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Effects of the Home Learning Environment and Preschool Center Experience upon Literacy and Numeracy Development in Early Primary School

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This study investigates the influence of aspects of home and preschool environments upon literacy and numeracy achievement at school entry and at the end of the third year of school. Individuals with unexpected performance pathways (by forming demographically adjusted groups: overachieving, average, and underachieving) were identified in order to explore the effects of the Home Learning Environment and preschool variables on child development. Multilevel models applied to hierarchical data allow the groups that differ with regard to expected performance to be created at the child and preschool center levels. These multilevel analyses indicate powerful effects for the Home Learning Environment and important effects of specific preschool centers at school entry. Although reduced, such effects remain several years later.

Many research studies document the relationship of socioeconomic status (SES) to cognitive development and academic achievement (e.g., Bloom, 1964;

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Feinstein, 2003), as well as other aspects of children's development (e.g., Davie, Butler, & Goldstein, 1972), although the strength of such relationships may vary widely between cultures (OECD, 2004). In terms of which aspects of SES relate most strongly with academic achievement, there is long-standing evidence (e.g., Mercy & Steelman, 1982; Sammons et al., 2004) that parental education is the best predictor, with maternal education being most potent in the early years. However, SES explains only a limited amount of difference in academic achievement, about 5% according to a meta-analysis of studies by White (1982). Thus, other factors are necessary to explain variation in academic achievement. The issues related to how to alleviate poor academic achievement are increasing in importance partly because a country's economic success is increasingly tied to the knowledge and skills of its workforce.

The extent and persistence of deficits in academic achievement associated with low SES (and minority ethnic status) led to policy initiatives in the United States such as the *Elementary and Secondary Education Act* of 1965 and the recent *No Child Left Behind Act* of 2001. Similar thinking also applies to policies in other countries aiming to improve schooling outcomes for disadvantaged children. However, several studies indicate that lower school achievement amongst disadvantaged children is presaged by preschool cognitive differences (e.g., Denton, West, & Walston, 2003). Indeed the relationship between SES and cognitive development is present from infancy on (McCall, 1981). Such evidence suggests that the causes of poor academic achievement may partly lie in experiences and development during the preschool years. For example, Heckman and Wax (2004) recently proclaimed, "Like it or not, the most important mental and behavioral patterns, once established, are difficult to change once children enter school" (p. 14). This may be overstated, but the importance of the early years is clear.

One approach to ameliorating this early inequality has been to consider the benefits for disadvantaged children of high quality preschool childcare or education. Barnett (2001) showed how the deficits in emergent literacy for lower SES children can be reduced by preschool education. There is now ample evidence of the benefits of preschool education for children generally and not just the disadvantaged (e.g., Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Sammons et al., 2004; Sylva et al., 2004; Melhuish et al., 2006). Such evidence has influenced the 2004 introduction of state-funded universal part-time preschool education for 3- and 4-year-olds in the United Kingdom, the universal state-funded preschool education for 4-year-olds in some American states (e.g., Oklahoma, Georgia), as well as increased state preschool provision in several other countries (Melhuish & Petrogiannis, 2006).

Parenting also matters. Typically, for cognitive outcomes, the effect sizes for preschool childcare are only about a half to a third as large as those for parenting (NICHD ECCRN, 2006). Parenting varies with SES. Parcel and Menaghan (1990) found that mothers with more intellectually stimulating jobs provided more support and stimulating materials for their children, which was, in turn, linked to children's verbal skills. The argument linking low SES to lack of stimulation and lower cognitive development has a long history and has regularly been supported by evidence (e.g., Bradley, Corwyn, Burchinal, McAdoo, & Coll, 2001 2001; Brooks-Gunn, Duncan, & Aber 1997).

Parenting practices such as reading to children, using complex language, responsiveness, and warmth in interactions are all associated with better developmental outcomes (Bradley, 2002). This partly explains links between SES and developmental outcomes, in that higher SES parents use more developmentally enhancing activities (Hess et al., 1982). Stimulating activities may enhance development by helping children with specific skills (e.g., linking letters to sounds), but also, and perhaps most importantly, by developing the child's ability and motivation concerned with learning generally. Additionally, it is possible that a feedback loop is operating whereby parents are influenced by the child's level of attainment, which would lead to children with higher ability possibly receiving more parental stimulation.

