was markedly increased compared with cases when only one was low.

Longitudinal designs are particularly useful ways of studying development because they make it possible to examine changes in human characteristics across time and to relate those changes to various biological and environmental conditions. Clearly, longitudinal studies have been valuable in helping to understand the nature of early environmental action, addressing such issues as the cumulating effects of impoverished or enriched environments, the relative importance of earlier and later environmental settings, and the significance of particular types of stimulation and support. Nonetheless, there remains considerable uncertainty regarding the generalizability of findings from such research (Bradley & Tedesco, 1982; Parke, 1978; Wachs & Gruen, 1982). Most studies have involved relatively homogeneous subject groups, and those where samples were more heterogeneous frequently have had samples that were too small to allow separate analyses of subsamples. The applicability of findings across cultural groups, geographic regions, family types, and handicapping conditions is questionable (Bronfenbrenner & Crouter, 1983; Laosa, 1987; Walberg & Marjoribanks, 1976). Moreover, there has been little consistency in the use of specific measures to represent variables (i.e., so called "marker" variables) across studies, and, even when the same measure has been used, the timing of measurements has often varied. The lack of comparability in measurement methodologies presents one especially serious problem: How to interpret seemingly divergent findings whenever they emerge. Are discrepant findings most parsimoniously interpreted as representing a unique yet reliable relationship (e.g., specificity of environmental action, to use Wachs & Gruen's, 1982, terminology)? Alternatively, are they better interpreted as mere artifacts of differing methodologies or inconsequential (i.e., unreliable) exceptions to a more general developmental pattern? As Bell and Hertz (1976) argued a decade ago, effective integration of information on children's development requires that we give more emphasis to collecting data on certain critical "marker" variables in many of our research studies.

In sum, because of the expense of conducting longitudinal studies, the total number of such studies directed as clarifying the relationship between the family environment and cognitive development is small. Those that exist tend to have restricted samples, and there is little evidence of comparability in the measurement procedures used across studies. Given these limitations, neither standard reviews of the literature nor more recently developed techniques, such as meta-analysis (Glass, 1978), have identified very many broadly generalizable findings (see Kagan, 1984, for instance).

In situations where there are common "marker" variables across studies, there is an approach to dealing with limitations of individual longitudinal studies that may be feasible as well

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as beneficial: combining data from several investigations into a single, larger data pool for purposes of analysis. Combined samples will be larger and probably more diverse (i.e., more representative of the total population and less subject to the idiosyncrasies of a particular locale). They may also contain enough "extreme" scores to permit investigation of them as a separate group—to test the generalizability of findings.

This report describes a collaborative investigation involving 11 researchers from six sites in North America. At each site, a group of investigators had conducted a longitudinal study of the relationship between children's early environments and their behavioral development in the first few years of life. It so happened that, even though studies at each of the six sites were done independently, many of the same measures were used. Most important, a common observational measure of the home environment was used as well as common measures of early developmental status. Although data collection protocols were not identical across all six sites, there was substantial commonality (e.g., all research groups consulted with the authors of the HOME inventory before using it in their respective studies), enough so that some of the data could be combined into a larger study of early environmental action. The commonalities of measurement and research strategies used by the independent investigators at each site provided an opportunity for examining environment–development relationships in a manner that went beyond what each could accomplish separately.

The general aim of the collaborative study was to delineate a heuristic model of the relationship between specific aspects of the home environment and cognitive development during early childhood and to make several key comparisons among subgroups from the general population in hopes of clarifying the generalizability of specific relationships. More specifically, the following questions were examined with respect to the relationship between early environment and cognitive development in the first 3 years of life:

1. What is the general pattern of relationships between aspects of the home environment and children's cognitive scores?

Over 20 years ago, Bloom (1964) and his students at the University of Chicago collected both detailed process measures of the home environment and cognitive development data from a representative sample of children, diverse in ethnicity, in the intermediate grades of school, using census tract information as a guide to sampling. None who have studied infants using detailed process environmental measures have collected data from a sample as diverse and representative. Thus, what is concluded about the general pattern of relations between environment and development during infancy and early childhood has been inferred from a compilation of much more restricted samples.

2. Are there ethnic differences in the pattern of relations between home environment and cognitive development?

Wachs and Gruen (1982) have suggested that there is "organismic specificity" in the relationship between environment and development as a function of ethnic differences. Few longitudinal studies have included sufficient numbers of children from different ethnic groups in order to examine the question of this type of organismic specificity. Among the studies that are available, however, most do show some evidence of ethnic difference in patterns of correlations between home environment and cognitive performance (Bradley & Caldwell, 1980; Clarke-Stewart, 1973; Henderson, Bergan, & Hurt, 1972).

3. Are there social status differences in the pattern of relations between home environment and cognitive development in infancy?

There are also few studies that have examined differences in patterns of correlations between environment and development across social class groups. Again, however, there is some evidence for such differences (Moore, 1968; Ramey, Mills, Campbell, & O'Brien, 1975; Tulkin & Covitz, 1975). The ecological theory of Bronfenbrenner and Crouter (1983) suggests that social class differences in the pattern of relationships between microenvironmental factors and children's developmental scores are likely to exist, but it does not stipulate the exact nature of those differences or the mechanisms through which they are realized.

4. Are there gender differences in the pattern of relationships between home environment and cognitive development in infancy?

Perhaps the most often studied organismic difference between home environment and cognitive development is gender. In their review of these studies, Wachs and Gruen (1982) found evidence for gender differences. There was little consistency in the pattern of findings, however, males being more sensitive to environmental inputs in some studies and females more sensitive in others. Synthesizing findings with respect to gender differences was especially difficult because of marked variations in measures used across studies and the fact that the available literature spanned nearly 40 years. The issue of generalizability is directly addressed by comparisons among the several groups included as participants.

The combined data set available to this consortium of investigators is not "ideal" for addressing these questions. Almost all Mexican–Americans in the sample are from a single site and nearly all are from lower-class and working-class backgrounds. The majority of Blacks are from one site (although smaller numbers of Blacks were obtained from two other sites), and only a small number were middle class. Thus, there is some natural confounding of ethnicity with site, especially with regard to the Mexican–American sample. There is also limited representation of middle class except for Whites—albeit there is variability in social status in all ethnic groups. Despite these clear limitations, it appears that the combined data set offers some distinct advantages in addressing questions about environment–development relationships that none of the independent samples afforded. Most important, the total group is more nearly representative of the North American population than any of its constituent subgroups, or, for that matter, the samples used in most other longitudinal studies. Second, the sample is large enough to assume reasonable stability in estimates from statistical procedures. Third, for the White group especially, and for the Black group to a lesser degree, there is no confounding between ethnicity and locale. Fourth, there is opportunity to examine extreme cases to check for generalizability of patterns in environment–development relationships.

In addition to the primary issues dealt with in the study, there are three secondary issues addressed: (a) how specific aspects of the home environment (i.e., those objects, persons, events, etc. that most directly have an impact on the individual) and social status factors (i.e., those aspects of the total ecology more distant or less directly involved with the individual) are related to mental development; (b) the relative importance of early developmental status and early environmental conditions when scores are in extreme ranges; and (c) the primary direction of effect between environmental and developmental variables in the first 3 years of life. Each of these efforts in its own way provides information on the continuity of development during infancy.

Method

Sample

A total of 931 children and their families participated in the study. These participants came from six project sites in North America: Seattle, Washington (n = 193), Hamilton, Ontario (n = 121), Chapel Hill, North Carolina (n = 84), Houston, Texas (n = 255), Fullerton, California (n = 130), and Little Rock, Arkansas (n = 148). The sample was pooled from six longitudinal studies begun in the 1970s (Barnard, Bee, & Hammond, 1984; Bradley & Caldwell, 1984; Caldwell, Elardo, & Elardo, 1972; Gottfried & Gottfried, 1984; Johnson, Breckenridge, & McGowan, 1984; Ramey, McPhee, & Yeates, 1982; Siegel, 1984). Children who had participated in an intervention experience or who had a diagnosed disorder (e.g., Down syndrome, cerebral palsy) were excluded from the combined sample. Characteristics of the total sample are presented in Table 1 (where numbers do not sum to 931, there was insufficient information to establish designations for a participant).

Socioeconomic Status (SES)

The Hollingshead four-factor index was used as a basis for computing SES for participating families. It was selected because of evidence showing its usefulness as an indicator of social status (Gottfried, 1985). Because data were missing on some fathers, and because education and occupation data were recorded differently at the six project sites, exact comparability across all participants could not be achieved. However, discussions among project sites made feasible a near common metric to compute the Hollingshead index on each participant. More specifically, because occupational data were recorded differently from site to site, it was necessary to arrive at a procedure whereby each case could be converted to Hollingshead categories. Because precision and equivalence of measurement was not possible in all cases, it was decided that participants should be placed into one of three broad SES categories for purposes of comparing SES groups: lower class (a Hollingshead score less than 20.0), lower middle class (a score of 20.0 to 39.9), and middle class (a score of 40.0 and above). These three broad classes yielded 197 participants in the lower-class (23%), 378 participants in the working-class to lower-middle-class (45%), and 269 in the middle-class (32%) categories. Insufficient information was available to classify 86 cases.

Measures

Demographic data. Eight types of basic demographic data were available on most participants. These included the following: sex of child (n = 931), race of child (n = 931), mother's age (n = 931), mother's education (n = 916), mother's occupation (n = 786), father's education (n = 731), father's occupation (n = 762), and SES (n = 844).

