



Family profiles and educational attainment

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ABSTRACT

The educational attainment of participants in the Chicago Longitudinal Study (93% Black and 7% Hispanic) was examined. Cluster analysis on measures of human capital resources, family dynamics and demographics was used to identify four distinct profiles of families. In general, children who had family profiles characterized by higher levels of human capital resources and more favorable scores on indicators of parenting practices towards children's schooling and family functioning were more likely to have higher educational attainment than other children. Moreover, children who experienced a positive change in family profile characteristics between the ages of 8 and 12 were more likely to have higher educational attainment than other children. Implications for intervention and research are discussed.

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1. Introduction

High school completion is a milestone of adolescence that serves as an entryway to post secondary education and nearly all career paths. Besides representing the transition to adulthood, graduation from high school has strong and direct impacts on employment, lifetime earnings, health, and criminal justice involvement (Cohen, 1998; Haveman & Wolfe, 1983, 1994, 1995; Hill & Sandfort, 1995; Reynolds et al., 2007; Reynolds, Temple, Robertson, & Mann, 2002). Earning a high school diploma represent a crucial step in gaining access to a college education that will enhance an individual's work prospects in an increasingly competitive society. School failure has significant costs to society and youth. The unemployment rate for dropouts is approximately 80% higher than the unemployment rate for high school graduates (National Center for Educational Statistics, 2000, Figure 24). The annual cost to society of school dropout linked to forgone earnings and tax revenues is estimated to be \$250 billion (National Science and Technology Council, 1997).

Despite a variety of educational reforms designed to increase high school graduation rates, little progress has been made (Kaufman, Kwon, Klein, & Chapman, 1999). In 1999, 85.9% of 18 to 24 year olds had completed high school by earning a regular diploma (76.8%) or GED (9.1%). This represents a net increase of only about 3 percentage-points since 1972 (82.8%). The number of high school graduates who achieve a degree via a GED is growing and when GEDs are classified as dropouts, the high school graduation rate has fallen or remained relatively stable since 1972 (Kaufman, Alt, & Chapman, 2004). The economic payoff for people who complete high school by alternative means (e.g., GED) can

be significantly less than what it is for people who earn a traditional high school diploma (Carneiro & Heckman, 2003).

Students in large cities, especially minorities and low-income youth are particularly at-risk for school failure. Large city school districts are more likely than mid-sized cities, large towns and rural districts to report four-year high school completion rates of less than 60% (Sable & Hoffman, 2005). Relative to White students, Hispanic and Black students are less likely to complete high school. Nationally, since 1972 the dropout rate for Blacks and Hispanics has been nearly 2 to 4 times higher than the dropout rate for Whites. Equally disturbing is that children from low-income families are 5 to 8 times more likely to dropout than children in high-income families (Laird, DeBell, & Chapman, 2006).

The powerful and long-term importance of early family experiences on the educational attainment of children is suggested by human capital theory (Carneiro & Heckman, 2003; Heckman, 2000; Karoly, 2001). Brooks-Gunn, Duncan, Leventhal, and Abner (1997) define human capital as "skills, knowledge, and capabilities acquired by individuals" (p.290). Guided by the human capital framework of Becker (1981, 1993), Haveman and Wolfe (1995) suggest that parents make choices and investments that influence their children's success by developing and impacting the environment in which children are raised. A central tenet of human capital theory and this paper is that parental capacities, family resources and family environments matter for children's education and long-term well being (Carneiro & Heckman, 2003).

The present study builds from a human capital framework and adds to a growing body of research which has established the heuristic value of pattern-oriented analyses. Pattern-centered approaches have been used to examine parenting and grand parenting, family functioning, dropout, homelessness and school performance (Baydar & Brooks-Gunn, 1998; Belsky & Fearon, 2004; Brenner & Fox, 1999; Cairns, Cairns & Neckerman, 1989; Danesco & Holden, 1998; Janosz, Blanc, Boulerice & Tremblay, 2000; Johnson, 2003; Mandara & Murray, 2002; Ramey, Ramey & Lanzi, 1998).

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Few longitudinal studies of low-income children have used pattern-oriented methods to examine variation in families related to school outcomes, psychological or other family processes (Henry, Tolan & Gorman-Smith, 2005). This may be because poor children and families are considered relatively homogeneous (Ramey et al., 1998). Most standard analytic approaches assume that measures of association are interrelated similarly and linearly across all families. However, a systems' view of families warns against embracing "the prevailing model of family influences that focuses on the specific, independent influence of relationships and assumes that identical processes exist in all families" (O'Connor, Hetherington, & Reiss, 1998, p.354).

According to a developmental science perspective, development occurs as part of an integrated system rather than the result of individual constituent parts (Magnusson, 1998). Examining developmental characteristics collectively within the context of a correlated system (e.g., family) can be more informative than investigating developmental characteristics as singular influences (Cairns, 2000; Magnusson & Cairns, 1996; Roeser & Peck, 2003). Within this context, the goal of the present study was to use cluster analysis to identify distinct family configurations for low-income minority children participating in the Chicago Longitudinal Study.

The study was guided by three primary aims. The first aim was to use cluster-analytic methods on measures of human capital resources, parenting practices and demographics to develop family characteristic profiles and describe a typology of families in the Chicago Longitudinal Study (CLS). The terms profile, typology, configuration, cluster and classification are used interchangeably throughout the text to describe and differentiate subgroups of families that exhibit relatively homogeneous characteristics. The second aim was to examine whether adolescents' educational attainment (e.g., eighth grade reading scores, high school completion, 4-year high school graduation, college attendance) differed by family profile. Youth whose family profiles were characterized by low levels of human capital resources and low levels of family functioning were expected to show less favorable outcomes on measures of educational attainment compared to youth whose family profiles were more advantaged. The third aim was to examine the degree to which family characteristic profiles changed over time and to estimate the effect of change (positive and negative) on educational attainment. Change was expected to be related to school performance. Youth whose family profiles showed gains on measures of human capital and indicators of positive family functioning were expected to have higher educational attainment.