Better understanding of the factors influencing children's preparedness for school and capacity for educational achievement has implications for (a) theories of educational achievement and (b) educational policy and practice. A theory of educational achievement must account for influences before schooling starts if it is to be worthwhile, and this study considers modifiable factors in the early years that can influence school readiness. Such evidence may be useful to governments wishing to maximize educational achievement and indicates appropriate steps to facilitate children's preparedness for school. Such policy changes may operate locally although enabling policies may need central government planning (Feinstein, Peck, & Eccles, in press). Findings from studies such as this may indicate the appropriate focus of such policies.

The study aims to advance research on parenting and preschool by considering aspects of the home environment and preschool composition as partial explanations for why home and preschool environments produce effects upon children's literacy and numeracy. To such ends, this study aims: to demonstrate that an interview-based measure of the home environment is associated with academic achievement at the start of school and in later years; to determine the influence of the child's preschool center upon academic achievement; and to identify whether preschool center composition is pertinent to developing literacy and numeracy during the first years of school. Groups with unexpected levels of attainment (not achieving as expected on the basis of demographic characteristics) were examined using multilevel modeling to examine performance at the level of both individuals and preschool centers. Thus, this study investigates sources of unexpected performance that are linked to the immediate environment (meso-level) rather than due to individual or more macro-level variables.

Method

Participants

One hundred and forty one preschool centers were randomly chosen in six local authorities, identified as having a demographic make-up similar to that of England overall. From these 141 centers 2857 children were recruited into a longitudinal study. Children already in preschools were recruited when they became 3 years old; children starting preschool after their third birthday were recruited at entry to preschool. Their mean age at entry to the study was 3 years 5 months ($SD = 4.6$ months). Full data exist for 2603 children and families at 3 and 5 years and 2354 at 3, 5, and 7 years.

Measures

When children entered the study, they were assessed with four subscales from the British Ability Scales II (BAS II; block building, picture similarities, verbal comprehension, and naming vocabulary) (Elliot, Smith, & McCulloch, 1996) to give a general cognitive ability (GCA) score. Upon entering primary school at age 5, children were assessed again with the BAS II. In addition, literacy was assessed by combining the Letter Recognition Test (Clay, 1993) and subscales on the Phonological Awareness assessment (Bryant & Bradley, 1985); numeracy was assessed by the Early Number Concepts subscale of the BAS II. At the end of the third school year (7+ years) nationally standardized, teacher conducted, national assessments of the children's achievement in reading and mathematics were obtained.

Shortly after initial child assessments, one of the child's parents or guardians was interviewed (usually the mother). Most questions in the semistructured interview were precoded, with some open-ended questions coded post hoc. The interview covered: parents' education; occupation and employment; family structure; ethnicity and languages used; the child's birth weight, health, development, and behavior; the use of preschool provision and childcare history; and significant life events. The parental interview included questions concerning the frequency that children engaged in 14 activities: playing with friends at home, playing with friends elsewhere, visiting relatives or friends, shopping with parent, watching TV, eating meals with the family, going to the library, playing with letters/numbers, painting or drawing, being read to, learning activities with the alphabet, numbers/shapes, and songs/poems/nursery rhymes, as well as having a regular bedtime. Frequency of activities was coded on a 7-point scale (0 = not at all; 7 = very frequent). A selection of these activities was used in the construction of a home learning environment index as described later.

Analytic Strategy

Children and families are clustered by preschool center and data are hierarchical. Using standard regression with such data can lead to inaccurate error variance estimates. Potentially, there is greater similarity between participants within the same centers so the independence of measurement assumption is violated and mis-estimating of levels of significance is likely. Hence, we used multilevel modeling (Goldstein, 2003) to overcome such problems and to provide estimates of center effects thus allowing the identification of preschool centers that were particularly effective or ineffective in fostering children's development.

Analyses focused on four outcomes: literacy and numeracy achievement at age 5 (start of primary school) and reading and mathematics achievement at 7+ years. First, multilevel models of age 5 outcomes were run to assess the extent of reliable variation in age 5 outcomes across preschool centers and to produce child and center residuals after controlling for family and background characteristics. These multilevel models estimate the proportion of variance not only between children within centers but also between centers. Children's predicted achievement in school was based on age, gender, birth weight, ethnic group, health, developmental or behavioral problems, mothers' and fathers' education, highest social class of mother and father (family socioeconomic status, SES), number of siblings, deprivation (eligible for free school meals or not), household income, and duration of preschool attendance. Several predictors were categorical (because the interview provided categorical answers) with a reference category (lowest usually, but for ethnicity white UK group as reference), and other predictors were continuous variables (i.e., birth weight, age, and duration of preschool).

