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ABSTRACT

The purpose of this study was to use data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 database for public use (version 2.9.2.1; Westat, 2000) to examine a sample of Head Start children and families to predict kindergarten and first grade success, The study controlled family variables of income level, family structure, and parent education level while predicting kindergarten and first grade success. Both repeated measures analysis of variance and latent curve analysis (LCA) were used to predict the academic success of kindergarten and first grade children. Results show that both income level and parent education level had statistically significant ($p<0.05$) effects on reading, mathematics, and general knowledge item response theory (IRT) scale scores, while family structure had a much weaker effect (nonsignificant) on reading, mathematics, and general knowledge IRT scale scores. Further, the means of Head Start children from families at or above the poverty level were consistently higher than those of children from families below the poverty level. The study compared LCA model fit statistics for the models tested. The growth model used for reading appears to provide the best-fit statistics. The growth model for knowledge provides the second best-fit statistics. The growth model for mathematics fit well overall, although the fit statistics are not as ideal as the reading and knowledge growth models. More studies need to be done in that area. (Author/SLD)

# Predicting Kindergarten Success for Economically Disadvantaged Head Start Children:

## A Latent Curve Analysis



Ying Hong Jiang

Doris Mok

Robert R. Weaver

Azusa Pacific University

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## Abstract

The purpose of this study is to utilize data from Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-Kindergarten-First Grade) database for public use version 2.9.2.1 (Westat, 2000) to examine a sample of Head Start children and families to predict kindergarten and first grade success. More specifically, the study controls family variables of income level, family structure, and parent education level while predicting kindergarten and first grade success for Head Start children. Both repeated measures ANOVA and Latent Curve Analysis (LCA) were employed to predict the academic success of kindergarten and first grade children. Results show that both income level and parent education level had statistically significant ($p < .05$) effects on reading, math, and general knowledge IRT scale scores, while family structure had a much weaker effect (non-significant) on reading, math, and general knowledge IRT scale scores Further, the means of Head Start children from families at or above the poverty level were consistently higher than children from families below the poverty level. The study compares LCA model fit statistics for the models tested. The growth model for reading appears to provide the best-fit statistics. The growth model for knowledge provides the second best-fit statistics. The growth model for math fit well overall, although the fit statistics are not as ideal as the reading and knowledge growth models. It is recommended more studies need to be done in that direction.

Introduction and purpose of the study:

For the year 2000, the total enrollment of Head Start reached 857,664 with a budget of $5,266,211,000. It is noted that 69% of children enrolled in Head Start are minority children, with 34.5% being black, and 28.7% being Hispanic (Head Start Bureau, 2001). This figure is likely to rise reflecting the trends of the US national population. There is an increasing awareness that research should acknowledge the demographic diversity, social changes and address specific community needs (Takanishi & DeLeon 1994; Zigler & Styfco, 1994). In recent years, the program has been challenged to demonstrate its effectiveness through rigorous research. The Advisory Committee on Head Start Research and Evaluation Committee was established in 1998 to provide recommendations for national analysis of the impact of Head Start. Some of the recommendations include random assignment of children and families, diversity of sites, quality of sites, and outcome measurement focusing on multiple domains (Head Start Bureau, 1999).

The purpose of this study is to utilize data from a national longitudinal study to examine a sample of Head Start children and families. More specifically, the current study intends to control several family variables such as income level, family structure, and parent education level while predicting kindergarten and first grade success for Head Start children.

Related literature on predictors of academic growth

A number of studies have sought to predict academic growth using income, parent education, and family structure as risk predictors. Income (Patterson, Kupersmidt, & Vaden, 1990; Entwisle & Alexander, 1990) and SES (Walker, Greenwood, Hart, & Carta, 1994) have predicted substantial variance in academic outcomes. Parent education (Greenberg, Lengua, Coie, & Pinderhughes, 1999; Walker et al.) has been associated with reading achievement. Race (Greenberg, et al.), SES, early language development, and IQ (Walker, et al.) are other predictors of primary level reading achievement. A variety of predictors including specific demographic factors (number of siblings, mother's age at the child's birth, family structure), life stress, family expressiveness (Greenberg, et al.), parent expectations, parent education, and kindergarten experience (Entwisle & Alexander) have accounted for math achievement. Family structure may not be good indicator of academic achievement because it does not necessarily indicate the level of involvement of fathers or other significant males in the lives of children (Fagan, Newash & Schloesser, 2000).

In the current study, we would expect income level to relate to all three academic achievement measures, and parent education to predict reading, but not necessarily math. Family structure may relate to any of the three academic achievement outcomes in the absence of more discriminating predictors.

