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ABSTRACT

Data from a 20-year longitudinal study of 125 males and 126 females born to Black teenage mothers in a Baltimore hospital between 1966 and 1968 were analyzed to identify early childhood, middle childhood, and early adolescence determinants of functional literacy. All 251 subjects were interviewed in 1987, and 202 of them completed a document literacy questionnaire. The questionnaire responses were subjected to a multivariate regression analysis. Demographic data and data from preschool cognitive and behavioral assessments and interviewer evaluations of the subjects' households/household members at different times throughout the study were also collected. Preschool cognitive and behavioral functioning was found to be highly predictive of literacy in young adulthood even when the effects of family environmental characteristics such as living arrangements, quality of home environment, maternal education, and income are controlled. Grade failure in elementary school was linked to later literacy; however, the effect of grade failure disappeared when the measure of preschool abilities was controlled. Family environmental factors identified as being predictive of literacy were as follows: maternal education, family size in early childhood, maternal marital status, and income in middle childhood and early adolescence. (Appended are data tables. Contains 61 references.) (MN)

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NATIONAL CENTER ON ADULT LITERACY

EARLY WARNING SIGNS OF FUNCTIONAL ILLITERACY:

PREDICTORS IN CHILDHOOD AND ADOLESCENCE

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PREDICTORS IN CHILDHOOD AND ADOLESCENCE[1]

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Frank F. Furstenberg

Abstract

Early childhood, middle childhood, and early adolescence determinants of functional literacy in adulthood are investigated in this paper by using 20-year longitudinal data from a sample of black children of teenaged mothers from the Baltimore metropolitan area. Preschool cognitive and behavioral functioning was found to be highly predictive of literacy in young adulthood, even when the effects of family environmental characteristics, including living arrangements, the quality of the home environment, maternal education, and income are controlled. Grade failure in elementary school is also associated with literacy, but this effect disappears when the measure of preschool abilities is controlled. Family environmental factors that are predictive of literacy include maternal education, family size in early childhood, maternal marital status, and income in middle childhood and early adolescence.

INTRODUCTION

Literacy is essential for functioning in industrial societies. Reading and writing skills are keys to a lifetime learning process in our society, where job requirements change continuously (Miller, 1988; National Academy of Science, National Academy of Engineering, & Institute of Medicine, 1984). Moreover, literacy enables active participation in the society where much of the political and economic transactions are based on written documents. However, there are significant literacy problems in the United States. The United States ranks forty-nineth among 159 members of the United Nations in its average level of literacy (Larrick, 1987). The number of adults who are not functionally literate in the United States is estimated to be 54-64 millions (Hunter & Harman, 1979). About one-fifth of all young adults and about one-half to one-third of minority young adults in the United States read under the eighth-grade level (Kirsch & Jungeblut, 1986). The number of individuals who have levels of literacy that are not adequate for active participation in an advanced technological society (Venezky, Kaestle, & Sum, 1987) and the disparities in literacy achievements of various subgroups, such as minority versus nonminority populations (Hunter & Harman, 1979), add to the literacy problem.

Levels of literacy of individuals and societies are often taken as indicators of well-being. The literacy problem became a focus of policymakers because of its implications for social and economic well-being. Low levels of literacy have been linked to low productivity, high unemployment, low earnings, and high rates of welfare dependency and teenage parenting, all of which are common measures of the socioeconomic well-being of a society (Berlin & Sum, 1988). Therefore, preventing illiteracy and improving the levels of literacy in all subgroups of the population, especially among minorities, are important educational policies.

The primary goal of the research presented here is to identify early childhood, middle childhood, and adolescence precursors of document literacy in a sample of black metropolitan young adults who were born to teenage mothers. We do not attempt to unravel the processes through which childhood and adolescence circumstances determine the formation of literacy skills. Rather, our aim is to identify early predictors of adulthood literacy levels that can be used to define high-risk groups in each developmental period (i.e., early childhood, middle childhood, and early adolescence) and in all developmental periods combined.

Environmental events occurring during the young childhood years and the abilities of the preschool child are key determinants of later development (Hunt, 1961; Wachs & Gruen, 1982), even though few studies followed very young children into young adulthood (as notable exceptions, see Brooks-Gunn, Phelps, & Elder, 1991; Elder, 1984; Gjerde & Block, 1991; Werner & Smith, 1982). The middle childhood years are less often postulated as a central developmental stage vis-à-vis young adult functioning. However, grade failure is a predictor of low long-term educational achievement (Haskins, 1989; Willet & Singer, 1992), and behavior problems, especially aggression and disengagement in elementary school, are associated with later school problems (Cairns, Cairns, & Neckerman, 1989; Connell, 1991). The

young adolescent years are characterized by the confluence of social, cognitive, and behavioral events. The number of new challenges faced by youth and the behavioral choices to be made render it a stage of importance for later functioning (Brooks-Gunn & Petersen, 1983; Feldman & Elliot, 1990; Gunnar & Collins, 1988; Lerner & Foch, 1987).

Our data come from a 20-year follow-up of approximately 250 teenage mothers and their children from Baltimore, most of whom are economically disadvantaged. These children were 18 to 21 at the time of the literacy assessment (Furstenberg, 1976). These data lend themselves to an analysis of antecedents of low literacy achievement because they include family and educational histories from birth to young adulthood, and early childhood assessments of cognitive and behavioral development. A multivariate model is employed to exploit the wealth of these data in order to identify early warning signs of illiteracy.