Second, using multilevel model residuals at the individual level, three groups were formed: unexpected overachieving, expected, and unexpected underachieving. Analyses explored how the 14 individual home activities influenced the probability of children performing better or worse than expected. Using the results from these analyses, seven of the 14 home activities were selected to create a home learning environment (HLE) index. Also, using multilevel model residuals at the center level, the analyses explored how center composition predicted centers that had higher or lower scores than expected. The categories of over-achievers, average, and underachievers were calculated using the individual-level standardized residuals from the multilevel model. A child was considered to be performing below expectation if the child's standardized residual was more than one standard deviation below the mean of zero, above expectation if the standardized residual was above one standard deviation from the mean, and as expected if their score was within one standard error of the mean. Center effects were similarly categorized from the center-level standardized residuals, which provided a measure of the extent to which the children attending a particular center were performing above or below expectation. Multinomial models assessed the effect of the home learning environment index (HLE) on children's level of achievement as well as the effect of compositional effects (i.e., percentage of children with highly educated mothers, and average level of children's ability in centers) on the levels of achievement at the center level.

Third, new multilevel models were constructed that included the HLE and preschool center variables. Using these models, the effect sizes of the variables SES, mother's education, father's education, household income, and HLE were computed for the outcomes at 5 and 7 years of age. For the age 5 outcome models, children are treated as clustered within preschools and in the age 7 outcome models clustering is within schools. In order to take account of preschool center effects at age 7, preschool composition variables and a measure of preschool effectiveness derived from the 5-year outcome models are used as individual-level predictors.

Results

Achievement at Age 5

Children's characteristics and family background were included in the demographic multilevel model to predict children's age-adjusted achievement. From these models, three categories of performance (unexpected over-achievers, expected, and unexpected underachievers) for literacy and numeracy were constructed based on child residual scores deviating by at least ± 1 standard deviation. Each category of unexpected over- or under-achievement is a nominal outcome variable with *average achieving* children as the reference category. Sixteen percent of children were achieving higher than predicted from their background in both literacy and numeracy, and a similar proportion (16% literacy, 15% numeracy) were achieving less well than would be predicted. The age 5 multilevel model produced residuals at the center level, identifying centers as *over-* and *underachieving* centers in the same way (e.g., overachieving centers produce children having higher than expected scores given intake characteristics). Greater proportions of centers fall into these categories than children—about one-third (33% literacy, 29% numeracy) overachieving and underachieving (28% literacy, 29% numeracy).

Quantifying the Home Learning Environment

Each of the 14 home activity items was regressed in separate equations on the individual categorical variables of over- or underachievement. The seven social/routine activities (play with friends at home, and elsewhere, visiting relatives/friends, shopping, TV, eating meals with family, regular bedtime) were not significant for under- or over-achievement in literacy and numeracy at age 5. Conversely, the seven activities providing clear learning opportunities (frequency read to, going to the library, playing with numbers, painting and drawing, being taught letters, being taught numbers, songs/poems/rhymes) had significant positive effects on unexpected achievements. Since the items are conceptually and statistically linked a combined measure, the home learning environment (HLE) was created. The frequency of each of the seven activities was coded on a 0–7 scale (0 = not occurring, 7 = very frequent), and the seven scores were added to produce an index with a possible range of 0–49, which was normally distributed with a mean of 23.42 ($SD = 7.71$).

Center Composition

Center composition was considered in terms of the level of mother's education and average child cognitive ability in center at age 3. The percentage of children with a mother with a degree in each center was standardized about the median to account for a negative skew, with a mean of.31 ($SD = .94$). Center average ability was constructed as the standardized average of children's 3-year-old cognitive ability score, with a mean of $-.04$ ($SD = 1.00$). Center mothers' education and center child ability are highly associated ($r = .58$).