HOME Inventory. The Home Observation for Measurement of the Environment Inventory (HOME; Caldwell & Bradley, 1984) was administered to each participating family. The HOME Inventory is designed to assess the quality of stimulation and support available to a child in the home environment. Information needed to score the Inventory is obtained through observation and interview done in the home with the child and the child's primary caregiver. For purposes of this investigation, both the Infant and Preschool versions of the Inventory were used. The Infant version contains 45 binary-choice items clustered into six subscales: (a) parental responsivity, (b) acceptance of child (previously entitled "avoidance of restriction and punishment"), (c) organization of the environment, (d) play materials, (e) parental involvement, and (f) variety of stimulation. The Preschool version contains 55 items clustered into eight subscales: (a) toys and learning materials, (b) language stimulation, (c) physical environment, (d) pride and affection, (e) stimulation of academic behavior, (f) encouragement of maturity, (g) variety of stimulation, and (h) punishment. Information concerning the reliability and validity of HOME can be found in Caldwell and Bradley (1984) and Elardo and Bradley (1981). For purposes of this study, the Infant version was given at 1 year (12–15 months) and 2 years (24–30 months). The Preschool version was given at 3 years (36–42 months). HOMEs at age 1 were available on 865 families (M = 32.7, SD = 7.1), at age 2 on 507 families (M = 34.2, SD = 7.0), and at age 3 on 559 families (M = 41.9, SD = 7.8). HOMEs at age 2 were unavailable for the samples from Fullerton and Hamilton. Because the Infant version, rather than the Preschool version, of HOME was used for the Houston sample at age 3, 3-year HOME data for participants from all sites were converted to z scores (calculated from data on the total sample). Furthermore, only two subscales from each version (play materials and parental responsivity from the Infant version and toys and materials and pride and affection from the Preschool version) were used in analyses involving 3-year scores. For purposes of these analyses the z score on play materials was considered equivalent to the z score on toys and materials; the z score on parental responsivity was considered equivalent to the z score on pride and affection. The z scores on these two pairs of subscales were considered equivalent for two reasons: (a) a high degree of item overlap (i.e., about half of the items were exact duplicates, and many of the others were similar in content except for the need to recognize developmental changes in capability) and (b) correlations between play materials and learning materials (.58) and between parental responsivity and pride and affection (.44) that were similar to the 1-year stability estimates for play materials (.55) and parental responsivity (.45). See Table 1 for more complete information concerning data available to the collaborative study.

Bayley Scales. The Bayley Scales of Infant Development were administered to participating infants at all six sites at 1 (12–15 months) and 2 (24–30 months) years of age. The Mental Development Index (MDI) from the Bayley was available on 810 children at age 1 (M = 107.7, SD = 15.4; M Whites = 110.9, SD = 13.8; M Blacks = 102.8, SD = 18.3; M Mexican-Americans = 103.7, SD = 13.7) and 652 children at age 2 (M = 102.5, SD = 21.4; M Whites = 110.3, SD = 20.2; M Blacks = 88.4, SD = 16.11; M Mexican-Americans = 89.7, SD = 13.8).

Stanford-Binet IQ. The Stanford-Binet Intelligence Test was given to 628 children from five sites between 36 and 42 months (M = 102.0, SD = 18.4; M Whites = 108.4, SD = 16.6; M Blacks = 90.0, SD = 15.4; M Mexican-Americans = 91.8, SD = 14.9). The McCarthy Scales were used at one of the participating sites. The General Cognitive Index from the McCarthy was treated as equivalent to the Binet IQ.

Quality Control Procedures for Project Measures

Two major issues that were considered when combining data across project sites for the purposes of analysis were the care and comparability with which measures were taken in the six sites. Because each project was conducted as an independent investigation, there was no a priori

Table 1
Demographic Characteristics of Participants by Site

Characteristics	Seattle Washington	Hamilton Ontario, Canada	Chapel Hill North Carolina	Houston Texas	Fullerton California	Little Rock Arkansas	Total sample
Sex							
Male	97	64	36	126	70	77	470
Female	96	57	48	129	60	71	461
Ethnic group							
White	169	121	49	0	117	41	497
Black	19	0	35	0	0	107	161
Mexican-American	0	0	0	255	7	0	262
Other	5	0	0	0	6	0	11
Maternal age (years)[a]							
14–19	23	6	40	22	3	21	115
20–24	66	39	23	90	20	60	298
25–29	77	56	10	57	50	42	292
30–34	24	16	9	45	44	20	158
35–39	1	4	1	29	12	3	50
40–45	2	0	1	10	0	2	15
Maternal education[b]							
Below high school	20	52	50	216	3	61	402
High-school graduate	53	43	23	30	39	57	245
Some college or trade	49	0	11	0	49	21	130
College graduate	55	18	0	0	23	5	101
Post graduate	14	4	0	0	16	4	38
Socioeconomic status[c]							
Lower class	13	11	33	104	0	36	197
Working class	56	72	49	113	28	60	378
Middle class	123	38	2	0	87	19	269
Home inventory[d]							
12 mo.							
M	36.5	35.3	27.9	28.5	36.4	30.7	32.5
SD	5.7	5.4	6.1	6.8	3.7	7.5	7.1
24 mo.							
M	39.8	—	30.5	32.0	—	31.6	33.8
SD	3.9	—	6.2	6.2	—	7.8	7.1
36 mo.							
M	44.3	44.7	37.4	—	42.8	35.8	41.4
SD	6.7	5.0	6.5	—	5.9	10.4	8.2
Bayley MDI[e]							
12 mo.							
M	117.1	105.0	107.2	103.2	113.6	98.4	107.7
SD	10.7	13.2	15.2	13.8	10.9	19.6	15.4
24 mo.							
M	116.8	104.6	84.8	89.1	115.2	89.1	102.5
SD	18.2	16.6	8.8	13.2	20.4	18.0	21.4
Stanford-Binet[f]							
36 mo.							
M	114.0	102.0	84.1	90.8	108.0	96.5	102.0
SD	16.8	14.5	13.4	14.9	13.0	18.5	18.4

Note. MDI = Mental Development Index.
[a] $N = 928$. [b] $N = 916$. [c] $N = 844$. [d] $N = 865$ (12 mo.); $N = 507$ (24 mo.); $N = 559$ (36 mo.). [e] $N = 810$ (12 mo.); $N = 652$ (24 mo.). [f] $N = 628$.

set of operational procedures established for determining, much less guaranteeing, comparability of measurements. At the outset of the collaborative effort, however, a review of procedures used at each site was undertaken by collaborating investigators. In the analyses, we included only those measures for which there was both detailed information on administration procedures for an instrument and high consistency of implementation across sites. Specifically, administration manuals are available, for the three major measures included (the Bayley scale, the Stanford-Binet, and the HOME Inventory), which provide considerable detail on the appropriate procedures to follow to obtain reliable information. Each of the independent investigators also contacted the developers of the HOME Inventory (Caldwell and Bradley) prior to beginning their studies to discuss recommended procedures for training and administering the HOME Inventory. Three (Barnard, Johnson, and Ramey) had on-site contacts with the instrument developers to assist with training. At all sites, from 5 to 10 joint visits were made by each home visitor to establish interobserver reliability prior to collecting data. At each site periodic checks were made across home visitors to reduce observer "drift." At all sites interobserver agreement remained high (90% or greater). About 1 hr was spent in the home at each site for the purpose of observing and interviewing the family in order to score the HOME Inventory. In most cases, some other information about the family was also gathered (family demographics, family routines, etc.) at the time the HOME was done. The additional information varied

somewhat from site to site and from time to time within sites, but most visits lasted no more than 1.5 to 2 hr. Interviews and tests for the Houston participants were administered in the participant's preferred language by interviewers and examiners who were bilingual. Direct comparisons regarding the comparability of measures across sites cannot be done because of the post hoc nature of the collaborative design; however, comparisons of similar social class by ethnic subgroups across sites reveals a high degree of consistency in mean scores for measures (see also, Gottfried, 1985).

Results

The first objective of this study was to examine the general pattern of relationships between specific aspects of the home environment, as measured by the HOME Inventory, and children's cognitive development over the first 3 years of life. A subsidiary objective was to investigate the generality of the relationships by comparing patterns of correlations for different ethnic, gender, and social status groups. The correlations in Table 2 were computed to provide a context for these analyses. These coefficients represent the simple bivariate relationships between the major variables used in the study: SES, HOME, and mental test scores. As the table reveals, there was a moderate degree of stability for the total HOME score (.59 between 12-month HOME and 24-month HOME, and .73 between 24-month HOME and 36-month HOME). There was also moderate stability for mental test scores (.53 between 12-month Bayley MDI and 24-month Bayley MDI, and .68 between 24-month MDI and 36-month IQ). Social status showed only a low correlation with early developmental status (about .25 with 12-month MDI). Both early developmental status and environmental status, however, showed modest relationships with the 24-month MDI score (about .50). Moreover, the closer in time specific aspects of the environment were measured, as compared with mental scores, the stronger the observed relationship (.58 between 24-month HOME and 24-month MDI). The predictive value of early developmental status waned as the distance from subsequent developmental measures increased (.38 between 12-month MDI and 36-month IQ). However, there were very few extremely low 12-month MDI scores. By contrast, early environmental scores showed about the same correlation with 36-month IQ as with 24-month MDI (about .53).