One limitation of this study is its relatively small, nonprobability, convenience sample. In order to gain a better perspective on this sample, its characteristics are compared to those of the metropolitan black young adults from the sample of the National Assessment of Educational Progress (NAEP) Literacy Survey, conducted in 1985 on a national sample of young adults aged 21 to 25. Additional comparisons of the Baltimore sample with the black subsample of the National Survey of Children are provided. The comparisons lead to a qualitative assessment of the generalizability of the Baltimore data.

Two questions are addressed regarding the predictors of literacy in young adulthood. First, are circumstances in early childhood, middle childhood, or early adolescence years predictive of later literacy? Our premise is that, while the most proximal events, specifically those occurring in early adolescence, will be highly predictive of young adulthood literacy, earlier events will also contribute to literacy, as has been demonstrated for other outcome measures (Kellum, Adams, Brown, & Ensminger, 1982; Rutter & Garmezy, 1983; Werner & Smith, 1982). Prior research has indicated that literacy skills are partly developed in early childhood (IRA, 1986; Larrick, 1987), and the characteristics of the home environment, such as language patterns and interaction patterns at home, plus the value placed on literacy and learning activities by a child's family, may mediate the acquisition of literacy (Fox, 1990). In addition, inadequate literacy experiences in early childhood were found to inhibit literacy achievement (Auerbach, 1989; Chall & Snow, 1982; Fox, 1990; Taylor, 1983). Since literacy is acquired primarily in early grade school years, and since preschool circumstances are predictive of early school achievement, we expect that the early childhood factors will be strongly predictive of young adulthood literacy. On the other hand, because middle childhood is the period when most formal literacy education is received, school achievement in this period may be highly indicative of young adulthood literacy. While educational achievement in early adolescence will be strongly associated with young adulthood literacy, it is believed that such indicators will have precursors in middle and even in early childhood.

The second question that is addressed in this paper pertains to the relative contribution of family environmental and cognitive or educational factors to literacy levels in young adulthood. Maternal life circumstances are known to

determine later school success (Furstenberg, Brooks-Gunn, & Morgan, 1987; Garfinkel & McLanahan, 1986; Kellum et al., 1982; Rutter, 1979) which, in turn, predicts literacy. To our knowledge, no longitudinal study has explored the power of childhood and adolescence family life circumstances for predicting functional literacy in young adulthood weighing the relative significance of factors measured at three different stages of the life cycle. Our expectation is that both cognitive/behavioral or educational factors will be more strongly predictive of literacy than family circumstances. Family environmental factors contribute to preschool cognitive and behavioral functioning (Sameroff, Seifer, Barocas, Zex, & Greenspan, 1987; Wachs & Gruen, 1982), which in turn contributes to subsequent school achievement and literacy (Furstenberg et al., 1987). Hence, the family environmental factors may be regarded as indirect determinants of literacy, while cognitive-behavioral and educational factors may be regarded as its proximate determinants.

METHOD

SAMPLE

The Baltimore study is an approximately 20-year follow-up of a sample of black teenage mothers and their firstborn children. All of the black young adults who are the focus of this study were born in a particular hospital in Baltimore between 1966 and 1968. The sample consists of 125 males and 126 females who were last interviewed in 1987 when they were 19 to 21 years old. From these, 202 young adults completed the document literacy questionnaire.[2] The six waves of the Baltimore study provide longitudinal demographic data, preschool cognitive and behavioral assessments, and interviewers' evaluations of the households and household members when the subjects were in early childhood, middle childhood, and early adolescence (for a detailed description of these data, see Furstenberg et al., 1987). The data used in this study come from the waves 4 (1972), 5 (1983-84), and 6 (1987) of the follow-up study.

Statistical inferences to a well defined population using the Baltimore sample are not possible since it is a convenience sample. Instead, we provide a qualitative assessment of the degree to which the characteristics of the Baltimore sample are similar to those of the metropolitan black young adults of the National Assessment of Educational Progress (NAEP) literacy sample. The NAEP adult literacy survey was administered to 3,618 adults in 1985, who constituted a nationally representative sample of approximately 21 million 21-to-25 year-old adults in the United States. Each subject was administered a background questionnaire and three blocks of questions out of seven possible blocks according to a Balanced Incomplete Block (BIB) spiraling design.[3]

MEASURES

MEASURES OF LITERACY

In this study, literacy is assessed by a document literacy test. Conventional literacy assessments were based on the measurement of abilities to read and write. Contemporary assessments of literacy measure the ability to negotiate some common literacy-dependent tasks. The emphasis on the skills that are necessary to fulfill one's role as a member of a society recognizes the social context of literacy skills (Hunter & Harman, 1979; Pellegrino, 1988). The ability to use written documents constitutes an important part of daily functioning in today's society (Guthrie, Seifert, & Kirsch, 1986). Document literacy may be distinguished from prose literacy because of the distinct forms of grammar and syntax that are used in documents (Kirsch & Mosenthal, 1988).