Predicting Under- and Over-Achievement at the Start of School (Age 5)

The multilevel models for age 5 outcomes treated children as clustered by preschool center, allowing the estimation and separation of residuals into individual and center variance, and estimation of the amount of variance explained by adding parameters to the model in stepwise fashion (see Table 1). For age 5 literacy and numeracy, family and background characteristics explained significant individual variation between children in centers: 16% for literacy and numeracy scores. Thus, most variation in children's achievement was not due to family or background characteristics but to other unmeasured factors not considered in the demographic model.

It was hypothesized that variations in predicted achievement based upon family and background characteristics (i.e., unexplained individual-level variance) would be partially accounted for by the home learning environment and by center composition. Firstly, the categories of over- and under-achievement for children and centers were examined for a relationship with home learning environment at the child level, and with center composition, at the center level. The mean HLE scores for the over-achieving (mean = 26.44, $SD = 7.26$), average (mean = 23.61, $SD = 7.45$) and underachieving (mean = 21.62, $SD = 7.83$) groups of children appear to vary systematically for the demographically adjusted levels of achievement (i.e., unexpected overachieving, expected, and unexpected underachieving) in literacy. Multinomial logistic regressions confirm, as hypothesized, that children with a higher HLE are more likely to be overachievers ($p < .0001$), while lower

Table 1. Fixed and Random Effects at Child and Center Levels for the Prediction of Age 5 Literacy and Numeracy Achievement (Standard Deviations in Brackets)

	Random effects	Demographic model	Add HLE	With center ability	With center % mothers with degree
1.1: Literacy achievement at age 5					
Intercept	.04	−1.27	−1.07	−1.06	−1.80
	(.40)	(.97)	(.96)	(.95)	(1.00)
Home learning environment	–	–	1.72*** (.17)	1.83*** (.17)	1.80*** (.62)
Center cognitive ability	–	–	–	1.89*** (.27)	–
Center% mothers with degree	–	–	–	–	1.77*** (.28)
Random effects					
Individual error variance (δ)	74.08***	61.69***	58.89***	58.81***	58.79***
	(2.07)	(1.77)	(1.69)	(1.68)	(1.65)
Center error variance (T)	18.06***	6.38***	7.49***	4.87***	5.32***
	(2.68)	(1.26)	(1.41)	(1.03)	(1.08)
Inter-class correlation between centers	.196	.094	.113	.076	.083
Explained variance		16.7%	20.5%	35.0% (center level)	29.0% (center level)
1.2: Numeracy achievement at age 5					
Intercept	.04	−.17	.03	−.002	−.52
	(.38)	(1.08)	(1.07)	(1.06)	(1.07)
Home learning environment	–	–	1.43*** (.19)	1.54*** (.19)	1.50*** (.19)
Center cognitive ability	–	–	–	1.40*** (.28)	–
Center% mothers with degree	–	–	–	–	1.20*** (.29)
Random effects					
Individual error variance (δ)	92.08***	77.63***	75.718***	75.572***	75.61***
	(2.49)	(2.22)	(2.16)	(2.16)	(2.16)
Center error variance (T)	15.24***	4.67***	5.18***	4.00***	4.35***
	(2.49)	(1.13)	(1.20)	(1.02)	(1.07)
Inter-class correlation between centers	.142	.057	.064	.050	.054
Explained variance		15.7%	17.8%	22.8% (center level)	16.0% (center level)

Statistically significant $^{*}p < .05$; $^{**}p < .001$; $^{***}p < .0001$.

HLE scores are associated with underachievement ($p < .0001$). For numeracy, the effects were also significant but not as strong as for literacy. Children with higher HLEs had a greater likelihood of overachieving in numeracy, and those with lower HLE had a greater likelihood of underachieving in numeracy.

Next the hypothesized link between center composition and differences at the center level in predicted achievement was considered. The mean center child ability varied for the overachieving (mean = 2.86, *SD* 7.39), average (mean = −.06, *SD* = 5.68), and underachieving (mean = −4.09, *SD* = 6.08) categories in literacy. For numeracy, mean center child ability also varied for the over-achieving (mean = 3.26, *SD* = 6.53), average (mean = −0.94, *SD* = 6.51), and underachieving (mean = −2.69, *SD* = 6.65) categories. The mean center percent of mothers with degree also varies for the overachieving (mean = 18.89, *SD* = 23.79), average (mean = 8.76, *SD* = 17.91), and underachieving (mean = .80, SD = 10.31) categories in literacy and for numeracy (overachieving mean = 13.14, *SD* = 2.92; average mean = 11.08, *SD* = 18.55; and underachieving mean = 4.88, *SD* = 17.20). Multinomial logistic regressions confirm that over- and underachievement for centers is significantly associated with center composition. Center average ability differentiated overachieving centers from average-achieving centers for literacy and numeracy, but only differentiated underachieving centers from average-achieving centers for literacy, with the difference for numeracy not statistically significant. Center levels of degree-educated mothers increased the likelihood of overachievement and reduced underachievement for literacy, but the differences for numeracy were not significant.