Table 2
Correlations Among Environmental and Developmental Variables

Variable	1	2	3	4	5	6	7	8
1. Mother's education	—	.69	.25	.46	.48	.50	.49	.38
2. SES		—	.16	.52	.52	.54	.47	.41
3. MDI (12 mo.)			—	.25	.53	.34	.38	.29
4. HOME (12 mo.)				—	.50	.59	.53	.59
5. MDI (24 mo.)					—	.58	.68	.50
6. HOME (24 mo.)						—	.62	.73
7. IQ (36 mo.)							—	.54
8. HOME (36 mo.)								—

Note. *N*s vary from 366 to 785. SES = socioeconomic status; MDI = Mental Development Index; HOME = Home Observation for Measurement of the Environment Inventory. All correlations are significant at the .05 level.

General Pattern

Table 3 displays the simple correlations between HOME subscale scores and other study variables. Several patterns appear significant with respect to the relationship between social status measures and HOME scores. First, there was a significant relationship between social status and most of the individual HOME subscale scores at each age level. Second, the availability of toys and learning materials showed a moderate relation with social status (.4 to .5) at all three ages. Third, stimulation from objects and persons (as measured by subscales such as play materials, parental involvement, and learning materials) showed a higher relation to social status than the quality of social and emotional support (as measured by subscales such as parental responsivity, nurturance, and acceptance) given to children (.4 to .5 compared with .2 to .3, respectively).

The following patterns emerged with respect to the relationship between HOME scores and mental test scores. First, correlations between HOME scores and mental test scores increased during the second year of life and became relatively stable thereafter—with the exception of parental responsivity, which continued to increase. Second, three sources of stimulation (the availability of toys and learning materials, the parent's involvement and encouragement of the child, and the variety of experiences to which the child is exposed) showed moderate relationships to mental test scores beginning at age 2 (about .4 to .5). Third, parent's responsivity to the child, especially in the form of verbal communications, appears to have increased in importance with age (up to .4 to .5).

Ethnic Differences

In order to determine the generalizability of relationships between home environment and cognitive development, comparisons were made among the various ethnic groups that participated in this study. Because there was a confound between ethnicity and social status, it was necessary to adjust the samples used for comparisons among ethnic groups so as to reduce (although not eliminate) the effects of the confound. Specifically, because correlation coefficients can be affected by both the *range of scores* present in the variables being correlated and the general *level of scores* present (i.e., in the case where the particular range of scores happens to fall within the total possible range of scores), a matched sample of Whites, Blacks, and Mexican-Americans was constituted. Triads were matched on 12-month HOME total scores, and 112 exact matches among the three groups were obtained. Nineteen additional matches were made (±1 point). The result was to eliminate many of the middle-class Whites. The 12-month HOME score was chosen as a basis of matching across subgroups for several reasons: (a) it was administered early in a child's life and, thus, presumably was relatively unaffected by differences in early cognitive competence; (b) it showed moderate stability across the three age points (greater than .5); and (c) it showed moderate correlations with mental test scores except for 12-month Bayley MDI (which

Table 3
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.25	.33	.20	.34	.33
Acceptance	.20	.22	.02	.17	.20
Organization	.19	.17	.09	.21	.22
Play materials	.48	.50	.28	.47	.48
Involvement	.39	.39	.22	.43	.47
Variety	.27	.35	.18	.35	.36
Total	.46	.50	.25	.50	.53
24 months					
Responsivity	.28	.31	.16	.40	.47
Acceptance	.25	.27	.12	.33	.39
Organization	.20	.13	.23	.22	.31
Play materials	.50	.42	.37	.53	.52
Involvement	.49	.43	.30	.55	.54
Variety	.34	.36	.31	.42	.45
Total	.50	.49	.34	.58	.62
36 months					
Learning stimulation	.40	.44	.31	.47	.49
Pride and affection	.09	.15	.15	.28	.34
Total	.38	.42	.29	.50	.54

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.

wasn't highly correlated with any of the other variables). Results of these analyses are displayed in Tables 4, 5, and 6.

Whites. Table 4 shows the correlations between HOME subscale scores and mental test scores for Whites from the matched sample. There were some notable differences between Whites and the other two ethnic groups (statistically significant differences between subgroups are indicated in Table 4). First, the correlations between HOME scores and social status indices

Table 4
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Whites From Matched Samples

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.24	.33[b]	.11	.29	.33[b]
Acceptance	.16	.15	−.02	.16[a]	.15
Organization	.13	.08	.09	.08	.18
Play materials	.41	.50[a,b]	.32[b]	.44	.32
Involvement	.33[a,b]	.48[a,b]	.12	.43	.30
Variety	.29[b]	.32[a,b]	.16	.32[a,b]	.37[a,b]
Total	.46[a,b]	.53[a,b]	.23	.52[a]	.47[b]
24 months					
Responsivity	.56[a,b]	.34[b]	.14	.48[b]	.49[b]
Acceptance	.29	.19	.11	.50[a,b]	.62[a,b]
Organization	.24	.17	.02	.13	.14
Play materials	.54[b]	.46[a,b]	.32[b]	.52	.41
Involvement	.55[a,b]	.48[a,b]	.14	.56[b]	.40[b]
Variety	.29	.22	.13	.23[b]	.10[c]
Total	.62[a,b]	.46[a,b]	.22[b]	.62[a,b]	.57[b]
36 months					
Learning stimulation	.36[b]	.42[a,b]	.06	.45[b]	.35
Pride and affection	−.11	.01	−.06	.18	.25[c]
Total	.39[b]	.41[a,b]	.09	.46[b]	.42[b]

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Higher than *r* for Blacks. [b] Higher than *r* for Mexican–American. [c] Lower than *r* for Blacks.

Table 5
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Blacks From Matched Samples

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.12	.14	.11	.15	.20
Acceptance	−.12	−.13	−.20	−.11[c]	.07
Organization	.22	.00	.13	.07	.37[b]
Play materials	.20	−.10[c]	.22	.23	.40
Involvement	.06[c]	−.10[c]	.25	.21	.32
Variety	.14	−.02[c]	.14	.09[c]	.14[c]
Total	.16[c]	−.06[c]	.17	.19[c]	.41
24 months					
Responsivity	.17[c]	.13	.06	.25	.33
Acceptance	.08	.03	.05	−.04[c]	.22[c]
Organization	.27	.03	.19	.20	.32
Play materials	.29	.02[c]	.19	.30	.45
Involvement	.27[c]	−.06[c]	.08	.29	.42[b]
Variety	.12	.07	.19	.24[b]	.47[a,b]
Total	.28[c]	.11[c]	.13	.28[c]	.49[b]
36 months					
Learning stimulation	.42[b]	−.01	.17	.28	.49[b]
Pride and affection	.10	.03	.16	.36[b]	.53[a,b]
Total	.30[b]	−.03	.25	.33[b]	.50[b]

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Higher than *r* for Whites. [b] Higher than *r* for Mexican–American. [c] Lower than *r* for Whites.

were generally higher for Whites. Total HOME scores, for instance, had correlations ranging from .4 to .6 with social status variables for Whites, compared with .0 to .3 for Blacks and essentially zero for Mexican–Americans. Second, correlations between Infant HOME scores and 2-year MDI scores tended to be higher for Whites than for Blacks or Mexican–Americans.

Table 6
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Mexican–Americans From Matched Samples

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.08	−.06[a]	.09	.30	.05[a]
Acceptance	−.12	−.26	.04	.00	.02
Organization	.12	−.01	.00	.24	.05[b]
Play materials	.23	.24[a]	.05[a]	.41	.21
Involvement	−.05[a]	.01[a]	−.02	.34	.34
Variety	−.03[a]	.09[a]	−.07	−.13[a]	.11[a]
Total	−.07[a]	−.01[a]	.03	.41	.22[a]
24 months					
Responsivity	−.09[a]	−.13[a]	.07	.00[a]	.05[a]
Acceptance	.21	.13	−.12	.10[a]	−.12[a,b]
Organization	.09	.16	.10	.05	.20
Play materials	.13[a]	.11[a]	−.06[a]	.43	.21
Involvement	.11[a]	−.03[a]	−.12	.23[a]	.06[a,b]
Variety	.07	.12	.08	−.11[a,b]	.01[b]
Total	.11[a]	.07[a]	−.08[a]	.24[a]	.14[a,b]
36 months					
Learning stimulation	−.02	−.13	.02	.14[a]	.15[b]
Pride and affection	−.18	−.30	−.04	−.05[a,b]	.07[b]
Total	−.07	−.18	.17	.05[a,b]	.10[a,b]

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Lower than *r* for Whites. [b] Lower than *r* for Blacks.

Table 7
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Lower Class

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.03	.14	.07	.28	.16
Acceptance	.05	.06	−.09	.13	.21
Organization	.04	.07	.07	.17	.24
Play materials	.30	.01	.04	.24	.27
Involvement	.14	−.02	.08	.25	.31
Variety	−.06[b]	.13	.00	.01[a,b]	.26
Total	.16[b]	.10	.03	.32	.34
24 months					
Responsivity	−.03[b]	.05[b]	−.12[b]	.09[a,b]	.30
Acceptance	−.02[b]	.08	−.20[b]	.09[b]	.17[b]
Organization	.19	.03	.03	.13	.28
Play materials	.29	−.11[b]	.11[a,b]	.31	.30
Involvement	.16[b]	−.08[b]	.02[a,b]	.26[a]	.27[a]
Variety	.04[b]	.02	.09	.08[a,b]	.29
Total	.07[a,b]	.06[b]	−.09[a,b]	.21[a,b]	.30[a,b]
36 months					
Learning stimulation	.08[b]	.14	.10	.21	.35
Pride and affection	−.10	.20	−.07[b]	.08	.21
Total	.11	.10[b]	.02[b]	.18[b]	.30

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Lower than *r* for lower middle class. [b] Lower than *r* for middle class.