The document literacy data used in this study came from a questionnaire of 22 items regarding 11 brief documents. All questions except one were borrowed from the NAEP adult literacy questionnaire. Subjects took about 20 minutes (median) to complete the questionnaire. Only two subjects took longer than 45 minutes. The tasks ranged from simple (signing a document) to moderately difficult (planning a trip using an arrival-departure table).

In this study, a simple index of literacy was employed denoting the percentage of correct answers to the set of questions that were administered to both Baltimore and NAEP samples (the mean equals seventy-four, standard deviation equals eighteen). All members of the NAEP sample did not answer the same set of questions because of the BIB questionnaire design. Hence, we computed a literacy score for each NAEP subject who was administered at least 10 questions out of the 21 possible questions that were included in both studies.[4] Since the document literacy proficiency scores reported by the NAEP studies and the percentile scores result in similar rankings of individuals' literacy levels, the interpretation of the proficiency scores based on NAEP's calibration studies (Kirsch & Jungeblut, 1986) can be employed to aid the interpretation of our results.[5]

- Percentage of correct answers up to 60% indicates a successful negotiation of no more complex tasks than those consisting of a single feature (a single item to be identified on the document in order to provide the correct answer) and a single exemplar (distractor on the document). Such tasks include signing and recognizing the expiration dates of identification cards, filling in personal data on application forms, and using television program listings to identify the show time of a particular program.
- From 60% to 90% of correct answers indicates achievement of two feature and two or more exemplar tasks. Scores of 75% to 90% indicate some knowledge of the process as well. Examples of such tasks are filling out a telephone message slip, identifying coupons for a shopping list, identifying the appropriate dosage for a medication, and completing a school registration form.
- Scores of 90% to 100% indicate achievement of multiple feature-multiple exemplar tasks. Planning a trip using a bus schedule, writing narrative telephone messages, checking the accuracy of a shipping list,

and interpreting tables and charts are examples of multiple feature-multiple exemplar tasks.

MEASURES OF THE FAMILY ENVIRONMENTAL FACTORS

We consider four types of measures that describe the family environmental factors: measures describing the living arrangements, quality of the home environment, maternal commitment to education, and economic well-being. These four types of measures are discussed below.

Family Living Arrangements

Family characteristics are determined on the basis of retrospective maternal reports taken when the subjects were approximately 15-17 years old. These data were elicited by a life calendar. The family living arrangement variables were constructed for three periods of childhood: ages 0-4, ages 5-10, and ages 11-15. In this study, measures describing the living arrangements in each developmental period of interest were used. Living arrangements and their stability define an important aspect of the family environment, since they reflect the presence and continuity of parent figures, family support that was available for the teenage mothers of the subjects, and the opportunity for interactions with the parents or parent figures. The following characteristics are considered in this study for each age interval:

- number of years the mother was the only adult in the household,
- number of years mother was married,
- number of years the father was present in the household, and
- number of siblings born.

Certain variables describing the living arrangements of the mother during childhood and adolescence are highly correlated. For example, the correlation between father presence and mother's being married during early childhood was .84, because during the first few years following the child's birth, teen mothers were most likely to marry the fathers of their children. During early childhood, mother's being unmarried does not imply that mother is the only adult in the household because it was common among teen mothers to continue living with their mothers (the subjects' grandmothers—29%). However, by middle childhood and adolescence, the negative association between being the only adult in the household and being married increased (-.48 in adolescence). In multivariate analyses, one variable must be chosen among the collinear variables. If more than one of the variables denoting maternal marital status, whether the mother was the only adult, and biological father presence were significantly associated with literacy scores in bivariate analyses, mother's marital status was chosen over a variable representing father presence since a father figure will have similar effects on a child as the biological father. Furthermore, mother's marital status is often readily available for the identification of at-risk groups.

Physical and Emotional Quality of the Home Environment

Two scales measure the physical and emotional quality of the home environments of the children. The quality of the relationship between the mothers and children was reported by the interviewers when the children were 4-6 years old. This scale includes eight items describing the degree of

involvement, encouragement, praise, confidence, severity, warmth, and verbal communication of the mother toward the child (alpha equals .76). The HOME scale is based on the interviewers' ratings of the homes in early childhood (ages 4-6) and in adolescence (ages 15-17) and consists of seven items that describe the physical quality of the home and neighborhood environment. These items measure whether the environment is safe for the child, the rooms are overcrowded with furniture, the house is dark or noisy, the furnishing quality is good, the physical condition of the house is good, and whether the house is kept in good condition. This scale is similar to the "stimulating physical environment" subscale of the HOME scale (Bradley & Caldwell, 1981; Bradley, Caldwell, & Elardo, 1979; Bradley & Rock, 1985), which is predictive of cognitive development in young children (e.g., Bradley & Caldwell, 1976). The reliability of the HOME scale is .76 in early childhood (the mean equals 4.9, the standard deviation equals 2.0) and .65 in adolescence (the mean equals 5.5, the standard deviation equals 1.0).