2. Method

2.1. Sample and design

The Chicago Longitudinal Study (CLS, 2005) is a prospective investigation that examines the social and educational development of a same-age cohort of 1539 economically disadvantaged minority children (93% Black and 7% Hispanic) born in 1980. The original Chicago Longitudinal Study sample included the entire cohort of 989 children who completed preschool and kindergarten in one of the 20 Chicago Child-Parent Center sites. The CPC preschool group further participated for up to 3 years in the school-age component of the CPCs during grades 1 to 3. The preschool comparison group of 550 children in this quasi-experimental design participated in alternative full-day kindergarten programs for low-income children emphasizing educational enrichment but they did not enroll in CPC preschool.

The study sample consisted of 1340 CLS children and families for which educational attainment, family human capital, family dynamics and demographic data were available. By age 23 of the study group, data were available for 88.2% of the original CLS sample. This represents 87.1% of the original sample for the preschool group ($n = 872$) and 85.1% for the comparison group ($n = 468$). In the CPC preschool comparison group, 15.6% of children participated in Head Start preschool and 100% participated in government-funded full-day kindergarten programs.

2.2. Educational attainment indicators

Educational attainment indicators were developed from school administrative records from Chicago Public and Parochial Schools, and the Illinois Shared Enrollment and Graduation Consortium (ISEGC). The ISEGC maintains college enrollment and credit records collected by the Illinois Community College Board (ICCB) and the Illinois Board of Higher Education (IBHE). These records were supplemented by written and phone interviews with the study participants and other family members.

2.2.1. Eighth grade reading scores

Eighth grade reading scores were assessed from the multilevel battery of the Iowa Test of Basic Skills (Hieronymus & Hoover, 1990; Hieronymus, Lindquist, & Hoover, 1980). The reading comprehension subtest has 58 items designed to measure comprehension of text passages (see Reynolds, 2000). Scores were based on the 1988 national average equating to a mean of 160 in the fall of eighth grade. Test scores ranged from a low score of 77 to a high score of 212.

2.2.2. High school graduation

High school graduation indicates that the study participant graduated from high school with a regular diploma in 4 years.

2.2.3. High school completion

High school completion indicates that the study participant completed his/her secondary education by obtaining either an official diploma or a General Education Diploma (GED).

2.2.4. Years of schooling

Years of schooling measures the last grade of school that the youth officially completed. Years of schooling ranged from a low score of 7 years to a high score of 16 years (Bachelor's degree).

2.2.5. College attendance by age 23

College attendance indicates that a study participant had been enrolled for one or more credits in a degree- or certificate-bearing program at an accredited two- or four-year college by the summer term of 2003.

2.3. Family typology measures and family characteristic profiles

2.3.1. Family typology measures

Cluster analysis was used on the measures of maternal age, maternal education, number of children living in the home, number of adults living in the home, family demographic index, child maltreatment scale, parental involvement and parental expectations to develop family profiles for children at 8 and 12 years of age. Data were obtained from parent and participant interviews, teacher interviews, and administrative records from the Illinois Department of Health and Human Services, the child protection division of the Illinois Department of Children and Family Services, Chicago Public and Parochial Schools, and the Cook County Juvenile Court.

2.3.2. Maternal age at child's birth

Maternal age at child's birth indicates the age of the mother in years at the time of the study participant's birth.

2.3.3. Maternal education

Maternal education is the number of years of education completed by the study child's mother.

2.3.4. Number of children

Number of children signifies the number of children including the participant living in the immediate family context (children were defined as any household member less than 18 years of age).

2.3.5. Number of adults

This indicates the number of adults living in the immediate family or home context (adults were defined as any household member more than 17 years of age).

2.3.6. Family demographic index

This index consisted of the sum of four dichotomous indicators (parent employed full- or part-time, child ineligible for fully subsidized meals (130% of poverty or higher), no AFDC/TANF participation, and two-parent family status) shown to be related to positive child and family functioning (Bendersky & Lewis, 1994; Rutter, 1987).¹

2.3.7. Child maltreatment scale

This four-level scale indicates whether child maltreatment was identified as a problem or potential problem in the participant's family. Quasi-absolute scaling (see Bergman et al., 2003) was applied to child maltreatment and foster care records. This four-level scale consisted of the following values:

- 1 = two or more substantiated reports of child maltreatment and/or two or more out-of-home placements because of child maltreatment (pronounced problem in family functioning);
- 2 = one substantiated report of child maltreatment and/or one out-of-home placement because of child maltreatment (presence of a problem);
- 3 = one or more unsubstantiated reports of child maltreatment and/or families with child protection service records not directly related to the study child (tendency to problem); and
- 4 = no child protection service records (no visible problem).

2.3.8. Parental involvement in children's schooling

This measure is the sum of the number of years a teacher rated parent involvement average or better (1 = average or above, 0 = below average or poor) between first and sixth grade. The original scale values were as follows: 1 = poor, 2 = below average, 3 = average, 4 = above average and 5 = excellent.

2.3.9. Parental expectations for children's educational attainment

This measure is the sum of the number of years a teacher and one or more parents rated parent expectations average or better between second and sixth grade (1 = average or above, 0 = below average or poor). The original scale values for the teacher reported measure were: 1 = poor, 2 = below average, 3 = average, 4 = above average and 5 = excellent.²

2.4. Changes in family characteristic profiles between ages 8 and 12

Two dichotomous indicators were used to examine the effect of change in family characteristic profiles during early adolescence.

2.4.1. Positive change

Positive change indicates that children showed gains on family measures of human capital, parent practices toward children's schooling and family functioning between the ages of 8 and 12.