Data source

Data for this study comes from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-Kindergarten-First Grade) database for public use version 2.9.2.1 (Westat, 2000). The database contains a nationally representative sample of 17,212 children enrolled in about 1,000 kindergarten programs. It includes information about the child, the child's parents/family, teachers, and schools. The design of the study allows for the examination of the

interaction of a variety of individual and familial characteristics as well as environmental factors such as school and community. We are particularly interested in effects from family variables on Head Start children's academic growth. The predictor variables of our particular interests are income level, parent education level, and family structure. The outcome variables are three repeated cognitive measures that were made during kindergarten and first grade, namely, a) the Reading IRT scale score, b) the Math IRT scale score, and c) the General Knowledge IRT scale scores. These measures have been collected longitudinally at four data points, Fall 98, Spring 99, Fall 99, and Spring 2000. We excluded Fall 99 data, because only 30 % of sample was tested.

Variables and Sample

In this study, the indicator of income level used is WKPOV_R, "poverty level revised." This variable has two levels representing two distinctive groups: a) Head Start children from families below poverty level and b) Head Start children from families at or above poverty level. The indictor of parent education level used is W1PARED, "parent highest education level." This variable has nine levels representing nine different categories of highest education level attained: a) 8th grade or below, b) 9th -12th grade, c) high school diploma/equivalent, d) vocational/technical program, e) some college, f) bachelor's degree, g) graduate/professional school-no degree, h) master's degree (MA, MS), and i) doctorate or professional degree. The indicator of family structure used describes the parent/guardian pattern of the household. This variable has nine levels: a) Biological mother and biological father, b) biological mother and other father, c) other mother and biological father, d) biological mother only, e) biological father only, f) two adoptive parents, g) one adoptive parent and one step parent, h) related guardians, and i) unrelated guardians. The sample for this study includes 1,930 Head Start children who had no missing data for the three indicator variables.

Data analyses and results

The major purpose of the study is to model Head Start children's academic growth from kindergarten through first grade in the domains of reading, math and general knowledge, while controlling family variables such as income level, parent education level, and family structure. We used the original weight variable C124CW0 to create a new weight to normalize the weights so that they sum to the sample size in the data set (rather than the population of kindergarten children by applying the formula 'New Weight = (C124CW0 * n) /sum(C124CW0)'. The new weight then was applied to all the analyses in the study.

There were two phases for the data analyses. In the first phase, we conducted three conventional Repeated Measures Analyses of Variance. The analyses were done using income level as the grouping variable and parent education level and family structure as covariates. Three repeated measures for Reading, Math, and General Knowledge IRT scale scores collected from kindergarten (Fall 98, Spring 99) and first grade (Spring 2000) were used. In the second phase of data analyses, we conducted three latent curve analyses to model Head Start children's academic growth measures using Reading, Math, and General Knowledge IRT scale scores collected from kindergarten (Fall 98, Spring 99) and first grade (Spring 2000), while controlling for poverty level, parent education level, and family structure.

*Repeated Measures ANOVAs*

The results from the Repeated Measures ANOVAs show that both income level and parent education level had statistically significant ($p < .05$) effects on reading, math, and general knowledge IRT scale scores, while family structure had a much weaker effect (non-significant) on

reading, math, and general knowledge IRT scale scores (Tables 1, 2, and 3). Further, the means of Head Start children from families at or above the poverty level were higher than children from families below the poverty level (Tables 4, 5, and 6).

Figures 1, 2, 3 in Appendix A plot the growths of Reading, Math, and General Knowledge based on the estimated means from three data points: Fall 98, Spring 99, and Spring 2000. We have observed the trend for an overall higher gain from Spring 99 to Spring 2000 compared with the gain from Fall 98 to Spring 99. This appears to indicate that the rate of change is different for these two periods. This effect may be due to the longer period from Spring 99 to Spring 2000.

**Table 1: Summary Table of Tests of Between-Subjects Effects on Repeated Measures of Reading IRT Scale Score**

| Source | SS | df | MS | F | p | Eta Squared |
|---|---|---|---|---|---|---|
| Intercept | 399641.043 | 1 | 399641.043 | 1995.556 | <.01 | .534 |
| Family Structure | 124.411 | 1 | 124.411 | .621 | .431 | .000 |
| Parent Education Level | 11495.660 | 1 | 11495.660 | 57.402 | <.01 | .032 |
| Poverty Level | 11131.685 | 1 | 11131.685 | 55.585 | <.01 | .031 |
| Error | 349062.710 | 1743 | 200.265 | | | |