To support the conclusions that the HLE and center composition added to the prediction of achievement over that provided by family and background characteristics for children, new multilevel models for literacy and numeracy were created. These models included HLE and either center average ability or center percent of mothers with degree as predictors in addition to the significant family and child background factors (see Table 1). By adding the HLE to the demographic model, the explained variance at the child level showed a 21% increase for age 5 literacy and an 18% increase for age 5 numeracy.

Although the magnitude of random variance between centers was relatively small compared to that between children, after accounting for the potentially selective effects of family background on the choice of preschool centers in the demographic model, variation in literacy and numeracy scores at the center level were significantly reduced. For example, center variance in age 5 literacy scores showed a 52% decrease due to selection effects. With HLE in the model, center variance for literacy was 11%. Adding center composition into the multilevel models separately led to a 33% reduction in center-level variance with center ability added and a 27% reduction with center percent of mothers with degree added. With HLE in the model, center variance for numeracy was 6%. Adding center composition into the multilevel models separately led to a 22% reduction in center-level variance with center ability added and a 16% reduction with center percent of mothers with degree added. While including center composition reduces unexplained center level variance, there was still significant center level variation remaining, suggesting that further unmeasured characteristics of preschool centers need to be explored.

Predicting Under and Overachievement at Age 7

The multilevel models for age 7 outcomes treated children as clustered within schools. The demographic multilevel models were used to produce three groups of children that vary in relation to expected performance (unexpected overachieving, expected, and unexpected underachieving) using the 7-year-old scores of reading and mathematics. The groupings based on child level residual scores indicates more homogeneity at 7 than at 5 years, with most children achieving at the expected levels in reading (76%) and mathematics (80%), which may be partly due to the relative lack of precision and differentiation of the national assessments administered in classroom groups by teachers at age 7 compared with the one-to-one standardized psychometric assessments used at age 5 and administered by the research team. HLE scores for the overachieving (mean = 23.81, *SD* = 7.89), expected (mean = 24.22, *SD* = 7.40), and underachieving (mean = 20.37, *SD* = 7.93) groups indicate lower HLE for the underachieving group but little difference between the average and overachieving groups in reading. Also, for mathematics, the HLE scores for the overachieving (mean = 23.38, *SD* = 7.32), expected (mean = 24.13, SD = 7.50), and underachieving (mean = 20.40, *SD* = 8.21) groups of children indicate lower HLE for the underachieving group but little difference between the average and overachieving groups. Multinomial logistic regression confirmed that links between HLE and achievement level at age 7 were significant in only one direction: Unsupportive home learning environment was associated with increased likelihood of underachievement for reading and mathematics. Supportive home learning environment did not have a statistically significant effect on overachievement at age 7 relative to predicted achievement.

To further examine the effects of HLE and preschool variables on the prediction of achievement over that provided by family and background characteristics for children, new multilevel models for reading and mathematics at age 7 were created that added the HLE, then preschool center effectiveness (derived from age 5 demographic models), and subsequently either center average ability or center percent of mothers with degree as predictors in addition to the significant family and child background factors (see Table 2). Comparison of models indicates a significant contribution of the HLE to children's attainment. Adding the HLE to the demographic model, the variance explained increased by 10% for reading and 6% for mathematics. Recall that the increased explanation given by HLE on age 5

Table 2. Fixed and Random Effects at Child and School Levels for the Prediction of Age 7 Reading and Mathematics Achievement (Standard Deviations in Brackets)