¹ Unfortunately, dichotomous measures are not well suited for the standard cluster-analytic approach based on Ward's method (Bergman, Magnusson, & El-Khoury, 2003). For this reason, as well as, parsimony these measures were not included as stand-alone measures.

² Because teacher reports were not available after grade 4 for the parent expectation measure, parent reports in grade 6 were used. The original scale values for the parent reported measure were: 1 = eighth grade, 2 = some high school, 3 = complete high school, 4 = some college, 5 = complete 4-year college, 6 = some graduate school and 7 = complete graduate school. Because the scales from the teacher survey and the parent survey were different, the median answer choice in the parent survey (4 = some college) was used to indicate the cut-point for average parent expectations in the parent survey.

2.4.2. Negative change

Negative change indicates that children showed declines on family measures of human capital, parent practices toward children's schooling and family functioning between the ages of 8 and 12.

2.5. Covariates

2.5.1. CPC preschool

CPC preschool includes all children who participated in the half-day preschool component of program for 1 or 2 years (ages 3 to 4 years).

2.5.2. CPC school-age

CPC school-age includes all children who participated in the school-age component of the program (ages 6 to 9).

2.5.3. CPC program sites

Twenty dichotomous variables were used to indicate the sites of CPC program participation. These indicators were used to control for the local unobserved influences associated with attending a particular CPC program site (see Reynolds, 2000).

2.5.4. Sex of child

Sex of child is the gender of the study participant.

2.5.5. Race/ethnicity

Race/ethnicity is the race/ethnicity of the study participant.

2.5.6. School mobility

School mobility indicates the number of times a participant changed schools from kindergarten to sixth grade (ages 5 to 13). School mobility from kindergarten to third grade was used in child age 8 models. School mobility from first to eighth grade was used in child age 12 models.

2.5.7. Grade retention

Grade retention indicates whether a child was ever retained from kindergarten to fourth grade (age 8 models) and kindergarten to sixth grade (age 12 models).

2.5.8. Kindergarten school achievement

Kindergarten school achievement indicates the word analysis score results at the end of kindergarten on the Iowa Test of Basic Skills (Hieronymus et al., 1980). The word analysis contained 35 items assessing prereading skills and letter-sound recognition (see Reynolds, 2000).

2.6. Data analysis

Family characteristic profiles were identified from the family typology measures using the SLEIPNER II statistical package for pattern-oriented analysis (Bergman & El-Khoury, 1998) following methods outlined by Bergman et al. (2003). Five procedures were employed:

- (a) IMPUTE, a procedure that imputes cases with missing data using a twin approach;³
- (b) CLUSTER, a clustering program that identifies initial classifications based on a clustering algorithm (with CLUSTER, initial configurations were determined using Ward's method (1963)

³ In a twin approach, a missing value in a variable is replaced by the value of that variable in a twin subject that has complete data (see El-Khoury & Bergman, 1992). A total of 104 cases (122 variable values) were imputed in the following four variables: maternal age ($n=58$), maternal education ($n=9$), number of children ($n=20$), and number of adults ($n=35$). To examine whether the imputed data was likely to bias the results, a missing data dummy variable indicator was constructed where 1 represented a case that was missing a variable data value and 0 represented a case with no missing data. This indicator was not correlated with any of the educational attainment measures used in the study. In a second analysis, the distributional pattern of the missing data was examined. There was no evidence to suggest the data was not missing at random.

- on standardized measures with the similarity among cases indicated by squared Euclidean distance);⁴
- (c) RELOCATE, a relocation procedure that repositions ill fitting cases to alternative classifications if doing so reduces the error sums of squares of the classification;
- (d) EVALUATE, a procedure that evaluates a cluster solution by examining the explained error sums of squares (ESS) and other indices such as the Point-biserial correlation that measure the goodness-of-fit between input data and the resulting classification (see Milligan, 1981; Milligan & Cooper, 1988); and
- (e) RANDOM, a procedure that draws a random sample without replacement from the population.⁵

Following previous analyses in the CLS, hierarchical probit regression analysis was used to estimate effects for dichotomous outcomes (e.g., high school completion and graduation, college attendance). To enhance interpretability, probit coefficients were transformed to marginal effects using STATA version 8 (Stata, 2003) which can be interpreted similar to the metric coefficient in ordinary regression analysis.⁶ Univariate analysis of covariance (ANCOVA) was used on outcomes that approximated normal distributions (e.g., eighth grade reading scores, years of completed schooling).

3. Results

3.1. Descriptive results

As shown in Table 1, the overall economic disadvantage of the study families was reflected by the measures used to develop family profiles. On average, mothers were likely to have less than 12 years of education. The majority of mothers at both child age periods were not employed full- or part-time, received AFDC/TANF benefits, had three or more children and were single-parents. As global indicators of family functioning and parenting practices toward schooling, overall scores on the child maltreatment scale, parental involvement and parental educational expectations, suggested that many families in the study were not functioning well and had low levels or did not have parents that were functioning well. For example, before age 9, 100 children (7.5%) had experienced child maltreatment. By age 13, 139 children (10.4%) had substantiated reports of maltreatment. The majority of children in the study were reported as having below average parental expectations and parental involvement. The at-risk status of the children in the study was also reflected by relatively high percentages of children who had been retained or experienced multiple and atypical school moves. By sixth grade, 331 children (24.7%) had been retained for at least 1 year of schooling. Between first and eighth grade, 496 children (17.0%) had changed schools 3 or more times. The correlations between like-item indicators between child age periods were relatively high ranging from $r = 0.51$ (*mother employed full- or part-time*) to $r = 0.95$ (*no TANF/AFDC participation*). The correlations among key study indicators for the age 12 sample are provided in Appendix A.

Overall, 64.0% of the youth in the study completed high school by age 23 (see Table 2). Slightly more than half of the study participants graduated from high school with a regular diploma in 4-years (50.2%). Females were more likely than males to complete high school (71.6% vs. 56.0%, $p < 0.001$), and have more years of schooling (11.73 vs. 11.08 years, $p < 0.001$).