Those ethnic differences did not tend to persist to age 3 for Blacks. Third, with respect to 3-year IQ, Whites differed from Blacks on those HOME subscales that assess more social and emotional aspects of the family environment (responsivity, acceptance, pride and affection). Correlations between 2-year HOME scores and 3-year IQ were higher for Whites; correlations between 3-year HOME and 3-year IQ were higher for Blacks.

Blacks. Correlations between Infant HOME scores and mental test scores tended to be about .1 to .2 lower for Blacks compared with the pattern for Whites (see Table 5 for statistically significant differences). However, correlations between Preschool HOME subscale scores and 3-year IQ were of the same general level of magnitude as were seen in the White group (about .50 for the total HOME score). Blacks differed from Mexican–Americans in a number of significant ways. First, correlations between HOME scores and maternal education were higher for Blacks—although differences between *r* values did not reach statistical significance until age 3. Second, correlations between HOME scores and 3-year IQ were higher for Blacks, especially for the 2-year and 3-year HOME assessments.

Mexican–Americans. Table 6 displays the correlations between HOME scores and mental test performance for Mexican–American children included in the matched sample. The pattern revealed here was substantially different from all other groups. There was little relationship between HOME scores and either social status indices or mental test scores. Moreover, it is hard to discern a pattern among the significant coefficients that were revealed—except, perhaps, that the correlations between more cognitively stimulating aspects of the home environment (play materials, parental involvement, and learning materials) and mental scores were a little higher than correlations between the more social aspects of the home environment. There appears to be a significant relationship between the play materials subscale and mental test scores, but the relationship is puzzling. The 12-month and 24-month play materials scores had higher correlations with 24-month MDI than with 12-month MDI (as expected), but neither was significantly correlated with 3-year IQ. Moreover, the learning materials subscale at 36 months was not significantly related to IQ. Parental involvement at 12 months was significantly related to 24-month and 36-month mental scores, but the 24-month involvement score was not. These seeming discrepancies in findings may reflect sample attrition in the Mexican–American group, a restricted range of scores, differences in the validity of measurements as applied to the Mexican–American group, or differences in structural relationships among the variables examined (see Laosa, 1981, for a discussion of this issue).

Gender Differences

The overall pattern for boys is not substantially different from the pattern for girls. So few differences were observed in the correlations obtained for boys and girls that coefficients are not displayed in tabular form.

Social Status Differences

Lower class. There were numerous differences between lower-class children and children from the other SES groups with respect to the pattern of correlations for HOME, social status, and mental test scores (see Table 7). First, HOME was

Table 8
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Lower Middle Class

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.13	.07	.14	.23	.28
Acceptance	.10	.13	−.06	.13	.07
Organization	.16	.03	.12	.11	.18
Play materials	.24	.15	.22	.38[b]	.34
Involvement	.17	.07	.17	.31	.30
Variety	.08	.10	.07	.24[a]	.28
Total	.23	.15	.17	.35	.37
24 months					
Responsivity	.16[d]	−.01[d]	.14	.33[a]	.37
Acceptance	.12[d]	−.01	.07	.16[d]	.26[d]
Organization	.22[b]	−.07	.24	.11	.28
Play materials	.29	−.02	.37[a]	.38	.42
Involvement	.28	.06[d]	.30[a]	.49[a]	.48[a]
Variety	.20	.03	.29	.31[a]	.32
Total	.31[a]	.00[d]	.35[a]	.47[a]	.55[a]
36 months					
Learning stimulation	.14	.06[d]	.18	.35	.35
Pride and affection	−.09	−.09[c,d]	.12	.24	.31
Total	.09	.06[d]	.22	.42	.43

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Higher than *r* for lower class. [b] Higher than *r* for middle class. [c] Lower than *r* for lower class. [d] Lower than *r* for middle class.

essentially unrelated to maternal education and family occupation for lower-class children. For lower-middle-class children, there was a small relationship with maternal education, and for middle-class children there were significant relationships with both maternal education (.3 to .5) and family occupation (.2 to .3)—these latter coefficients being statistically significant when compared with those of lower-class children. Second, there were only low correlations between HOME and mental test scores for lower-class children (never greater than .34), whereas correlations between HOME and mental test scores were often moderate in strength (up to .60) for the other two SES groups. As Table 7 shows, many of these differences were statistically significant.

Lower middle class. Table 8 shows the correlations for lower-middle-class children. As a general rule, the magnitude of the *r*s fell somewhere between those for lower-class and middle-class children, except that most of the differences were not statistically significant. The two major differences between the lower-middle-class group and the other two SES groups were (a) slightly lower *r*s between HOME and occupational status than for middle-class children and (b) slightly higher *r*s between HOME and mental scores than for lower-class children. There were a couple of interesting exceptions. First, the play materials subscale from HOME was more highly correlated with mental test scores for lower-middle-class than for middle-class children. Second, the acceptance subscale was more highly correlated with mental scores for lower-middle-class than for lower-class children.

Middle class. Correlations for middle-class children varied in a number of ways from those observed for the other groups (see Table 9). Correlations between HOME total scores and mental test scores—especially contemporaneous correlations—were not that different in magnitude, but a number of the correlations for specific subscales were. Both responsivity and variety measured at 12 months were unrelated to mental performance, and play materials showed only a minimal relationship to 36-month IQ. These lower correlations probably reflected attenuation in the range of scores for middle-class children on these subscales. As compared with the other two SES groups, *r*s for middle-class children tended to be somewhat higher (especially with regard to the lower-class sample). These differences in *r* values were often not statistically significant. Two differences that were statistically significant are, perhaps, worthy of comment. First, HOME scores for middle-class children were more highly related to social status indices. Second, the acceptance subscale of HOME was more highly related to mental test scores.

Process and Status Environmental Factors

The second major issue addressed in this study was how process and status factors in the family environment are related to early mental development. Process environmental factors include those aspects of the environment that are experienced most directly (i.e., particular objects, persons, events, and transactions). Status environmental factors involve aspects that are experienced more indirectly or at a greater distance (e.g., social class or the general area where one lives). Environmental processes were operationalized as the total scores from the HOME Inventory at 12, 24, and 36 months. Environmental status was

Table 9
Correlations Between HOME Subscales, Socioeconomic Status, and Mental Test Scores for Middle Class

Age/HOME subscales	Maternal education	Occupation	MDI (12 mo.)	MDI (24 mo.)	IQ (36 mo.)
12 months					
Responsivity	.15	.23	.17	.15	.16
Acceptance	.21	.05	.06	.05	.14
Organization	.08	.01	.01	.12	.05
Play materials	.15	.09	.21	.15[c]	.23
Involvement	.28	.18	.20	.24	.38
Variety	.16[a]	.12	.23	.29[a]	.15
Total	.34[a]	.23	.25	.33	.37
24 months					
Responsivity	.40[a,b]	.34[a,b]	.34[a]	.34[a]	.45
Acceptance	.34[a,b]	.18	.26[a]	.48[a,b]	.51[a,b]
Organization	.01[c]	.05	.15	.21	.15
Play materials	.36	.15[a]	.35[a]	.46	.44
Involvement	.37[a]	.32[a,b]	.46[a]	.46	.42
Variety	.24[a]	.23	.30	.40[a]	.36
Total	.47[a]	.34[a,b]	.49[a]	.62[a]	.64[a]
36 months					
Learning stimulation	.34[a]	.26[b]	.29	.37	.43
Pride and affection	.09	.20[b]	.16[a]	.21	.28
Total	.33	.30[a,b]	.31[a]	.41[a]	.48

Note. HOME = Home Observation for Measurement of the Environment. MDI = Mental Development Index.
[a] Higher than *r* for lower class. [b] Higher than *r* for lower middle class. [c] Lower than *r* for lower middle class.

operationalized as socioeconomic status. When using data from the total collaborative sample, it does not make a great deal of difference whether the total HOME score or SES is used as a single variable to "predict" later IQ.

In an effort to help delineate the relationship between environment and mental development during infancy, two multiple regression analyses were performed as a means of determining the joint contribution of these two aspects of the environment. IQ at 3 years was the dependent variable. Model 1 involved forced entry of the environmental process variables (HOME total scores at 12, 24, and 36 months) followed by forced entry of the status environment variable (SES). Model 2 reversed the order of entry. These two models were tested for the total group, by gender, and by ethnicity, and the results are displayed in Table 10. (As Table 2 shows, the correlation between HOME and SES ranges from about .5 to .6.)

Results for the total group indicated that SES contributes significantly to the total regression model even when HOME scores were forced into the model first. However, the actual increase in R^2 was only .04. The very large sample size made even this small increase in R^2 statistically significant. In the second model, HOME improved the regression model significantly. The increase in R^2 was .17 (from .30 to .47).

Gender differences. There was no significant increase in R^2 when SES was added to the regression model for boys. However, the R^2 increased from .20 to .41 when the HOME scores were added to the model containing SES. For girls, SES did contribute a significant amount of additional variance to the regression model when added to HOME scores (R^2 increased by .06). However, the increase in R^2 was .13 when HOME was added to the model that contained SES.