Maternal Commitment to Education

There are three measures that reflect mothers' commitment to education. These are the maternal educational attainment when the subjects were 4-6 years old, maternal educational aspirations at that time, and maternal educational aspirations for the child (i.e., the subject) at that time, all measured in years of education. Since the measures of maternal educational attainment and maternal educational aspirations are strongly correlated (0.55), and since at the time of reporting the mothers were very young, the educational aspirations could be taken as an important indicator of educational commitment, alongside the educational attainment. We use the mean of the two measures to indicate maternal educational level (the mean equals 11.6, the standard deviation equals 1.1). The measure of maternal educational aspirations for the subjects in early childhood is correlated with this measure by 0.34. In multivariate analyses, when one of the two measures had to be selected, maternal educational level was preferred for the following reason: The maternal educational aspirations for the child may partly be determined by the child's ability level, and hence confound the effects of early childhood developmental outcomes with maternal commitment to education.

Economic Well-Being

Two measures of economic well-being are available—mother's dependence on public assistance and per-person family income. For each of the three periods of childhood, variables denoting the number of years mother was dependent on public assistance were constructed. The percentage of mothers who did not receive any public assistance was 58% in early childhood, 61% in middle childhood, and 67% in early adolescence. Per-person family income is available at the time of the interviews in 1972 (the mean equals 1,509; the standard deviation equals 1,397) and 1983 (the mean equals 4,739; the standard deviation equals 4,264). While the number of years spent on public assistance summarizes the level of economic well-being over a period of several years, it is not a very accurate measure of economic well-being. Per-person family income, on the other hand, provides an accurate measure of economic well-being, but only at two points in time; hence it lacks the broader time frame of the prior measure.

MEASURES OF COGNITIVE AND BEHAVIORAL DEVELOPMENT IN EARLY CHILDHOOD

Three scales measure the level of cognitive and behavioral development of the subjects when they were aged 4 to 6. These are (a) the Peabody Picture Vocabulary Test (PPVT), (b) the Caldwell Child Behavior Inventory (CBI), and (c) the tester's rating of the subject's verbal skills. The PPVT is a test that measures verbal ability in early childhood by showing children four pictures and asking them to point to the picture that best describes a word that is read to them (Dunn & Dunn, 1981). The mean PPVT score in the Baltimore sample was 78 (national norm is 100). The CBI is an inventory of small tasks that measure concept recognition, associative vocabulary, and social responsiveness of preschoolers (Cooperative Tests and Services, 1970). The mean CBI score in the Baltimore sample was 58.[6] The verbal skills scale consists of the interviewer's ratings (the mean equals 8.2, the standard deviation equals 2.2) and is based on 4 items (alpha equals .68) that describe the verbal communication (3-point scale), verbal behavior (5-point scale), ability for descriptive speech (2-point scale), and the monosyllabic nature of the speech (2-point scale). While the three measures of verbal and behavioral development are correlated, they do not overlap totally. The CBI and the interviewer's rating of verbal development measure verbal as well as social and behavioral skills, although the PPVT measures verbal development only.

All three measures of cognitive and behavioral development are associated with the age of the subjects at the time of testing. In order to eliminate the confounding effects of age, these three measures were standardized to reflect measurements taken at age 5.[7] The two standardized test scores measuring the subjects' developmental level, PPVT and CBI, are highly correlated (0.66). Therefore, in this study we use the average standard test score as a measure of developmental level (the mean equals 77, the standard deviation equals 26).

Measures of Educational Career

We consider two variables representing the educational experiences of the children. The first variable measures whether a child has failed a grade in elementary school. This variable is based on the self-reports of the respondents in 1987, when they were 19-21. If these reports indicated the repetition of the sixth or a lower grade, a grade failure was assumed (23%). Because of the self-reported nature of these data, it is possible that some kindergarten and early grade school failures may be underreported. The second variable indicates whether a child was ever suspended from school, based on self-reports (54%). Although further details about the educational careers of Baltimore subjects are available, it is not clear that such measures can be interpreted as precedents of literacy. For example, while elementary school grade failure could be interpreted as a precursor of low levels of adulthood literacy, high school grade failure might be a consequence of illiteracy rather than a precursor. Similarly, dropping out of high school might be due to illiteracy, and hence must be interpreted as a possible covariate of illiteracy, not a precursor. School suspensions are often a consequence of behavioral-disciplinary problems rather than academic problems. Therefore, one may interpret school suspension as an indicator of behavioral problems that might interfere with literacy acquisition.

RESULTS

The Baltimore sample members have lower levels of educational achievement than metropolitan black young adults nationally. Three out of ten young adults 19 years old or older in the Baltimore sample, have not completed the high school, as compared to 25% of 21-25 year old metropolitan black persons of the NAEP survey in 1985. The mean completed grade level of the Baltimore sample is 11.4. The educational dropout rates are 41% for males and 29% for females. Over half of the initial dropouts occurred at or before the 10th grade. These percentages compare to 17% of the 18 to 21 year-old black subsample of the National Survey of Children (NSC; Furstenberg, Hughes, & Brooks-Gunn, 1990). Grade repetition rates are 64% for males and 41% for females, compared to 26% in the black NSC sample. Disciplinary problems at school accompany and probably have contributed to school failure. About 70% of males and 40% of females report having been suspended at least once, compared to 43% in the black NSC sample.

COMPARISON OF LITERACY IN NAEP AND BALTIMORE SAMPLES

Levels of literacy in the NAEP metropolitan black sample and the Baltimore sample are similar with means of 77 (standard deviation equals 19) and 74 (standard deviation equals 18), respectively. The proportion of individuals who could complete no more than single feature-single exemplar tasks is 19% among the members of the Baltimore sample and 17% among the members of the NAEP metropolitan black sample.