⁴ The scales, metrics, and standard deviations of measures can have large impacts on cluster solutions. Standardization prevents measures with large standard deviations (e.g., maternal education, maternal age) from dominating cluster results and profiles (Aldenderfer & Blashfield, 1984; Bailey, 1994; Bergman et al., 2003).

⁵ The procedure was used to examine the sensitivity of the results to sampling variation. The same hierarchical cluster analysis with Ward's method of linkage and K -means relocation was applied to a random sample of slightly over 50% of the data. There was no evidence that random sample clusters differed from the full sample clusters.

⁶ For dichotomous predictors, marginal effects represent the percentage-point difference between groups derived from the partial derivative evaluated at the mean of the explanatory variable (Greene, 1997).

Table 1

Descriptive statistics, sample sizes and correlations between age periods for the family profile measures and school-level covariates.

	Age 8		Age 12		Pearson correlation
	Mean	<i>n</i>	Mean	<i>n</i>	
Family profile measures					
Maternal age at child's birth, years ⁺	22.7	1283	–	–	–
Maternal education, years ⁺	11.3	1329	11.4	1332	0.68
Family demographic index (0–4), mean ⁺	1.3	1338	1.3	1340	0.77
No TANF/AFDC participation, % [#]	41.2	1338	38.7	1340	0.95
Mother employed (full- or part-time), % [#]	43.6	1338	48.5	1340	0.51
No free lunch eligibility, % [#]	12.6	1338	16.8	1340	0.75
Two-parent status, % [#]	40.2	1338	32.2	1340	0.54
Number of children (1–7), mean ⁺	3.2	1313	3.1	1322	0.78
Number of adults (1–6), mean ⁺	1.6	1305	1.8	1305	0.91
Number of children (1–7), mean ⁺	3.2	1313	3.1	1322	0.78
Number of adults (1–6), mean ⁺	1.6	1305	1.8	1305	0.91
Child maltreatment scale (1–4), mean ⁺	3.8	1338	3.7	1340	0.89
No visible problem (4), %	89.6	1338	87.2	1340	0.70
Tendency toward problem (3), %	2.9	1338	2.4	1340	0.72
Presence of problem (2), %	3.5	1338	3.3	1340	0.62
Pronounced problem (1), %	4.0	1338	7.1	1340	0.63
Parental involvement (0–3, 0–6), mean ⁺	1.1	1338	2.0	1340	0.82
Parental educational expectations (0–3, 0–5), mean ⁺	1.5	1338	2.3	1340	0.85
School-level covariates					
Number of school moves (0–5, 0–9), mean	1.4	1338	2.3	1340	0.91
Grade retention, %	20.0	1338	24.7	1340	0.87

Note. ⁺Variable is included in cluster analysis as a stand-alone indicator. [#]Variable is included in cluster analysis as part of the family demographic index. Maximum *n* for Pearson correlation was 1338.

Other sizable differences existed for participants based on family subgroups derived from rates of parent education, TANF/AFDC participation, child maltreatment, and parental involvement and expectations. For example, children whose mothers completed high school were more likely to complete high school (72.5% vs. 53.1%, $p < 0.001$) and complete more years of schooling (11.74 vs. 10.99, $p < 0.001$). Relative to children in families with one or more substantiated reports of child maltreatment (pronounced, presence of a problem), children in families without substantiated reports of child maltreatment (tendency to problem, no visible problem) were more likely to complete high school (65.9% vs. 47.5%, $p < 0.001$) and complete more years of schooling (11.50 vs. 10.68, $p < 0.001$). Relative to low levels of parent involvement, average or above parent involvement was significantly associated with higher rates of high school completion and more years of completed schooling. Similarly, relative to low levels of parental expectations, average or above parental expectations was significantly associated with higher rates of high school completion and more years of completed schooling.

3.2. Cluster analysis and four distinct family profiles

Table 3 illustrates the four family profiles that emerged from the cluster analysis.⁷ To highlight differences between profiles, post hoc

⁷ Several criteria were used to determine the appropriate number of family profiles. These included statistical evaluation criteria, such as, the error sums of squares explained by the classification (ESS), the Point-biserial correlation, and subjective criteria, such as, the expectation of patterns established in previous work, the agglomeration schedule, scree plot and dendrogram, and practical considerations including cell size, theoretical interpretability and utility (see Bergman et al., 2003; Milligan, 1981; Milligan & Cooper, 1988). For specific details related to the evaluation statistics and procedures used to determine the four family profiles in the Chicago Longitudinal Study, see Robertson (2004).

Table 2
Descriptive statistics of educational attainment by key study indicators for the age 12 sample.

Factor	Total sample	CPC preschool		Extended	
		Any	None	4 to 6	1 to 3
High school completion, %	64.0	67.3	57.9	69.5	60.6
Girls	71.6	72.8	69.4	76.3	67.3
Boys	56.0	61.1	47.6	61.4	54.2
Mother HS completer	72.5	75.5	66.3	76.1	71.9
Non completer	53.1	55.6	49.4	59.2	46.4
No TANF/AFDC	74.4	77.5	68.7	80.7	72.1
TANF/AFDC participation	57.5	60.9	51.1	62.7	53.9
Child maltreatment	47.5	49.3	45.2	47.2	44.4
No visible problem/tendency to problem	65.9	69.1	59.9	71.2	62.9
Low parent involvement	57.1	60.7	52.7	61.2	56.2
Average or better	75.9	78.3	70.3	78.2	75.4
Low parent expectations	56.5	59.9	51.1	61.8	53.7
Average or better	73.2	75.3	68.5	74.9	73.0
Highest grade completed, years	11.41	11.53	11.17	11.64	11.24
Girls	11.73	11.80	11.58	11.97	11.60
Boys	11.07	11.23	10.80	11.26	10.97
Mother HS completer	11.74	11.85	11.49	11.91	11.60
Non completer	10.99	11.08	10.84	11.22	10.78
No TANF/AFDC	11.84	11.94	11.64	12.05	11.71
TANF/AFDC participation	11.14	11.28	10.87	11.40	10.94
Child maltreatment	10.68	10.70	10.65	10.50	10.71
No visible problem/tendency to problem	11.50	11.61	11.26	11.73	11.31
Low parent involvement	11.10	11.22	10.90	11.21	11.04
Average or better	11.99	12.06	11.79	12.10	11.90
Low parent expectations	11.05	11.19	10.81	11.22	10.96
Average or better	11.95	11.90	11.74	11.93	11.85