Ethnic differences. As with the comparison of bivariate correlations between ethnic groups, the regression analyses for ethnic groups were done using data from the "matched samples" so that more direct comparisons could be made. For Whites, there was no increase in adjusted R^2 when SES was added to HOME in predicting IQ. When HOME was added to SES, however, the adjusted R^2 increased from .14 to .34. In the case of Blacks, SES did not add a significant amount of variance to the regression model. By contrast, HOME increased the adjusted R^2 from −.01 to .32. The regression equation was not significant when SES was used alone to predict IQ. For the Mexican-American group, none of the regression models provided significant prediction of IQ at 3 years.

In sum, both SES and the total HOME score are useful in simply "predicting" later mental test scores. However, SES does not seem to contribute as much as an independent predictor of IQ as does continuous monitoring of more specific environmental factors—especially for Blacks and males.

Extreme Scores

The third issue addressed by this collaborative study was the impact of extreme scores on children's mental test performance. Figure 1 displays profiles of mean mental test scores for three groups: (a) those who had total scores on the 12-month HOME one or more standard deviations below the mean; (b) those whose total scores were between −1z and 1z on the 12-month HOME; and (c) those whose total scores on the 12-month HOME were one or more standard deviations above the mean. The three groups began with slightly different mean scores on the 12-month Bayley MDI (112, 109, and 101, respec-

Table 10
Multiple Regression Analyses Comparing HOME and SES in Terms of Their Relationship to IQ at 3 Years

Sample	Step/ variable entered	R	R^2	Adjusted R^2	F for equation	p	ΔR^2	ΔF	Δp
Total group	1/HOME	.66	.43	.43	75.7	.001	.43	75.7	.001
	2/SES	.69	.47	.46	65.4	.001	.04	20.1	.001
Total group	1/SES	.55	.30	.30	129.3	.001	.30	129.3	.001
	2/HOME	.69	.47	.46	65.4	.001	.17	31.1	.001
Boys	1/HOME	.63	.40	.38	29.5	.001	.40	29.5	.001
	2/SES	.64	.41	.39	23.1	.001	.01	2.8	*ns*
Boys	1/SES	.45	.20	.19	34.1	.001	.20	34.1	.001
	2/HOME	.64	.41	.39	23.1	.001	.21	15.7	.001
Girls	1/HOME	.69	.47	.46	47.0	.001	.47	47.0	.001
	2/SES	.73	.54	.52	45.3	.001	.06	21.6	.001
Girls	1/SES	.64	.40	.40	108.2	.001	.40	108.2	.001
	2/HOME	.73	.55	.52	45.3	.001	.13	14.9	.001
White[a]	1/HOME	.58	.34	.28	6.4	.001	.34	6.4	.001
	2/SES	.58	.34	.26	4.7	.001	.00	0.0	*ns*
White[a]	1/SES	.37	.14	.11	6.2	.02	.14	6.2	.02
	2/HOME	.58	.34	.26	4.7	.001	.20	3.7	.02
Black[a]	1/HOME	.60	.36	.33	11.8	.001	.36	11.8	.001
	2/SES	.60	.36	.32	8.9	.001	.00	0.4	*ns*
Black[a]	1/SES	.03	.00	−.01	.05	*ns*	.00	.05	*ns*
	2/HOME	.60	.36	.32	8.9	.001	.36	11.8	.001
Mexican–American[a]	1/HOME	.38	.14	.04	1.3	*ns*	.14	1.3	*ns*
	2/SES	.39	.14	−.01	1.0	*ns*	.01	0.1	*ns*
Mexican–American[a]	1/SES	.13	.02	−.02	.5	*ns*	.02	.4	*ns*
	2/HOME	.38	.14	−.01	1.0	*ns*	.13	1.1	*ns*

Note. HOME = Home Observation for Measurement of the Environment. SES = socioeconomic status.
[a] Based on matched samples.

tively). The high HOME group showed an increasing profile. The medium HOME group had a slightly decreasing mental test profile. The low HOME group showed a decreasing mental test profile, so that the mean scores on the 36-month IQ were 116, 103, and 88, respectively. Of the 89 children who had 12-month HOME scores that were less than −1z, 82 had 36-month IQ scores less than 100. Of the 123 who had 12-month HOME scores that were greater than 1z, 99 had IQ scores less than 100.

Gender differences. As Figure 1 reveals, the profiles for both boys and girls were essentially equivalent to the profile for the total group. In all three groups, the mean 36-month IQ score for boys was a little lower than the score for girls.

Ethnic differences. Figure 2 displays mean mental test profiles for the three HOME groups for Whites, Blacks, and Mexican–Americans (designations were based on scores from the total sample, not the particular ethnic groups). Among Whites, the high HOME group showed an increasing profile, the medium HOME group showed a decreasing mental test profile, and the low HOME group showed a decreasing profile—albeit the 24-month MDI score was lower than the 36-month IQ score. Among Blacks, the high HOME group showed an increase from 12 to 36 months, although there was a small decline between 12 and 24 months. The medium HOME group declined markedly from 12 to 36 months, as did the low HOME group. Among Mexican–Americans, the high HOME group showed a very slight increase in mental test scores. Both the medium HOME and low HOME groups declined, although their 36-month mean scores on IQ were the same.

Social status differences. Figure 3 shows differences within social status groups as a function of 12-month HOME scores. The pattern varies as a function of social status and is reminiscent of a "classic" Treatment × Selection interaction in quasi-experimental research (Cook & Campbell, 1979). Low HOME scores were associated with decreasing mental test scores in all three groups. Medium HOME scores were associated with declining mental test scores in children from lower-class and lower-middle-class backgrounds but a flat profile for middle-class children. High HOME scores were associated with a slower rate of decline in lower-class children, a flat profile in lower-middle-class children, and an increasing profile for middle-class children. There were only three middle-class children who had low HOME scores at 12 months, too few for reliable estimates of mental test profiles.

Extreme scores on 24-month and 36-month HOME. The pattern of relationships between later HOME scores and IQ was similar to that described for 12-month HOME. Fifty-six out of 376 children had 24-month HOME scores that were less than −1z. Of those, 52 had IQ scores that were less than 100 at 36 months. Ninety-seven had 24-month HOME scores that were greater than 1z. Eighty-three had 36-month IQs that were greater than 100. Thirty-nine of 587 children had 36-month HOME scores that were less than −1z. Thirty-five had IQ scores that were less than 100 at 36-months. One hundred fifty-one had HOME scores that were greater than 1z. One hundred seventeen had IQ scores that were greater than 100.

Extreme Bayley MDI scores. The relation of early Bayley MDI scores to later IQ was also examined. Eighty-three of 605 children had 12-month MDI scores that were less than −1z.

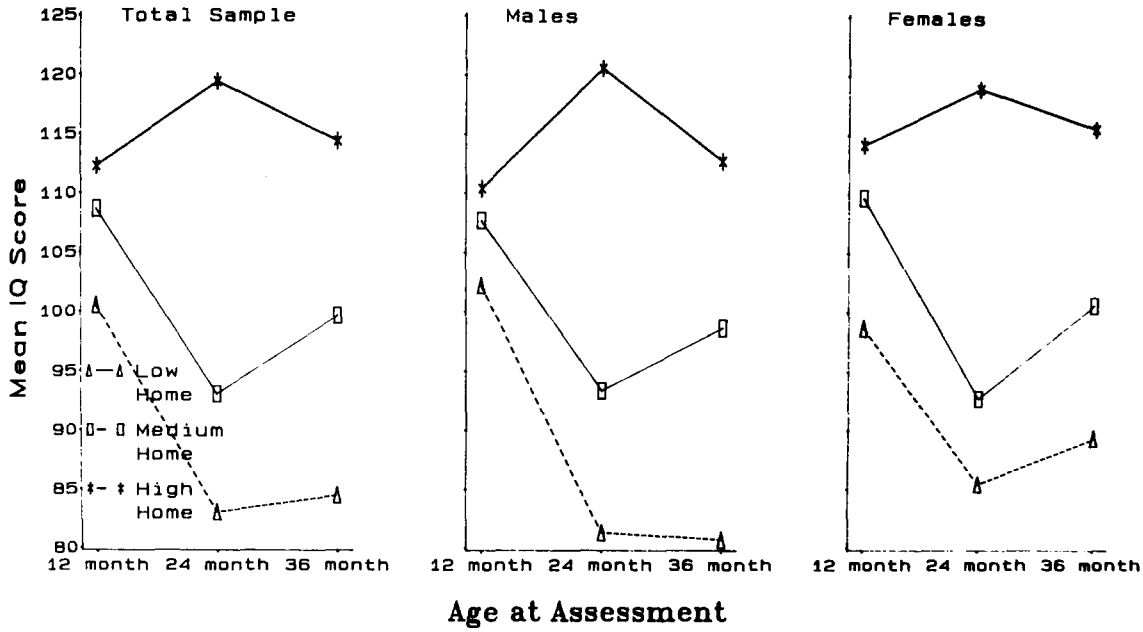

Figure 1. Mean IQ scores for three levels of HOME Inventory scores for boys, girls, and the total group. (Low HOME = at least 1 *SD* below the mean; Medium HOME = within 1 *SD* of the mean; and High HOME = at least 1 *SD* above the mean.)