Table 1 (see Appendix) compares the mean levels of literacy of various subgroups in the NAEP and Baltimore samples. In both samples, females have significantly higher literacy scores than males. As expected, self and maternal education are significantly associated with literacy. However, one must add that high school education does not assure high levels of document literacy either in the Baltimore or the NAEP samples. Multiple feature-multiple exemplar tasks could not be completed by a total of 73% of the Baltimore and 78% of the NAEP high school graduates (result not presented in Table 1).

This comparative description of the literacy levels of the NAEP metropolitan black and Baltimore samples indicates that the two samples are similar. The subgroup differences are of the same direction and approximately of the same magnitude.

PREDICTORS OF YOUNG ADULTHOOD LITERACY IN THE BALTIMORE SAMPLE

Table 2 (see Appendix) summarizes the differentials in literacy scores by family environmental, developmental, and educational career factors in early childhood, middle childhood, and adolescence. Among the family environmental factors, measures of living arrangements in early childhood do not account for a significant proportion of the variance in literacy scores in young adulthood. In middle childhood and adolescence, however, father

presence and mother's being married predicts higher literacy scores. Similarly, mother's being the only adult in the household for three or more years during adolescence is associated with significantly lower literacy scores. Birth of two or more siblings in the first five years of life result in significantly lower literacy scores. Birth of siblings in middle childhood and adolescence however, is not a predictor of subsequent level of literacy.

The physical and emotional quality of the home environment in early childhood is a significant predictor of literacy. Subjects who had homes of high physical quality and subjects whose mothers initiated positive interactions with them averaged higher literacy scores than subjects who scored low on these scales. The HOME scale measured in adolescence is not a significant predictor of literacy scores.

Mothers' commitment to educational achievement when the subjects were in early childhood strongly predicts literacy differentials. High maternal educational level, measured by achievement and aspirations, and high educational aspirations for the subject in early childhood predict high literacy scores in young adulthood. One of the measures of economic well-being, per-person family income, both in early childhood and in adolescence, is a significant predictor of literacy scores. Early dependence on public assistance, however, is not significantly associated with young adulthood document literacy in this sample.

All of the variables measuring different aspects of cognitive and behavioral development and educational achievement are significant predictors of literacy. Early childhood standardized assessments significantly differentiate literacy levels in young adulthood. The interviewer assessments of the subjects' verbal development also predict literacy differentials in young adulthood. Educational careers of the subjects are also strongly associated with literacy levels, such that subjects who experienced early grade failure and school suspension in adolescence (i.e., severe behavioral problems in school) scored significantly lower in the literacy assessment.

A Multivariate Analysis of Literacy in the Baltimore Sample

In order to assess the relative contribution of different factors in early childhood, middle childhood, and adolescence precursors to young adulthood literacy, multivariate least-squares regression models were estimated. Table 3 (see Appendix) summarizes the findings from these regression models. First, three separate regression models were estimated in order to identify the factors in each developmental period that account for most of the variance in young adulthood literacy scores. The factors that were identified as significant bivariate predictors were included in the multivariate regression model. Next, we estimated a model that combined the factors from each developmental period that were identified as statistically significant predictors of young adulthood literacy scores. This model assesses the relative predictive value of precursors of document literacy in each period in a multivariate context. Each model was estimated in two steps. The first step included only those variables pertaining to family environmental factors. The second step included the measures of developmental level or educational achievement. All models that are presented in Table 3 control for gender differences in literacy scores (see Table 1), although these coefficients are not

presented. In addition, residuals of all regression models were examined to assure that outliers do not play an undue role in the estimation of the regression coefficients. Residuals with absolute standardized values larger than 3.0 did not exist.

The first column (Model I) of Table 3 displays the estimated coefficients of the regression model that represents the effects of early childhood family environmental factors on young adulthood document literacy scores. The number of siblings born during early childhood is a significant predictor of young adulthood literacy levels, controlling for the indicators of the quality of the home environment, maternal education, and economic well-being. Maternal educational level and per-person family income have positive significant effects on young adulthood literacy, controlling for the other family environmental factors. The indicators of physical and emotional quality of the home environment were not predictive of young adulthood literacy scores, controlling for other family factors.[8] The second column (Model II) of Table 3 includes early childhood developmental level alongside the variables describing family environmental factors. Controlling for early developmental level, each additional sibling born within the first 5 years of life of the subjects resulted in a 4 percentile point reduction in predicted literacy scores. Although maternal educational level, assessed when the subjects were 4-6 years old, was a significant predictor of young adulthood literacy when only family environmental factors were considered, this association was no longer significant when controlling for early developmental level. Similarly, per-person family income was significantly predictive of literacy scores when only family environmental factors were considered; when the measure of early childhood developmental level was considered, however, this variable was no longer a significant predictor. The measure of developmental level of the child based on standardized assessments was significantly predictive of literacy scores assessed 15 years later. One standard deviation unit of difference in the cognitive and behavioral developmental measures resulted in a predicted literacy score different by approximately one-third standard deviation unit. Overall, the factors measured in early childhood accounted for 28% of the variance in adulthood literacy scores.