Note. Child maltreatment indicates that by child age 12 there was 1 or more substantiated report of maltreatment. No visible/tendency to problem indicates that there were no child protection service records or unsubstantiated reports of maltreatment by age 12.

Table 3
Family characteristic profile (child age 12).

Measure	Family profile			
	Low human capital/ low family functioning LHC/LFF	Low human capital/ mod. family functioning LHC/MFF	Moderate human capital/ mod. family functioning MHC/MFF	High human capital/ high family functioning HHC/HFF
Maternal age at child's birth, mean (SD), years ⁺	20.3 ³ (3.9)	20.4 ³ (3.9)	29.3 ¹ (5.2)	21.8 ² (4.4)
Maternal education, mean (SD), years ⁺	10.7 ³ (2.0)	10.9 ³ (1.7)	11.6 ² (2.0)	12.2 ¹ (1.9)
Family demographic index (0–4), mean (SD) ⁺	0.9 ³ (0.9)	0.9 ³ (0.8)	1.9 ¹ (1.2)	1.5 ² (1.2)
Mother employed full- or part-time, % [#]	40.9 ²	37.8 ²	55.1 ¹	58.0 ¹
Child ineligible for free lunch, % [#]	5.7 ²	8.9 ²	27.6 ¹	21.7 ¹
Two-parent family status, % [#]	20.9 ³	20.8 ³	56.0	33.1 ²
No AFDC/TANF participation, % [#]	24.4 ³	26.3 ³	60.1 ³	43.0 ²
Number of children, mean (SD) ⁺	3.9 ¹ (1.9)	3.4 ² (1.7)	3.1 ³ (1.9)	2.6 ⁴ (1.4)
Number of adults, mean (SD) ⁺	1.5 ² (1.0)	1.4 ² (0.7)	3.1 ¹ (1.4)	1.5 ² (0.7)
Child spent time in a non parent family, %	37.4 ¹	2.5 ²	3.6 ²	3.4 ²
Parent(s) reported health or disability problem, %	14.5	10.0	13.2	8.7
Child maltreatment scale (1–4), mean (SD) ⁺	1.3 ² (0.5)	3.9 ¹ (0.2)	3.9 ¹ (0.2)	3.9 ¹ (0.3)
Parent(s) involvement in child's school (1–5), mean (SD) ⁺	1.2 ³ (1.2)	1.1 ³ (1.0)	1.9 ² (1.2)	3.4 ¹ (1.2)
Parent(s) expectations for achievement (1–5), mean (SD) ⁺	1.7 ³ (1.2)	1.5 ³ (1.1)	2.3 ² (1.2)	3.5 ¹ (0.9)
Maximum n	131	509	288	412

Note. Means and percentages are unadjusted. Standard deviations are enclosed in parentheses. Rows with superscripts indicate significant differences ($p < 0.001$) between typologies for the typology measure based on Analysis of Covariance (ANCOVA) for non dichotomous indicators and Chi-square analyses for dichotomous measures. Means and percentages in the same row that do not share superscripts differ by $p < 0.05$ in follow-up Bonferroni corrected t tests.

⁺Variable is included in cluster analysis as a stand-alone indicator.

[#]Variable is included in cluster analysis as part of the family demographic index.

comparisons are shown. Means and percentages in the same row that do not share superscripts differ ($p < 0.05$) in follow-up Bonferroni corrected t tests. It should be noted that the term “family profile” and the ensuing labels are heuristic and used for descriptive purposes to facilitate discussion and characterize the heterogeneity of the sample. They are not intended to stereotype behavior traits of families nor are they intended to be used for direct parallels among children with similar family profiles.

For ease of reference the family profiles are order from seemingly most to least disadvantaged. The most disadvantaged family profile was low human capital and low family functioning (LHC/LFF), which represented 9.8% of the families in the study ($n = 131$). The most distinguishing characteristics of the LHC/LFF profile were those pertaining to child abuse and neglect. All children within this family subgroup were involved with the Illinois Department of Child and Family Services or the Cook County Juvenile Court because of one or more substantiated report of child abuse or neglect. Over one-third of these children (37.4%) spent time in relative and nonrelative foster homes and other non-biological parent settings. Other notable profile characteristics were low rates of maternal education (10.7 years), low scores on the family demographic index (0.9), and low rates of parent involvement (1.2) and expectations (1.7).

The second most disadvantaged cluster representing nearly 40% of the families in the study ($n = 509$) was the low human capital and moderate family functioning (LHC/MFF) profile. Notable profile characteristics were low rates of maternal education (10.9 years), parent involvement (1.1) and parent expectations (1.5) and low scores on the family demographic index (0.9). In terms of most indicators, this family profile was comparable to the LHC/LFF profile, except for numbers of children and child maltreatment. Relative to the LHC/LFF cluster, the LHC/MFF cluster had significantly fewer numbers of children (3.4 vs. 3.9). Moreover, none of the children in the LHC/MFF profile had substantiated reports of child maltreatment.