Sixty-nine of these had 36-month IQ scores that were less than 100. Eighty-three of 605 also had Bayley MDI scores that were greater than 1z. Sixty-three of these had 36-month IQ scores that were greater than 100.

"Double Advantage"—"Double Disadvantage". A corollary concern to the impact of extreme scores on the HOME and Bayley scales was the potential impact of children having either both high HOME and high Bayley scores or both low HOME and low Bayley scores. Table 11 displays the number of children having a "double disadvantage" early in life (i.e., both 12-

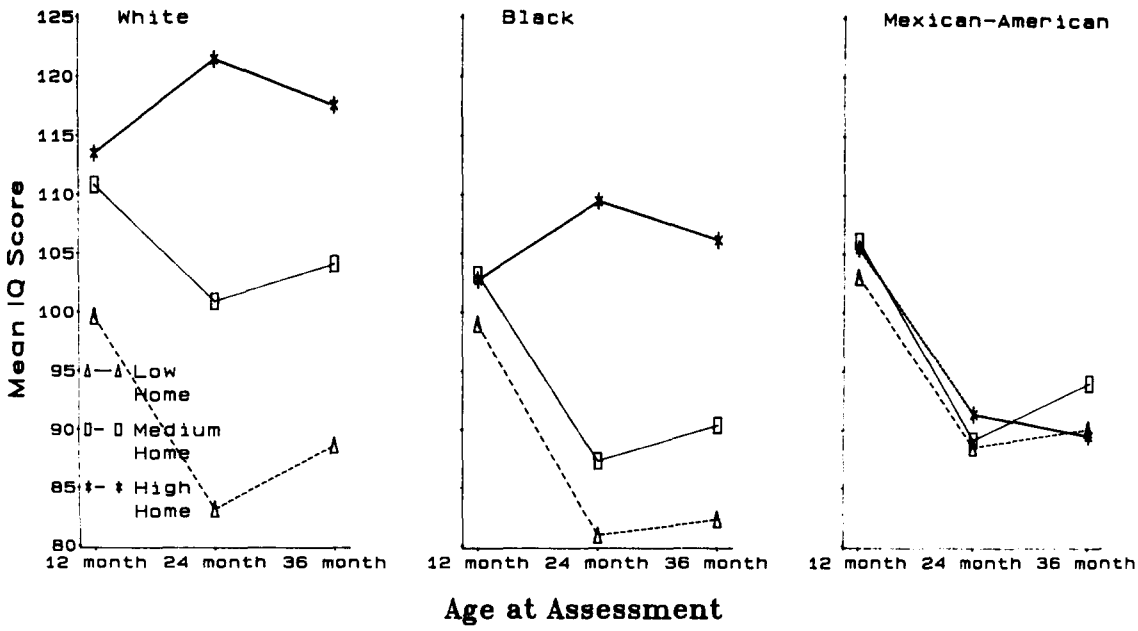

Figure 2. Mean IQ scores for three levels of HOME Inventory scores for Whites, Blacks, and Mexican-Americans. (Low HOME = at least 1 *SD* below the mean; Medium HOME = within 1 *SD* of the mean; and High HOME = at least 1 *SD* above the mean.)

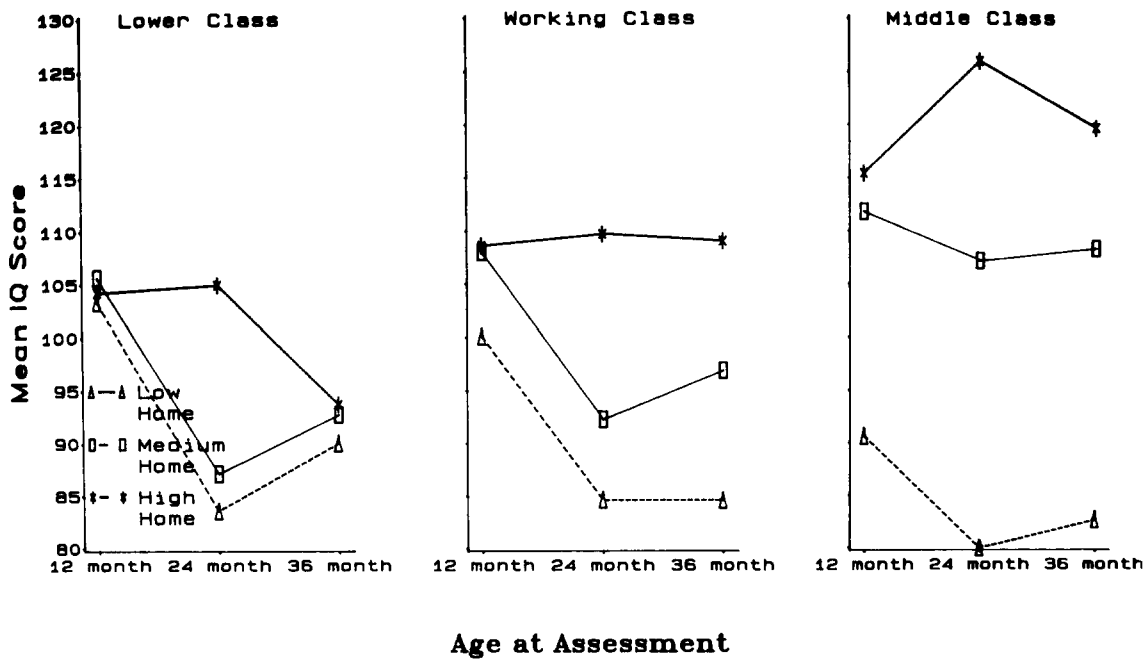

Figure 3. Mean IQ scores for three levels of HOME Inventory scores for lower-class, working-class, and middle-class groups. (Low HOME = at least 1 *SD* below the mean; Medium HOME = within 1 *SD* of the mean; and High HOME = at least 1 *SD* above the mean.)

month HOME and 12-month MDI scores that were less than −1z). Twenty-five of the 27 children who fell into this category had 36-month IQ scores that were less than 100. Table 11 also displays the number of children who had a "double advantage" at age 1 (i.e., both 12-month HOME and 12-month MDI scores that were greater than 1z). Twenty-six of the 27 children in this category had 36-month IQs that were greater than 100. The remaining 519 children, who were in neither "double" category, formed a near normal distribution on 36-month IQ, with only a slight positive skew. A 3 × 3 analysis of variance (ANOVA),

Table 11
Distribution of IQ Scores at 36 Months for Children who Scored in Extreme Ranges on Both the HOME Inventory and the Bayley Scales of Infant Development at 12 Months

	MDI and HOME scores (12 months)			
IQ standard scores (36 months)	Both at least 1 *SD* below *M*	No more than one extreme score in the same direction	Both at least 1 *SD* above *M*	*N*
−3.0 to −2.5	1	2		3
−2.5 to −2.0	1	7		8
−2.0 to −1.5	4	25		29
−1.5 to −1.0	5	41		46
−1.0 to −0.5	5	68		73
−0.5 to 0	9	115	1	125
0 to 0.5	1	95	5	101
0.5 to 1.0	1	77	5	83
1.0 to 1.5		63	7	70
1.5 to 2.0		21	7	28
2.0 to 2.5		2	1	3
2.5 to 3.0		1	1	1
3.0 to 3.5		2		2
N	27	519	27	573

Note. MDI = Mental Development Index. HOME = Home Observation for Measurement of the Environment.

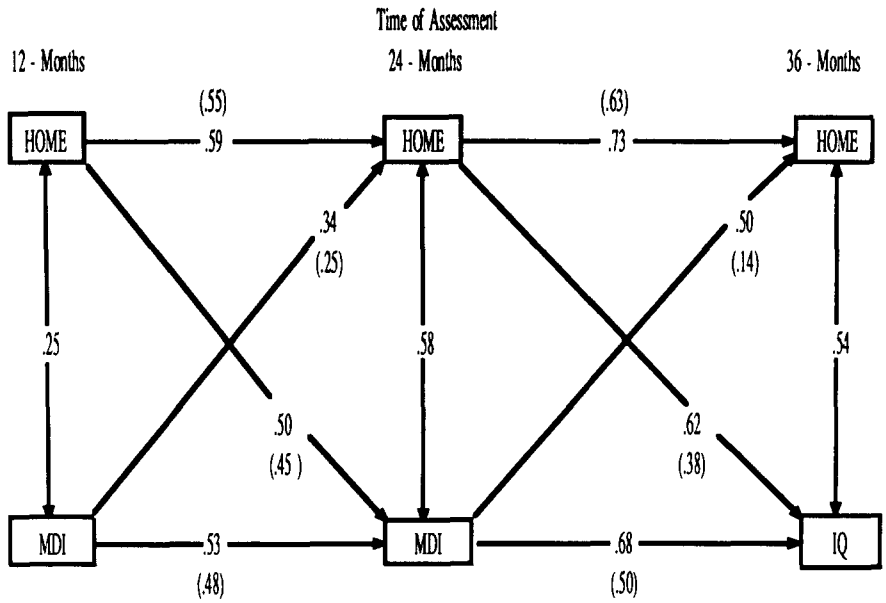

Figure 4. Cross-lag panel analysis of HOME scores and mental test scores from 1 to 3 years of age.

using high, medium and low designations on the 12-month HOME and the 12-month Bayley, revealed a significant interaction between the two variables with respect to 36-month IQ.