The third and fourth columns of Table 3 presents the effects of factors pertaining to middle childhood on young adulthood literacy scores. The number of years the mother was married positively predicted literacy scores in young adulthood; the measure of economic well-being, that is, dependence on public assistance, however, did not significantly predict literacy scores. Repeating a grade in early elementary school was significantly predictive of adulthood literacy scores. The factors measured in middle childhood accounted for a much lower proportion of variance in literacy scores than the factors measured in early childhood (14% vs. 28%).

The fifth and sixth columns of Table 3 display the effects of family circumstances and behavioral problems in adolescence on literacy in young adulthood. Among family environmental factors, the number of years mother was married and higher per-person family income in adolescence predicted higher literacy scores. Having been suspended from school was not significantly associated with literacy scores primarily because this variable is

strongly associated with gender, males being more likely to be suspended than females, and a control for gender was included in the multivariate model.

The seventh and eighth columns of Table 3 display the estimated coefficients of a regression model that combined the significant predictors of literacy scores from early childhood, middle childhood, and adolescence. Among the family environmental factors, the birth of siblings during early childhood resulted in lower predicted literacy scores, controlling for other family environmental characteristics. Total number of years the mother was married in middle childhood and early adolescence, maternal education, and average per-person family income were also significant predictors of young adulthood literacy scores. Model VIII in Table 3 present the coefficients of a multiple regression model that includes developmental and educational career factors in addition to the family environmental factors from all three developmental periods under consideration. Per-person family income and maternal educational level were no longer significantly predictive of literacy score in young adulthood, controlling for early childhood developmental level. Similarly, grade repetition in grade school was not predictive of young adulthood literacy, controlling for early childhood developmental level. The early childhood developmental assessments were the strongest predictor of adulthood literacy, controlling for other significant predictors from early and middle childhood and early adolescence. Model VIII accounted for 32% of the variance in literacy scores.

CONCLUSIONS AND DISCUSSION

In this paper, predictors of young adulthood literacy were investigated in a sample of economically disadvantaged black young adults who were born to teenage mothers in Baltimore. This sample combines several attributes that point to a high risk of educational failure. Nevertheless, the level of literacy of this sample is similar to that of the nationally representative sample of black metropolitan young adults of the NAEP study. Only one fifth of the study sample has literacy skills required to complete tasks such as finding information in an almanac, checking the accuracy of a mail order shipping slip, interpreting charts and tables, or locating information in a tax table. A little under one fifth of the sample have inadequate literacy levels. At a minimum, these young adults have attained a literacy level that is sufficient for signing documents, recognizing traffic signs, extracting information from television program listings, and filling in personal information on documents. However, their skills are insufficient for tasks such as making out a check, locating dosage information on a medicine label, filling in a school registration form, or using classified advertisements. The majority of the sample fall between these two extremes of adept and subsufficient functional literacy (see also Carroll & Chall, 1975; Hirsch, 1987). These young adults constitute the group that Miller (1988) has labelled "semi-literate." Because of the historical trend in the job market (i.e., increasing proportions of jobs requiring higher levels of skill and literacy), semiliterate adults are ill equipped to enter today's work force (Berlin & Sum, 1988; Diehl & Mikulecky, 1980).

In this paper, the predictors of document literacy were identified among family environmental, developmental, and educational career-related factors from early and middle childhood and early adolescence. These factors include family living arrangements, quality of the home environment, maternal commitment to education, economic well-being, developmental level of the child, and educational career of the child. A few limitations of this study must be acknowledged before further discussion of the findings. First, the generalizability of our analyses are limited by the nature of our sample. The sample is of limited size, and its reference population is not heterogeneous. Although we provide evidence that the characteristics of the young adults in the Baltimore sample are similar to high-risk subsamples of two nationally representative samples, the analyses presented in this paper will not lead to the identification of precursors of functional illiteracy in high-risk subgroups that are not represented in our sample (e.g., children of immigrant families, nonminority children who are in poverty, etc.). In addition, certain limitations of the data must be noted. Despite the wealth of information on early childhood, middle childhood, and early adolescent living arrangements, the reports on living arrangements by the mothers may be subject to some errors due to their retrospective nature. In addition, information on other factors that may contribute to literacy acquisition are lacking. For example, details of the educational experiences of the subjects when they were children and adolescents and measures of achievement in each developmental period are not available, although undoubtedly these factors would have been strong predictors of young adulthood literacy.

The most compelling finding of this study is the significance of factors measured in early childhood in predicting literacy levels measured in young adulthood, supporting our hypothesis about the importance of this developmental period. Particularly noteworthy is the power of standardized cognitive and behavioral assessments in early childhood in predicting young adulthood literacy measured 15 years later. The skills that are indicative of cognitive and behavioral development as measured by standardized tests including items assessing social responsiveness, concept recognition and associative vocabulary knowledge are powerful predictors of young adulthood literacy. This finding points to the importance of early childhood intervention programs that result in gains in cognitive abilities, quality of language interactions, and social-behavioral skills prior to entry in grade school.