	Random effects	Demog. model	Add HLE	With center effect/ness	With center ability	With center % mothers with degree
2.1: Reading attainment at age 7						
Intercept	.073***	−.208*	−.166	−.164	−.163	−.16
	(.018)	(.086)	(.085)	(.085)	(.085)	(.085)
Home learning environment	–	–	.125***	.123***	.121***	.123***
			(.015)	(.015)	(.015)	(.015)
Preschool effectiveness				.022*	.015	.022*
				(.007)	(.008)	(.008)
Center cognitive ability	–	–	–	–	.042*	–
					(.019)	
Center% mothers with degree	–	–	–	–	–	−.005
						(.019)
Random effects						
Individual error variance (δ)	.452***	.356***	.344***	.343***	.342***	.343***
	(.015)	(.012)	(.011)	(.011)	(.011)	(.011)
School error variance (T)	.064***	.035***	.036***	.035***	.036***	.035***
	(.011)	(.008)	(.008)	(.008)	(.008)	(.008)
Interclass correlation between schools	.124	.088	.095	.094	.095	.093
Explained variance		21.7%	23.9%	24.1%	24.4%	24.1%
2.2: Mathematics attainment at age 7						
Intercept	.052*	−.066	−.032	−.031	−.031*	−.035
	(.016)	(.072)	(.069)	(.069)	(.069)	(.069)
Home learning environment	–	–	.087***	.086***	.085***	.085***
			(.013)	(.013)	(.013)	(.013)
Preschool effectiveness				.028*	.025*	.026*
				(.009)	(.009)	(.009)
Center cognitive ability	–	–	–	–	.018	–
					(.016)	
Center % mothers with degree	–	–	–	–	–	−.014
						(.019)
Random effects						
Individual error variance (δ)	.342***	.286***	.282***	.281***	.281***	.281***
	(.011)	(.009)	(.009)	(.009)	(.009)	(.009)
School error variance (T)	.047***	.025***	.026***	.025***	.025***	.026***
	(.008)	(.006)	(.006)	(.006)	(.006)	(.006)
Inter-class correlation between schools	.121	.081	.084	.083	.083	.084
Explained variance		16.5%	17.5%	18.6%	18.6%	18.7%

Statistically significant $^{*}p < .05$; $^{**}p < .001$; $^{***}p < .0001$

Table 3. Effect Sizes for SES, Mothers' and Fathers' Education, Income, and HLE on 5- and 7-Year Outcomes

	5 year		7 year	
	Literacy	Numeracy	Reading	Mathematics
SES	.29	.43	.37	.39
Mothers' education	.35	.23	.33	.33
Fathers' education	n.s.	n.s.	.19	.16
Earned income	.31	.28	.15	.15
HLE	.73	.65	.60	.50

Note: n.s. = not significant; HLE = Home Learning Environment.

achievement scores was 21% and 18%, respectively. Hence the HLE's effects on children's achievement were reduced by age 7, but were still significant. Preschool center effectiveness has significant effects for both 7-year reading and mathematics attainment. Adding center average ability reduced this effect to insignificance for reading but had no impact for mathematics. The educational level of mothers of children in a center had no significant effect for reading or mathematics.

Effect Sizes for Child Level Variables

The final multilevel models allow for the calculation of effect sizes for an independent variable having allowed for the influence of all other variables in the model. Effect sizes are calculated for the HLE variable and also the main aspects of social class (i.e., family SES, mother's and father's education, and household income); these are shown in Table 3. For 5-year-old literacy achievement, the effect size for HLE (bottom 10% compared with top 10%) was greater than that for any of the variables reflecting social class. For 5-year-old numeracy, HLE again had the largest effect size followed by SES, then household income and mother's education. For both 7-year-old reading and mathematics, the largest effect size was still for HLE, followed by SES, mother's education, father's education, and household income.

Discussion

The results clearly support the importance of the Home Learning Environment (HLE) and the influence of the HLE was over and above that of standard proxy measures of parental education and SES. The results also demonstrate that this interview method is useful for identifying variability in parenting. While other family factors such as parents' education and SES are also important, the extent of home learning activities exerts a greater and independent influence on educational attainment.