The combination of extreme scores on both HOME and Bayley MDI was compared with the situation where a child had a very extreme score on one variable (two or more standard deviations from the mean) but a nearer to average score on the second variable. Between 75% and 80% of those children with extremely low 12-month Bayley scores (less than −2z), but whose HOME scores were not low, had 3-year IQ scores less than 100. Between 75% and 80% of those children with extremely high 12-month Bayley scores (greater than 2z), but whose HOME scores were not high, had 3-year IQ scores greater than 100. About 85% to 90% of those with extremely low HOME scores (less than −2z), but who did not have low Bayley scores, had 3-year IQs less than 100. None of those with extremely high HOME scores (greater than 2z) had 3-year IQs below 100.

Panel Analysis

We used cross-lagged panel analysis in an effort to delineate further the relationship between process environmental factors and mental test scores during infancy. Specifically, as Figure 4 shows, panel analysis was used on three waves of HOME scores and mental test scores (1, 2, and 3 years of age). Panel analysis is designed to determine the primary direction of effect among two variables when each is measured at the same points in time. As Appelbaum and McCall (1983) stated, the use of this statistical technique requires some rather stringent assumptions: (a) The causal relationship between the two variables does not change over time, and (b) the stability coefficients must be equal. We followed the procedures, described by Kenny (1979) for examining stability, stationarity, quasi-stationarity, and differences in cross-lagged correlations, including those procedures used to determine whether synchronous correlations are equal after they have been corrected for shifts in communality. The assumption of stationarity was not fulfilled given the differences in synchronous correlations at the 12-month and 24-month assessment points. However, the Pearson–Filon test indicated that quasi-stationarity was achieved in the first wave of the cross-lag (age 1 to age 2) and that stationarity was achieved in the second wave (age 2 to age 3). Even when these assumptions are met, however, causal interpretations of the data can be ambiguous. Mindful of the limitations inherent in panel analysis and granting that key variables such as parental IQ are not included in the analyses, cross-lagged panel analyses were done using partial correlations. We felt that these analyses would be useful in the sense of narrowing the range of alternatives that might explain the relationship between aspects of the home environment and mental development (see Appelbaum & McCall, 1983, for a discussion of this issue).

A Pearson–Filon test showed that 12-month HOME predicts 24-month Bayley MDI better than 12-month MDI predicts 24-month HOME (.45 and .25, respectively) (see Figure 4). Similarly, 24-month HOME predicts 36-month IQ better than 24-month MDI predicts 36-month HOME (.38 and .14, respectively). Both differences were statistically significant.

Discussion

The major focus of this collaborative study was on the relationship between the family environment and cognitive development in the first 3 years of life and, more specifically, the generalizability of the relationship across gender, social class, and ethnic groups. Measures of specific aspects of the home environment showed moderate correlations (.2 to .6) with both family demographic and cognitive development measures, correlations with mental test scores being higher at ages 2 and 3 than at age 1. Few gender differences were noted in the pattern of

relationships, however, a number of ethnic and social class differences were observed. Overall, home environment scores for Whites showed somewhat higher correlations with both social status and cognitive measures than those of either Blacks or Mexican–Americans. HOME scores for Blacks were more highly correlated with mental test scores than were HOME scores for Mexican–Americans, especially 2-year and 3-year mental test scores. Lower-class children showed lower correlations between HOME and mental test scores, especially at ages 2 and 3. There was also evidence of a Social Class × HOME interaction effect, with the greatest gains in mental test scores coming from middle-class children whose families received "high" HOME scores and "low" HOME scores being associated with decreasing mental test scores in all groups, especially lower-class and lower-middle-class groups. The combination of low HOME score and low 12-month Bayley score (both at least one standard deviation below the national mean) or high HOME score and high 12-month Bayley score (both at least one standard deviation above the mean) seemed particularly significant for 3-year IQ. Twenty-six out of 27 children identified as having a "double disadvantage" using these criteria scored at or below 100 on the Stanford–Binet at age 3. Twenty-six out of 27 who were identified as having a "double advantage" scored at or above 100 on the Stanford–Binet at age 3. Finally, a cross-lag panel analysis that was done on three waves of home environment and mental test data indicated that both between the ages of 1 and 2 and between the ages of 2 and 3 the primary direction of effect was from environment to development (i.e., the more highly enriched the home environment, the more likely the child was to show higher mental scores at the next assessment point).

Data were not available to examine the joint impact of heredity and environment on early mental development in this study. Therefore, any causal inference drawn from these findings must remain quite tentative. The issue of the joint relationship of heredity and environment to early mental development is one of renewed interest given findings from the Colorado Adoption Study that suggest that genes may increasingly mediate the relation between home environment and cognitive development as children grow older (Plomin, Loehlin, & DeFries, 1985). Our intent was to examine patterns of association among commonly used developmental and environmental measures across a variety of subgroups in the hope that the results obtained would afford a useful information base for studies of environmental action. The breadth and size of the sample available to this collaborative study made it possible to derive reasonable estimates of generalizability.

In general, there appears to be a moderate relation between social status and mental test scores that increases from age 1 to age 3 (.2 to .5). However, the relation appears to vary considerably across ethnic groups within North America, perhaps partially because of the restriction in range of family socioeconomic status among the Black and Mexican–American samples. The relationship between occupational status and mental test scores appears especially inconsistent, showing a near-zero correlation in both Black and Mexican–American samples. The correlation between cognitive scores and maternal education appears more stable, except for the Mexican–American group in which maternal education was not related to HOME scores (Johnson et al., 1984).

Consistent with other studies (McCall, 1981), Bayley MDI measured at 12 months showed low, but significant, correlations with subscales from the HOME Inventory (.25 to .34). Correlations between later developmental measures (MDI at 24 months and IQ at 36 months) and the HOME Inventory were moderate in strength (about .5 to .6). Similar increases in the strength of the relationship over the first 3 years of life were observed by Bakeman and Brown (1980).

The HOME Total score at 12 months displayed a moderate level of correlation with both the 24-month Bayley MDI score (.50) and the 36-month IQ score (.53). Correlations for the 24-month HOME measure were a little higher (.58 and .62, respectively). In essence, with respect to SES and the total HOME score, the relation with cognitive development appears to emerge in the first year of life, to become reasonably well established by two, and to remain fairly stable thereafter (see McCall, 1981).

Correlations between 36-month HOME scores and other study variables were actually a little lower than those between 24-month HOME scores and the same study variables (whether they were social status or mental test scores). The reasons for the differences are not entirely clear, but part of the difference probably represents a small measurement artifact resulting from the use of the Preschool version of the HOME at 36 months as compared with the use of the Infant version of the HOME at 24 months. Two factors are potentially significant in this change. First, the 36-month measurement point is the lowest age point at which the Preschool HOME can be used. Because the scale is designed for families of children 3 to 6 years of age, some of the items are only marginally relevant for many children just turning 3. Second, items such as those contained in the parental involvement subscale, one of the most powerful predictors of later development from the Infant scale, are not included as such in the Preschool scale. Part of the difference may also stem from sampling differences in the 24-month and 36-month data sets. The 36-month set included a higher proportion of working-class and middle-class Whites.

Regarding the results obtained for the total sample, there is an indirect indication of how differences in children's early developmental status may affect their parents' behavior. The Bayley MDI score at 12 months shows a stronger relationship with HOME scores during later time periods than with the 12-month HOME. Most interesting are correlations between the 12-month MDI and the following subscales: play materials, parental involvement, variety, and academic stimulation. Correlations with subscales at 24-months and 36-months are higher than correlations with corresponding HOME subscales at 12 months (however, differences are not always statistically significant). To a degree, such an interpretation may seem to be in opposition to the stronger finding that the lagged correlation between antecedent HOME scores and subsequent mental test scores was higher than the lagged correlation between the antecedent Bayley MDI scores and subsequent HOME scores. However, this seeming contradiction is consonant with a model of early mental development that sees influence between child and environment as bidirectional (Bell, 1968).

Analyses of data from the three ethnic groups revealed some

similarities and some differences in environment–development relationships. Correlations for Whites tended to be the highest of the three groups. Correlations for Blacks were slightly lower, although less so by age 3. These findings suggest that, although there may be relatively fewer Black children living in highly enriched home environments, differences in the quality of the environment at *lower average levels of enrichment* are associated with dispersion in developmental pathways—a finding supported in the analysis of "extreme environmental scores" (see Figure 2). Among Whites, where there is a higher percentage of highly enriched home environments, differences in developmental profiles begin to manifest themselves a little earlier (by the second year of life). Differences in correlations between HOME scores and maternal education for Blacks and Whites also suggest that the process of providing enriched environments may begin earlier with White mothers (see Tables 4 and 5). Black mothers may more often wait until the third year of life to begin emphasis on providing stimulating materials and varied experiences for their infants. In essence, there may be cultural differences regarding the time when a baby is no longer a baby but a child in need of preparation for success in later life. The findings suggest the following hypotheses. First, within a very broad range of home environments, differences in the home environment are associated with differences in cognitive development *irrespective of average level of environmental quality* that is observed in a particular subgroup. Second, at lower average levels of stimulation and support, the association of environment and development is slower in manifesting itself, but the same basic mechanisms seem to be operative (Bloom, 1964; White, 1978). Third, there are cultural differences in the timing of particular parenting practices, certain cultural groups waiting longer before providing greater stimulation for development or demanding more from their children.