Our hypothesis that family environmental factors will affect literacy indirectly through only early childhood developmental level and educational achievement, was not supported. Certain aspects of early childhood family environment are predictive of later literacy, even when early childhood developmental level is controlled. Such family environmental factors may be regarded as those facilitating or impeding a child's attainment of his or her literacy potential. These include number of years the mother was married and number of siblings born. These environmental factors are particularly important since our and other researchers' results indicate that once a trajectory for low verbal and cognitive ability and for poor communication skills is established, it strongly influences school achievement (Bloom, 1961; Hunt, 1961) and literacy. Additional environmental factors, such as the quality of the home environment (see endnote 7) in early childhood, are strongly associated with preschool cognitive and behavioral outcomes (Brooks-Gunn & Furstenberg, 1987; Sameroff et al., 1987; Wachs &

Gruen, 1982). These findings suggest that certain components of environment early in the child's life influence adulthood literacy indirectly via their impact upon preschool abilities. Nevertheless, unfavorable childhood environmental factors often persist throughout childhood and adolescence, and hence can also be viewed as indicators of risk factors for outcomes measured later in life. Other studies have demonstrated that improvement of environmental conditions after the preschool years results in an improvement in cognitive skills in children (Dusewicz & Higgins, 1971).

A family environmental factor that can be targeted by policies is the control of subsequent fertility of teenage mothers. Our results show that childbearing in close succession after the first birth may have long-term negative effects on children, such as low levels of literacy. Other studies showed the association between sibship size and school performance (Polit, 1982; Steelman, 1985; Zajonc & Markus, 1975). This association might be attributed to the ways children spend their time and the extent of verbal interaction between mothers and children (Hill & Stafford, 1980; Stafford, 1987). Programs that promote fertility control and provide awareness of the risks of subsequent high fertility result in a reduction of additional children born to teenage mothers in close succession (Furstenberg et al., 1987; Hayes, 1987; Paikoff & Brooks-Gunn, in press), which in turn has the potential to positively influence the long-term outcomes.

Our study showed that economic well-being measured by per-person family income is associated with young adulthood literacy, but not when the early childhood developmental level is controlled. Hence, the effects of economic well-being on long-term outcomes such as adulthood literacy may be primarily through its effects on cognitive and behavioral development in early childhood, again pointing to the importance of targeting early childhood developmental level. Grade failure in elementary school was highly predictive of literacy levels. Grade failure is an important indicator of compliance with the requirements of educational system. However, when controlling for preschool cognitive and behavioral functioning, the measures of school achievement are no longer significantly predictive of literacy. This suggests that, regarding adulthood literacy, preschool developmental level may be a policy target even more significant than educational remediation once a school failure has occurred. Economically disadvantaged minority children who are at risk of entering school with a delay in cognitive and social-behavioral skills might benefit from participation in high-quality intervention programs that target preschool children and their families. Participation in high quality intervention programs for disadvantaged toddlers and preschoolers and their families results in significant gains in verbal and cognitive abilities and in school success as compared to control group children not receiving such intervention (Clarke-Stewart & Fein, 1983; Haskins, 1989; Ramey, Bryant, Sparling, & Wasik, 1985; Zigler & Muenchow, 1984). Studies show that enhanced cognitive ability persists through childhood, as seen in rates of grade failure and enrollment in special education classes (Lazar, Darlington, Murray, Royce, & Snipper, 1982).

ENDNOTES

[1] Frank Furstenberg (University of Pennsylvania) served in 1991-1992 as a project director at NCAL. Note: NCAL occasionally reprints papers published elsewhere that are relevant to the field of adult literacy.

[2] Those who received the literacy assessment were not different from those who did not in sex and age composition, self and mother's education, or pre-school age Peabody Picture Vocabulary Test scores.

[3] The Balanced Incomplete Spiraling design allows a broad coverage of content in a questionnaire without requiring a lengthy questionnaire from each respondent. The NAEP literacy questionnaire items were divided into seven blocks of tasks, and each respondent received three such blocks in addition to the core questionnaire. Each block was answered by approximately the same number of respondents who constituted a random subsample of the NAEP sample (Kirsch & Jungeblut, 1986).

[4] NAEP studies often report "proficiency scores" which are statistically estimated on the basis of the questions answered by each respondent and several parameters describing their background and the difficulty of the questions (NAEP, 1986). "Proficiency scores" of reading, prose comprehension, document utilization, and practical computation were estimated for the NAEP literacy survey. Unfortunately, none of these scales correspond exactly to the set of questions that were administered to the Baltimore sample.

[5] In order to interpret the percentile scores using concepts underlying the proficiency scores, one must assume that the respondents answered all of the questions that they could, given their level of literacy. In other words, one must assume that the respondents did not skip questions that seemed too easy. For the Baltimore sample, both proficiency scores and percentage of correct answers were computed. The comparison of the two measurements of literacy show that there is almost complete agreement between them ($r = .97$). In the subsample of black young adults, the NAEP scale that includes most of Baltimore study's literacy questions, that is, the document utilization scale, correlates .79 with the percentile score constructed for this study.

[6] The Caldwell Preschool Inventory is predictive of some outcomes in adolescence, such as juvenile delinquency in this sample (Furstenberg et al., 1987).

[7] The following standardization procedure has been employed: The developmental scores were regressed on age in months at the time of the testing. The predicted scores were then computed using the age of 60 months as a predictor, and the residual for each observation was added to compute the developmental measure standardized to age 5.