The comparison of over, average, and underachieving groups indicates that at age 5 the HLE is effective in differentiating both over and underachieving groups from children achieving as expected (i.e., across the ability range). However, by age 7 the HLE for both reading and mathematics achievement only differentiates underachieving children from average and overachieving children, with no difference between average and overachieving children, indicating that its effects are more localized on the lower ability range. The changes in effect size by age 7 could be due to several reasons: (a) age 5 assessments are more precise and have better differentiation in the upper ability range than those at age 7; (b) over time, earlier experiences become less influential, losing their developmental significance; or (c) new sources of influence, especially schooling, affect children's development. Possibly, the continuing effects at age 7 of the HLE, measured 4 years previously, is to be expected from continuity over time in the relative standing of homes on developmentally enhancing activities (i.e., it is concurrent effects of the HLE rather than earlier experience producing longer-term effects upon development). However, the interpretation that earlier home experience matters is supported by NICHD study evidence (Belsky et al., 2007) indicating that parenting sensitivity at 4.5 years predicts cognitive development at age 10 with current parenting controlled. Also, the importance of early parenting variables is further supported with adolescent educational achievement reported by Englund, Egeland, & Collins (in press). Developmental versus environmental continuity issues pervade longitudinal research and require ongoing attention.

With regard to preschool center effects, the significant center level variance at 5 years of age for both literacy and numeracy indicates that specific preschool experiences matter. The addition of either preschool composition variable to the 5-year model significantly reduces the preschool center level variance, but this reduction is greater for center composition in terms of average ability of children in a center rather than in terms of the educational level of mothers using a center, for both literacy and numeracy. However these effects leave much preschool center variance unexplained indicating that yet further characteristics of preschools, such as quality of provision, need to be considered to understand more completely how specific preschools influence children's development. One approach is to use qualitative case studies to explore quantitatively defined effective and ineffective preschools (e.g., Siraj-Blatchford et al., 2003; Sammons et al., 2005). At age 7, the measure of preschool center effectiveness derived from the 5-year models significantly contributes to explaining both 7-year reading and mathematics attainment. However, adding average ability of children in a center reduces this effect to insignificance for reading. Hence preschool composition in terms of average ability of children in a center has a persisting effect on 7-year reading (but not mathematics) while the educational level of mothers of children in a center no longer has a significant effect. Such specific preschool effects are further evidence of the importance of preschool education for children's school readiness.

The home learning environment is important for school readiness in addition to benefits associated with preschool. The home learning environment is only moderately associated with SES and parents' educational levels (correlations = .28 –.32), indicating that low SES homes sometimes score highly and, conversely, high SES homes sometimes score poorly on the HLE measure. In studies using the Home Observation for the Measurement of the Environment (HOME), the correlations between HOME and maternal education or SES are in the range 0.36 to 0.50 for differing social and ethnic groups. Generally HOME measures are significantly associated with social and cognitive development after controlling for demographic factors (Bradley et al.). Others have found that the affective quality of mother-child interactions predicts cognitive skills (e.g., Estrada, Arsenio, Hess, & Holloway, 1987). Such findings led Conger et al. (1992) to conclude that between 20–50% of the variance in child outcomes can be accounted for by differences in parenting.

The effects of the home environment and parenting upon children's development may partly be due to the teaching and learning of specific skills (e.g., letter-sound relationships). However, the multiplicity of learning opportunities included in the HLE suggests that the effects may be related to more generalized and motivational aspects of child development (e.g., learning to learn). Also, children may internalize aspects of parental values and expectations (implicit in the activities of the HLE) as they form a self-concept of themselves as a learner. Such a perspective is congruent with Vygotsky's (1978) theory that children learn higher psychological processes through their social environment and specifically with adult guidance operating within a child's "zone of proximal development" (stimulation within the child's comprehension) and reinforces the idea that children acquire cognitive skills such as literacy through interaction with others who aid and encourage skill development.

It is quite possible that the strong relationship between home learning environment and cognitive scores is mediated by some intervening unmeasured factor. Those parents, who answer the questions in a way leading to a high score, may have other characteristics that lead their children to have higher cognitive scores. Even if this were so, the HLE would still be an efficient proxy measure of such unmeasured factors.

Whatever the mechanisms, the influences of parenting upon child development are pervasive. Research involving 0–3 year-olds from the evaluation of the Early Head Start (EHS) program, which provided combinations of home-visits and center childcare intervention for disadvantaged families, found that the intervention increased both the quantity and quality of parents' interaction with children, as well as children's social and cognitive development (Love et al., 2005). A review of early interventions concluded that, to gain the most impact, interventions should include both parent and child together with a focus on enhancing interactions (Barnes & Freude-Lagevardi, 2003). Such work indicates that parenting behaviors are learnable, and changes in parenting are associated with improved child development. Similar conclusions derive from a study by Hannon, Nutbrown, and Morgan (2005) in the United Kingdom, where children showed better literacy progress when parents received a program on ways to improve child literacy during the preschool period.