Correlations between HOME total score and mental test scores within the three major SES groups examined (lower class, lower middle class, middle class) showed some consistency. Among lower-class participants, 36-month IQ was moderately correlated with HOME total score at all three age points (about .3). Correlations for lower-middle-class subjects were a little higher (.4 to .5). Correlations for middle-class participants were a bit more variable (.4 to .6), perhaps in part because of sampling fluctuations at the 2- and the 3-year assessment points. Altogether, these findings suggest several things about the relationship between early environment and mental development. First, there is variability in parenting practices within social status groups that is associated with differences in mental test scores (Bloom, 1964). Second, the general social class milieu within which a child is reared may moderate the impact of differing parenting practices. This second hypothesis is based on four findings from the collaborative study: (a) Although there are variations in parenting practices within each social class, children in lower-class environments rarely experience "highly enriched" homes. (b) The correlation between total HOME score and 36-month IQ remains about .3 for lower-class children regardless of whether the HOME is given at 12, 24, or 36 months, whereas for the other two groups correlations for 24-month and 36-month HOME are higher than those for the 12-month HOME. (c) The correlation between HOME and 24-month Bayley MDI is significantly lower than the correlation between HOME and 36-month IQ for lower-class but not for working-class and middle-class children. (d) Even when lower-class children come from homes with an "average level of enrichment," their mental test scores still decline from age 1 to age 3. It is only in those few instances when lower-class children experience a "highly enriched" home environment that their mental test scores increase. Again, this is not so in the other two social status groups.

There appear to be relatively minor gender differences in the general pattern of correlations between home environment and mental test scores in the first 3 years of life. Girls seem a little more responsive to environmental "inputs" during the first year of life, but the difference appears temporary. A longer-term follow-up will be necessary to determine if girls are more amenable to environmental conditions. There also appear to be some small ways in which parents respond differently to differences in capabilities in boys and girls. They appear to react to girls who score higher on the Bayley MDI by being more verbally and emotionally responsive. They appear to react to boys who score higher on the Bayley MDI by being more stimulating. Again, however, it is important to do a longer-term follow-up to determine if these small differences in parenting persist.

The issue of the relative importance of the process and status factors in the family environment in terms of their relationship to early development appears to be a complex one. First, there is a moderate relationship between the HOME scores and social status variables (an average correlation of about .5). There are proportionately fewer enriched home environments in families from lower-class than middle-class circumstances. Second, the relationship between process and status environmental factors varies across ethnic groups at this point in North America. The relationship of occupational status and the home environment varies enormously across ethnic groups, perhaps owing to some restriction in range among Blacks and Mexican–Americans. Third, adding information about socioeconomic status to information already available on the home environment increased the predictability of 3-year IQ by only a fractional amount. There were some small gender and ethnic differences in the findings, but, in general, adding SES to a regression model that already included HOME scores increased the total amount of variance accounted for very little. Fourth, adding information about the home environment to a regression equation that contained SES information resulted in significant improvements in the amount of variability accounted for for all groups tested. There was more improvement in boys than in girls, and more improvement in Blacks than in Whites. None of the regression models was useful in predicting IQ among Mexican–Americans. These findings mirror results reported for older children by Bloom (1964) and by Moore (1968). Findings from these analyses seem to confirm Scarr's (1985) conclusions about both the desirability and difficulty of pitting proximal and distal variables against one another in testing models of development. In this instance, the proximal measure of parenting seems to carry more weight in predicting IQ than the distal measure of social status. This contrasts with findings that Scarr obtained when maternal IQ was used as the distal variable in a model. It also points to the likelihood that SES, when computed as a combination of parental education and occupation, may be a more or less fallible measure of social class in different cultural groups.

In any event, the findings help delineate the relationships between varied components of a child's total environment and mental development and indicate that the relationships are constrained by the broader sociocultural context in which they are embedded (Bronfenbrenner & Crouter, 1983).

The finding that HOME scores were of much greater value in predicting IQ among Blacks than were SES indices seems rather easily explainable in terms of historical restrictions in educational and job opportunities among Blacks. Occupational status, in particular, appears largely unrelated to the kinds of parenting that Black children receive (see Table 5). For Whites, there appears to be a closer link between social status and the quality of parenting that a child receives.

The failure to observe a relationship between environmental measures and mental test scores in the Mexican–American sample is somewhat more difficult to explain. Part of the difference may reflect the homogeneity of the Mexican–American sample with respect to social status. Differential access to education may have contributed to the negligible correlations. It is also possible that the level of parental education below high school has a near uniform effect on children's mental development, thus, allowing other factors (e.g., parental IQ) to exert a relatively greater degree of influence (see Laosa, 1987). Another part of the difference may be associated with yet to be explicated cultural factors. The findings observed here are not, however, without precedent. Both Henderson et al., (1972) and Laosa (1983) report differences between Mexican–American and Anglo samples with respect to patterns of environment–development relationships. Laosa (1981, 1983) explains that this difference may reflect differences in the "structural organization" of parental behaviors across cultures and the "meaning" of those behaviors for development in children. In essence, parents from different cultural groups not only parent differently, but the "effect" of particular parent behaviors may vary across groups as well. To complicate matters further, there is a lack of consistency in findings regarding environment–development relationships across Mexican–American families, thus suggesting an even more elaborate set of ecological factors at work. There is a clear need for future studies of Mexican–American families that take into consideration recency of emigration and degree of acculturation into the major society. The explanation offered by Laosa is consonant with one offered by Blau (1981) with regard to Black families. In sum, the ecology of mental development may vary somewhat across ethnic and social class groups, those variations resulting in different patterns of environment–development relations. Although commonalities in patterns also seem to occur across many groups, there may be more consistency at extreme levels of environmental input than in the midrange. Finally, it is essential to concede that observed differences in the pattern of correlations for Mexican–Americans may reflect differences in the validity of measures as applied to the groups available. The Bayley scales, the Stanford–Binet, the HOME, and the Hollingshead were not initially developed on a Mexican–American sample. And, although each has been previously used with Mexican–Americans, the issue of differential validity remains. This possibility, coupled with the possibility that some undetected difference in test administration could have occurred from site to site, leaves the reason for the observed difference uncertain.

The final concern of this phase of the collaborative investigation was to examine early environmental action in terms of extreme scores on environmental and developmental measures. Results were quite consistent. Having an extremely high HOME score (operationalized as one or more standard deviations above the mean) was related to increases in mental test scores from age 1 to age 3. The only exceptions to this general pattern were found in the Mexican–American sample, where mental test scores remained about the same, and in the lower-class sample, where there was a decrease from age 2 to age 3. With regard to this latter finding, it is important to remember that there was only moderate stability in HOME scores (about .5 to .6), thus, later environmental factors may also contribute to mental test scores (Kagan, 1984). For example, high levels of parental warmth and nurturance in the first year of life (contributing to a high HOME score) may not be routinely followed by high levels of cognitive stimulation in the second and third years of life in some sociocultural groups. By contrast, an extremely low score on the HOME Inventory (i.e., one or more standard deviations below the mean) was associated with decreasing mental test profiles. There were too few low HOME scores among middle-class children to make a reliable statement about the relationship.

High scores on the Bayley at 12 months were associated with high scores on the Stanford–Binet at age 3, albeit the relationships were not as strong as for high HOME scores. Low scores on the Bayley at 12 months were somewhat more predictive of low IQ scores. Sixty-nine of 83 children whose 12-month MDI scores were 85 or lower had 3-year IQ scores below 100. These findings are reminiscent of those reported by Siegel (1982).

A most interesting set of findings from the current study concerned children who had both an extremely low 12-month HOME score and an extremely low 12-month Bayley MDI score or extremely high scores on both measures at 12-months. As Table 11 shows, having a "double advantage" or a "double disadvantage" with respect to early developmental and early environmental scores was highly predictive of future developmental status. None of the 27 children who had a double disadvantage at age 1 had a high IQ score at age 3. None of the children who had a double advantage at age 1 had a low IQ score at age 3. These results seem to support recent findings by Breitmayer and Ramey (1986) and by Bradley, Caldwell, Rock, Casey, and Nelson (1987) that indicate the value of considering extreme scores on both early environmental and early developmental (in this case perinatal) factors in estimating later developmental performance. They are also consonant with previous findings reported by Willerman, Broman, and Fiedler (1970). Children who had 8-month Bayley scores in the lowest quartile were seven times more likely to have 4-year IQ scores that were less than 80 if they came from lower-class families.

Despite some potential benefits of combining data from independent longitudinal studies into a larger data pool for purposes of analysis, there are risks and limitations to the approach. Combined samples are likely to be more representative than individual samples, but the degree of representativeness is dependent on the particular samples available. An ideal sample will be realized rarely. Moreover, there is a concern as to whether data have been collected in the same fashion across available studies. If it is hard to maintain conformity of data collection

across sites in a prospective study, it is harder to assume conformity across studies that were originally managed by independent investigators. Finally, in cases where data collection protocols have not been identical across studies, there is the problem of determining how much latitude in procedure is acceptable from the standpoint of scientific integrity. Thus, there is a need to make careful checks on these potential threats prior to combining individual data sets.

In sum, pooling data from several independent longitudinal studies for the purpose of further investigating environment–development relationships represents a potentially valuable alternative to dependence on the individual studies themselves. Limitations in individual longitudinal studies and lack of comparability among them leave the generalizability of findings uncertain. Thus, secondary analysis done on combined data sets where there is some consistency in methodology may be of value in delineating the relationship of environment and development in early childhood.

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