The second most advantaged cluster representing 21.5% of study families ($n = 288$) was the moderate human capital and moderate family functioning profile (MHC/MFF) characterized by moderate rates of maternal education (11.6 years), parent involvement (1.9) and parent expectations (2.3). Relative to all other profiles, families within this cluster scored highest on the family demographics index (1.9). Notable family profile characteristics that distinguished this cluster

Table 4
Adjusted mean and percentages for measures of children's educational attainment by child age 12 family profile.

Educational outcome	Family profile				F/Chi-square
	Low human capital/ low functioning LHC/LFF	Low human capital/ moderate functioning LHC/MFF	Moderate human capital/ moderate functioning MHC/MFF	High human capital/ high functioning HHC/HFF	
Eighth grade reading scores	140.50 ³	141.56 ³	144.40 ²	149.31 ¹	$F(3, 1258) = 13.74, p < 0.001$
High school graduation	29.4 ³	41.9 ²	49.9 ¹	53.3 ¹	$\chi^2(3, N = 1340) = 25.20, p < 0.001$
High school completion	54.1 ³	63.1 ²	66.1 ²	77.5 ¹	$\chi^2(3, N = 1340) = 25.56, p < 0.001$
Highest grade completed	10.83 ³	11.13 ³	11.52 ²	11.81 ¹	$F(3, 1318) = 14.65, p < 0.001$
Any college attendance	20.8 ²	24.3 ²	31.5 ¹	36.7 ¹	$\chi^2(3, N = 1340) = 18.42, p < 0.001$
Maximum n/total	131	509	288	412	1340

Note. Means and percentages have been adjusted for sex of child, race/ethnicity, CPC program participation, CPC program sites, kindergarten word achievement, any grade retention, and number of school moves by child age 12. Analysis of Covariance (ANCOVA) was used to test for differences for eighth grade reading scores and highest grade completed. Probit hierarchical regression was used to test for differences for high school graduation and completion, and any college attendance. Percentages are based on probit coefficients transformed to marginal effects. Means and percentages in the same row that do not share superscripts differ by $p < 0.05$ in follow-up Bonferroni *t* tests.

from all others were maternal age and household composition. On average, mothers in this group were 7 to 8 years older than mothers in other family subgroups. Moreover, relative to all other family subgroups, this family cluster was likely to have twice as many adults in the household. Among the four profiles of families, mothers in the MHC/HFF cluster had the lowest rates of single-parent status (44.0%), and AFDC/TANF participation (39.9%).

The seemingly least disadvantaged family profile was high human capital and high family functioning (HHC/HFF), representing 30.8% of the families in the study ($n = 412$). Relative to all others, this family profile had higher rates of maternal education, parent involvement, and parent expectations, and significantly fewer numbers of children. In terms of many other indicators, (e.g., AFDC/TANF participation, Free Lunch eligibility, parent employment, child maltreatment), HHC/HFF families were comparable to MHC/MFF families. Notable differences between the two more advantaged family subgroups were related to family size and structure, maternal education, parental involvement, and expectations. Relative to MHC/MFF families, HHC/HFF families were smaller in size with fewer children (2.6 vs. 3.1) and adults (1.5 vs. 3.1), more likely to be single-parent status (66.9% vs. 44.0%), have mothers with more years of schooling (12.2 vs. 11.6) and have higher rates of parental involvement (3.4 vs. 1.9) and parental expectations (3.5 vs. 2.3).

3.3. Family profiles and the relationship to educational attainment

As shown in Table 4, family profiles were related to eighth grade reading scores $F(3, 1258) = 13.74, p < 0.001$, high school graduation, $\chi^2(3, n = 1340) = 25.20, p < 0.001$, high school completion, $\chi^2(3, n = 1340) = 25.56, p < 0.001$, years of completed schooling, $F(3, 1318) = 14.65, p < 0.001$, and college attendance, $\chi^2(3, n = 1340) = 18.42, p < 0.001$. Differences in youths' educational attainment between profiles were sizable and most pronounced between the LHC/LFF and the HHC/HFF profiles. Children in the HHC/HFF profile were more likely than children in the LHC/LFF profile to have higher eighth grade reading scores (149.3 vs. 140.5, $p < 0.001$), complete high school (77.5% vs. 54.1%, $p < 0.001$), graduate from high school (53.3 vs. 29.4, $p < 0.024$), complete more years of schooling (11.81 vs. 10.83 years, $p < 0.001$), and attend college (36.7% vs. 20.8, $p < 0.001$). In general, children who had family profiles characterized by higher levels of human capital resources and more favorable scores on indicators of family functioning were more likely than other children to have higher educational attainment. For example, children in the HHC/HFF and the MHC/MFF profiles were more likely than children in the LHC/LFF and the LHC/LFF to have higher eighth grade reading scores, graduate from high school, complete more years of schooling, and attend college. A comparison of the two more advantaged family profiles indicated that children in the HHC/HFF profile were more

likely than children in the MHC/MFF profile to have higher eighth grades reading scores (149.31 vs. 144.40, $p < 0.001$), complete high school (77.5% vs. 66.1%, $p < 0.001$) and complete more years of schooling (11.81 vs. 11.52, $p < 0.041$). A comparison of the two more disadvantaged family subgroups indicated that children in the LHC/MFF profile were more likely to than children in the LHC/LFF profile to complete high school and complete more years of schooling.

3.4. Changes in family characteristic profiles for children between ages 8 and 12

Table 5 provides a cross-tabulation of the age 8 and 12 family classifications to examine the extent to which children experienced a change in family characteristic profiles based on the measures used to develop the family typologies.⁸ The bolded diagonal represents children with stable family characteristic profiles between ages 8 and 12. Overall, 1003 out of 1338 children (75%) had similar family characteristic profiles at both child age periods. The numbers above the diagonal indicate children who experienced a positive change in family characteristic profiles during early adolescence. Overall, 171 children (12.8%) showed beneficial changes in family characteristic profiles. For example, 61 children who showed LHC/MFF profiles at age 8 had HHC/HFF profiles at age 12. The numbers below the diagonal represent children who experienced a negative change in family characteristic profiles. Overall, 164 children (12.2%) showed negative changes in family characteristic profiles. For example, 85 children who had HHC/HFF profiles at age 8 showed LHC/MFF profiles at age 12.