With primary school children, similar links between parenting and academic achievement occur. DeGarmo, Forgatch, Martinez (1999) found that the effects of parent education upon primary school achievement were primarily mediated through parents' provision of opportunities for building intellectual skills. Reviewing studies, Mason and Allen (1986) concluded that the quality and quantity of interactions, not just reading materials and a story time routine, shaped early literacy. Similarly, Zellman and Waterman (1998) found parent-child interaction more important than other family variables for primary school children's success in reading or mathematics.

With secondary school children, similar effects are detectable. In the United States, Siu-Chu and Willms (1996) analyzed data for 24,000 14-year-olds and found that parental involvement was linked to academic achievement over and above the effects of family demographics; in particular, parent-child interaction seemed most important. Similarly, in the UK, Feinstein and Symons (1999) found that indicators of parental interest and involvement with child learning were more important in predicting academic achievement at 16 than parental education and social class.

Such research indicates the importance of school readiness, and mounting evidence demonstrates the role of parenting for children's school readiness skills and ongoing achievement. Academic achievement in adolescence and beyond can be linked to academic skills at school entry (Alexander, Entwisle, & Horsey, 1997), and school entry ability can, in turn, be linked to preschool abilities (Agostin & Bain, 1997). Possibly, preschool experience matters because behavior is more susceptible to the environment earlier rather than later in childhood or because starting school is a critical social transition when ability predicts longer-term achievement through creating expectations.

The influences upon parenting and how parenting may influence educational achievement are not simple matters. Poverty, parental education, culture, ethnicity, parental age, health, and other factors are all likely to be important, and multiple factors will interact complexly as shown by Messersmith and Schulenberg (in press) for college students. However, it is clear that parenting is influenced by poverty. For instance, NICHD ECCRN (2005) reported that families in chronic poverty have less stimulating home environments but that the home environment improves as families move out of poverty. Also, families exposed to transient poverty appear to manage to maintain adequate home stimulation despite restricted resources. Wachs and Camli (1991) noted that crowding, the number of people coming and going in the home, and noise level, may have adverse effects on parenting and child development via a reduction in maternal involvement, verbal stimulation, and maternal responsivity.

Poverty is linked to poorer child outcomes as well as poorer parenting (Brooks-Gunn et al., 1997). Children in persistent poverty have greater cognitive and behavioral deficits at age five than those exposed to transient poverty, who in turn have more deficits than children in nonpoor families (Korenman, Miller, & Sjaastad, 1995). Some deficits can be attributed to health problems associated with poverty, but the greatest part can be explained by reduced emotional support and less cognitive stimulation from parents (McLoyd, 1998).

Such findings suggest that policies for disadvantaged parents that encourage active parenting strategies can help to promote young children's literacy and numeracy and facilitate later academic achievement. However, responsibility should not be placed solely on parents. The provision of good quality preschool education from 3 years of age is likely to produce further benefits, particularly when the preschool center works closely with parents. Studies of successful preschools by Siraj-Blatchford et al. (2003) indicate that preschools that promote activities for parents and children to engage in together are likely to be most beneficial for young children, and this has implications for strategies to help disadvantaged children start school with more academic skills and maintain their educational achievement. Studies as described in this paper, and other work on preschool education, have been influential in the formulation of early years policy in the UK as evidenced in the *Children Act* (2004) and the UK government's *Ten Year Childcare Strategy* (DfES, 2004; see Sylva & Pugh, 2005). Additionally, this work has influenced the guidelines developed by the UK government for Children's Centres, which provide integrated services including childcare, preschool education, and parent support in disadvantaged areas, and has attracted interest from policy makers in several countries such as China, Malaysia, Australia, and Canada. With regard to the United States, Heckman (2006) argued that later compensation for deficient early family environments is very costly, and that early intervention is the only cost-effective route to take to simultaneously promote social justice and economic productivity. Finally, it is noteworthy that several countries such as China appear to be recognizing the importance of preschool experience and early years education as an essential part of the infrastructure for economic development (Melhuish & Petrogiannis, 2006).

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Queries

Q1 Author: Please provide all author names in reference Love et al. 2005.