[8] The emotional quality of the home environment, however, is a significant predictor of the standardized measure of developmental level used in this study ($p < .05$).

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APPENDIX A

TABLE 1

Comparison of the literacy levels of the NAEP and Baltimore Samples.

CHARACTERISTIC	NAEP METROPOLITAN BLACK SAMPLE			BALTIMORE SAMPLE		
	Mean	p^a	*N*	Mean	p^a	*N*
GENDER						
Male	73.5	.00	184	68.7	.00	96
Female	78.8		298	78.2		106
EDUCATIONAL ATTAINMENT						
Less than high school	70.9	.00	135	64.7	.00	85
High school or more	78.4		346	80.3		117
MATERNAL EDUCATION						
Less than high school	75.2	.06	188	70.5	.01	90
High school or more	78.5		251	77.5		93

[a] Probability levels indicate the significance of F statistic that tests the between-subgroup differences as compared to within-subgroup variance.

TABLE 2

Comparison of Mean Literacy Scores in Young Adulthood by Family Environmental Factors, Developmental Level, and Educational Career Indicators in Early and Middle Childhood and Early Adolescence.

CHARACTERISTIC		EARLY CHILDHOOD		MIDDLE CHILDHOOD		ADOLESCENCE	
		Mean	p^b	Mean	p^a	Mean	p^a
FAMILY ENVIRONMENTAL FACTORS							
Living Arrangements							
Mother was the only adult in household[c]	Yes	75.4	.63	69.9	.11	69.7	.05
	No	73.7		75.1		75.5	
Father was present in the household for at least 1 year	Yes	74.1	.87	78.5	.03	79.5	.05
	No	73.7		72.3		72.8	
Mother was married for at least two years	Yes	75.8	.18	77.4	.00	78.0	.01
	No	72.2		69.7		70.9	
Had siblings born during the period[d]	Yes	59.0	.00	75.6	.32	76.0	.53
	No	75.8		72.8		73.6	
Physical and Emotional Quality of the Home Environment							
HOME scale	Low	70.7	.01			70.5	.16
	High	76.8				74.6	
Quality of the mother's relationship with child	Low	69.5	.07				
	High	76.0					
Maternal Commitment to Education							
Maternal educational level[e]	< HS	70.5	.01				
	≥ HS	77.5					
Maternal educational aspiration for the subject	< HS	70.5	.01				
	≥ HS	77.7					
Economic Well-Being							
Mother received public assistance during the entire period	Yes	71.4	.46	69.1	.08	68.4	.08
	No	74.2		74.9		74.7	
Per-person family income	Low	72.4	.05			70.8	.00
	High	78.1				79.8	
COGNITIVE AND BEHAVIORAL DEVELOPMENT OF THE CHILD							
Mean standardized test score	Low	63.8	.00				
	High	80.7					
Interviewer's assessment of verbal development	Low	70.2	.01				
	High	78.4					
EDUCATIONAL CAREER OF THE CHILD							
Repeated a grade in elementary school	Yes			67.4	.01		
	No			75.7			
Got suspended from school	Yes					71.3	.02
	No					77.3	

[a] Probability levels indicate the significance of F statistic that tests the between-subgroup differences as compared to within-subgroup variance.

[b] Probability levels indicate the significance of *F* statistic that test the between subgroup differences as compared to within subgroup variance.

[c] Yes = 1 or more years in early childhood; Yes = 3 or more years in middle childhood and adolescence.

[d] Yes = 2 or more siblings in early childhood; Yes = 1 or more siblings in middle childhood or adolescence.

[e] Mean of maternal educational attainment and aspiration.

TABLE 3

Results of Multivariate Regression Analyses to Identify Predictors of Young Adulthood Literacy Levels.

Predictors[a]	Early Childhood		Middle Childhood		Adolescence		Combined	
	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII	Model VIII
FAMILY ENVIRONMENTAL FACTORS								
Living Arrangements								
Number of years mother was married			1.185*	1.083*	1.218*	1.148+	.950*	.750*
Number of siblings born	-4.276*	-3.867*					-4.897*	-4.289*
Physical and Emotional Quality of the Home Environment								
HOME scale	.448	.257						
Quality of the mother's relationship with child	.438	.025						
Maternal Commitment to Education								
Maternal educational level	2.496*	1.717					2.431*	1.827
Economic Well-Being								
Number of years mother received public assistance			-.633	-.666	-.009	.009		
Per person family income x 1,000[b]	2.014+	1.254			1.175*	1.172*	1.095*	.553
COGNITIVE AND BEHAVIORAL DEVELOPMENT OF THE CHILD								
Mean standardized test score		.256*						.236*
Interviewer's assessment of verbal development		.455						
EDUCATIONAL CAREER OF THE CHILD								
Repeated a grade in elementary school				-7.116*				-3.374
Got suspended from school						-2.031		
r^2	0.16	0.28	0.11	0.14	0.14	0.15	0.22	0.32[c]

[a] All models include subjects' sex as a control, although these coefficients are not presented. For the definitions of the predictors, please see the text.

[b] For model VII and Model VIII, average of income measured in early childhood and early adolescence.

[c] There were no observations with standardized residual larger than |3|.

* $p < .05$

\+ $p < .10$