Table 6 illustrates estimates of the effect of positive and negative change in children's family characteristic profiles on educational attainment after controlling for age 8 family characteristic profiles, positive/negative change, sex of child, race/ethnicity, CPC program participation, CPC program sites, kindergarten reading achievement, number of school moves, and grade retention. Children who experienced a positive change in family characteristic profiles showed higher eighth grade reading scores ($b = 5.2, p < 0.001$), completed nearly one-third of a year more of schooling ($b = 0.31, p < 0.038$) and were more likely to attend college ($b = 9.0, p < 0.030$). On the contrary, children who experienced a negative change in family characteristic profiles were less likely to

⁸ The age 8 and age 12 family profiles were compared using the CENTROID module in SLEIPNER. CENTROID compares two cluster solutions by providing descriptive information about the centroid means and variances by providing pairwise comparisons based on the squared average Euclidean distance. The mean of the average squared Euclidean distances can be used as an index of similarities between the centroids in different classifications (Bergman et al., 2003). Small differences between cluster pairings in terms of squared Euclidean distance indicate that there are minimal differences between two cluster classes.

Table 5
Cross-tabulation of the child age 8 and age 12 family profile.

Classification	Age 12				Total	
	LHC/LFF	LHC/MFF	MHC/MFF	HHC/HFF		
Age 8	LHC/LFF	94	0	0	3	97
	LHC/MFF	26	410	51	61	548
	MHC/MFF	2	13	207	56	278
	HHC/HFF	8	85	30	292	415
Total	130	508	288	412	1338	

graduate from high school ($b = -11.0, p < 0.020$), less likely to complete high school ($b = -10.9, p < 0.021$) and more likely to complete fewer years of schooling ($b = -0.46, p < 0.003$). There was some evidence that the effect of positive or negative change in family characteristic profiles on adolescent's educational attainment was affected by school-level factors (kindergarten reading achievement, number of school moves, and grade retention). In general, the magnitude of positive or negative change was larger in models that excluded school-level factors. For example, the effect of positive change was raised to statistical significance on high school graduation ($b = 10.1, p < 0.034$) and high school completion ($b = 9.4, p < 0.015$).

4. Discussion

Through cluster analysis, this study identified four profiles of families for children who participated in the Chicago Longitudinal Study. In general, children who had family profiles with higher levels of human capital resources, more favorable scores on indicators of parent practices toward children's schooling and family functioning were more likely than other children to have higher levels of educational attainment. Children that showed a negative change (i.e., a decrease in human capital resources, parenting practices toward schooling and/or family functioning) between the ages of 8 and 12 were less likely than other children to complete high school, graduate from high school and complete additional years of schooling. In contrast, children who experienced a positive change over the same time period were more likely than other children to have higher reading scores and complete additional years of schooling.

The identification of four subgroups of CLS families demonstrates that there are important differences among low-income families with respect to family human capital resources, parenting practices, family functioning and demographics. These differences counter stereotypes about the homogeneity of poor families and early intervention participants. To date, few studies have described different profiles of low-income families among early intervention participants. Identifying different profiles of families can contribute to preventative interventions by providing a framework to view variation among low-income families that can affect how children respond to intervention services.

Table 6
Estimates of family profile change on children's educational attainment.

	Positive change		Negative change	
	<i>b</i>	<i>p</i> -value	<i>b</i>	<i>p</i> -value
Eighth grade reading scores	5.15	0.001	-1.25	0.449
High school graduation	4.9	0.289	-11.0	0.020
High school completion	5.2	0.231	-10.9	0.021
Highest grade completed	0.31	0.038	-0.46	0.003
Any college attendance	9.0	0.030	-4.6	0.252

Note. Means and percentages have been adjusted for sex of child, race/ethnicity, CPC program participation, CPC program sites, kindergarten word achievement, any grade retention by age 12, and number of school moves by child age 12. MANCOVA was used to test for differences for eighth grade reading scores and highest grade completed. Probit hierarchical regression was used for dichotomous outcomes. Percentages are probit coefficients transformed to marginal effects.

This type of insight could be used to help ecological, multicomponent programs more effectively target and tailor services to meet the different strengths and needs of children and families.

The results of the present study also confirm the importance of human capital resources and family processes within low-income families on adolescents' educational outcomes. The considerable variation in school outcomes among the four profiles of low-income families identified in the present study indicates that family pathways contributing to the educational attainment of at-risk children are not uniform. The development and use of family typologies can serve to clarify variation in family factors, processes and other experiences that have been shown to influence children's educational attainment and response to preventative interventions (Bendersky & Lewis, 1994; Janosz et al., 2000; Rutter, 1987; Sameroff, Bartko, Baldwin, Baldwin & Seifer, 1998).

4.1. Changes in family characteristic profiles and effects on school outcomes

A large body of research has shown that family human capital resources and family poverty characteristics (including timing, duration and intensity) affect children's cognitive development, socio-emotional functioning and educational attainment (Carneiro & Heckman, 2003; Duncan, Brooks-Gunn & Klebanov, 1994; Hill & Sandfort, 1995; Korenman & Miller, 1997). Few longitudinal studies, however, have documented changes in family human capital resources and poverty characteristics for low-income populations post early childhood. In the present study, nearly, 8 out of 10 participants experienced no major change on family measures of human capital resources and functioning between the ages of 8 and 12. Less than 18% of children with disadvantaged family profiles (i.e., LHC/LFF, LHC/MFF) at 8 years of age showed advantaged family profiles at 12 years of age (i.e., MHC/MFF, HHC/HFF). Similarly, less than 16% of children with advantaged family profiles at 8 years of age had disadvantaged profiles at 12 years of age. These findings are consistent with Sameroff et al. (1998) that show a high level of stability for family risk factors between child ages 4, 13, and 18 and that children reported living in high-risk environments at 4 years of age were likely to be in high-risk environments throughout their childhood and adolescence.

In the present study, for the minority of children who experienced a change in family characteristic profiles between the ages of 8 and 12, the effect of the change on their educational attainment was sizable and long-term. A positive change was associated with gains in eighth grade reading scores, years of completed schooling and rates of college attendance. Conversely, a negative change was associated with decreases in rates of high school completion and graduation rates and years of completed schooling. Similar findings have been reported for the effect of change in cumulative social and family risk. In the Rochester Longitudinal Study, Sameroff et al. (1998) found that children who changed from a high-risk to a low-risk group between the ages of 4 and 13 increased in IQ by 13 points. In contrast, children who changed from a low-risk to a high-risk group during the same-age period dropped in IQ by 15 points.

4.2. Limitations

The findings of this study should be interpreted within the context of two limitations. The first is that the family profiles were in great part dependent on the input variables. A different or a larger set of family typology measures could yield different results. Similar findings based on alternative family measures would strengthen reliability and validity.

The second limitation is that the generalizability of findings to other populations and contexts is uncertain. While the consistency of findings across different clustering methods was strong and the 4-cluster solution was replicated across subsamples, tests of the model in

different social contexts, in different geographic areas, and with samples that are more ethnically and culturally diverse will provide the strongest tests of the external validity of the findings.

4.3. Implications

Our findings have practical implications for preventative research and policy and serve to underscore the body of research that indicates that family resources matter for children's education. This study suggests that increasing the human capital and family functioning of low-income families can improve the odds that children will be successful in school. Moreover, findings suggest a potentially broader time frame for preventative services in contrast to previous studies that indicate low returns for compensatory interventions post early childhood and that the educational trajectories of at-risk children are well-established by the early years of schooling (Alexander, Entwisle, & Horsey, 1997; Carneiro & Heckman, 2003; Dauber, Alexander, & Entwisle, 1996; Ensminger & Slusarcick, 1992).

Among the children in this study that are enrolled in government-funded early childhood programs because they were considered economically at-risk for school difficulties, family human capital resources and measures of family functioning were found to vary substantially and have strong effects on children's education. The four profiles of families identified in this study were unique and differentially related to children's educational attainment suggesting that needs and strengths of poor families may not be optimally met with a single model of service delivery (Ramey et al., 1998). Programs oriented towards fostering school success and healthy behavior for at-risk populations may be more effective when they provide differentiated services that account for child and family variation.

The results of this study demonstrate that typological frameworks can provide valuable insight about children and families which could be used to benefit intervention strategies and research on school failure in three ways. First, typological frameworks could be used to strengthen "needs assessments" to help programs more effectively target and tailor services. Second, typological frameworks could be used to document, and reevaluate changes in the target population's needs on a regular basis. The systematical generation of a knowledge base about a prevention programs target population, operation and impact can help guide the programs future services, and the resource allocation process (Ramey et al., 1998). Ongoing programs such as the Child-Parent Centers that provide services to two-generations could benefit from documenting changes in the needs of the target population which occur due to the fluid nature of political, economic, and social forces.

Lastly, and perhaps most importantly, a typological research approach could be used to evaluate the effects of a program or policy on subgroups of the population. Findings indicate that the differences among CLS families with respect to family human capital resources, family demographics, and family processes explain variation in children's educational attainment. The differential relationship between family subgroups and measures of educational attainment raises important questions regarding further research on intervention services and effects. Identifying children that are more seriously affected by family poverty factors is warranted given that these children and families may need more intensive interventions. Additional evaluations of children's outcomes for subgroups of low-income families would likely yield useful information relevant for developing more effective service models for at-risk children and their families.

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Appendix A. Correlations among key study indicators (child age 12)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Maternal age	1														
2. Maternal education	0.132***	1													
3. Family demographic index	0.228***	0.255***	1												
4. Parent not employed	-0.047	-0.203***	-0.646***	1											
5. Free lunch status	-0.125***	-0.248***	-0.600***	0.146***	1										
6. Single-parent status	-0.214***	-0.039	-0.620***	0.147	0.229***	1									
7. TANF/AFDC	-0.206**	-0.176***	-0.672***	0.218***	0.295	0.257***	1								
8. Number of children	-0.060*	-0.134***	-0.161***	0.152***	0.186	-0.025	-0.211***	1							
9. Number of adults	0.300***	0.059*	0.202***	0.008	-0.077	-0.078	-0.234***	0.070	1						
10. Child maltreatment	0.144***	0.122***	0.106***	-0.042	-0.078	-0.058*	-0.088***	-0.139***	0.060*	1					
11. Parent involvement	0.085**	0.130***	0.123***	-0.060*	-0.058	-0.070*	-0.058*	-0.110***	0.016	0.149***	1				
12. Parent expectations	0.075**	0.138***	0.115***	-0.039	-0.072	-0.043	-0.040	-0.122***	0.049+	0.584***	0.133***	1			
13. High school completion	0.052+	0.173***	0.177***	-0.080**	-0.118	-0.062*	-0.171***	-0.136***	0.033	0.248***	0.110***	0.187***	1		
14. Highest grade completed	0.085**	0.179***	0.207***	-0.090***	-0.131	-0.094***	-0.182***	-0.116***	0.065*	0.287***	0.134***	0.232***	0.831***	1	
15. CPC preschool	-0.025	0.097***	-0.002	-0.003	-0.021	0.019	0.006	-0.098***	-0.010	0.072**	0.141***	0.101***	0.093***	0.092***	1

Note. n = 1340. ***p<0.001. **p<0.01. *p<0.05. +p<0.09.

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