**Table 2: Summary Table of Tests of Between-Subjects Effects on Repeated Measures of Math IRT Scale Score**

| Source | SS | df | MS | F | p | Eta Squared |
|---|---|---|---|---|---|---|
| Intercept | 320643.340 | 1 | 320643.340 | 2585.524 | <.01 | .579 |
| Family Structure | 166.277 | 1 | 166.277 | 1.341 | .247 | .001 |
| Parent Education Level | 6891.815 | 1 | 6891.815 | 55.573 | <.01 | .029 |
| Poverty Level | 4493.229 | 1 | 4493.229 | 36.231 | <.01 | .019 |
| Error | 232899.831 | 1878 | 124.015 | | | |

**Table 3: Summary Table of Tests of Between-Subjects Effects on Repeated Measures of General Knowledge IRT Scale Score**

| Source | SS | df | MS | F | p | Eta Squared |
|---|---|---|---|---|---|---|
| Intercept | 215727.274 | 1 | 215727.274 | 2094.271 | <.01 | .547 |
| Family Structure | 335.559 | 1 | 335.559 | 3.258 | .071 | .002 |
| Parent Education Level | 7055.377 | 1 | 7055.377 | 68.493 | <.01 | .038 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Poverty Level | 5598.503 | 1 | 5598.503 | 54.350 | <.01 | .030 |
| Error | 178925.404 | 1737 | 103.008 | | | |

**Table 4: Means and Standard Deviations of Reading IRT Scale Score for Head Start Children by Poverty Level**

| Measures | Group | Mean | Std. Deviation | n |
|---|---|---|---|---|
| FALL 98 READING IRT SCALE SCORE | Below Poverty and Head Start | 18.06213 | 4.98720 | 820 |
| | At or Above Poverty and Head Start | 20.38861 | 6.83918 | 927 |
| | Total | 19.29661 | 6.15002 | 1747 |
| SPRING 99 READING IRT SCALE SCORE | Below Poverty and Head Start | 27.10140 | 7.85989 | 820 |
| | At or Above Poverty and Head Start | 30.55024 | 9.83005 | 927 |
| | Total | 28.93143 | 9.12089 | 1747 |
| SPRING 2000 READING IRT SCALE SCORE | Below Poverty and Head Start | 46.65681 | 12.66391 | 820 |
| | At or Above Poverty and Head Start | 52.51253 | 13.05697 | 927 |
| | Total | 49.76399 | 13.19809 | 1747 |

**Table 5: Means and Standard Deviations of Math IRT Scale Score for Head Start Children by Poverty Level**

| Measures | Group | Mean | Std. Deviation | n |
|---|---|---|---|---|
| FALL 98 MATH IRT SCALE SCORE | 1.00 Below Poverty and Head Start | 15.40524 | 4.87403 | 919 |
| | 2.00 At or Above Poverty and Head Start | 17.40988 | 5.71150 | 963 |
| | Total | 16.43099 | 5.41129 | 1882 |
| SPRING 99 MATH IRT SCALE SCORE | 1.00 Below Poverty and Head Start | 22.40912 | 7.15077 | 919 |
| | 2.00 At or Above Poverty and Head Start | 25.20204 | 7.67418 | 963 |
| | Total | 23.83822 | 7.55148 | 1882 |
| SPRING 2000 MATH IRT SCALE SCORE | 1.00 Below Poverty and Head Start | 37.75367 | 9.09779 | 919 |
| | 2.00 At or Above Poverty and Head Start | 40.44993 | 8.74689 | 963 |
| | Total | 39.13332 | 9.01891 | 1882 |

**Table 6: Means and Standard Deviations of General Knowledge IRT Scale Score for Head Start Children by Poverty Level**

| Measures | Group | Mean | Std. Deviation | n |
|---|---|---|---|---|
| FALL 98 KNOWLEDGE IRT SCALE SCORE | Below Poverty and Head Start | 16.81738 | 5.73225 | 818 |
| | At or Above Poverty and Head Start | 19.46775 | 6.13883 | 923 |
| | Total | 18.22249 | 6.09492 | 1741 |

| | | | | |
|---|---|---|---|---|
| SRPING 99 KNOWLEDGE IRT SCALE SCORE | | | Below Poverty and Head Start | |
| | 21.51420 | 6.42521 | 818 | |
| | At or Above Poverty and Head Start | | 24.39060 | 6.76784 |
| | 923 | | | |
| | Total | 23.03914 | 6.76143 | 1741 |
| SRPING 2000 KNOWLEDGE IRT SCALE SCORE | | | Below Poverty and Head Start | |
| | 29.11585 | 7.08258 | 818 | |
| | At or Above Poverty and Head Start | | 32.23758 | 6.68517 |
| | 923 | | | |
| | Total | 30.77085 | 7.04725 | 1741 |

*Latent Curve Analyses*

After analyzing the findings from the conventional Repeated Measures ANOVAs, we attempted to conditionally model the growths of Head Start children in reading, math, and general knowledge ability (measured by IRT scale scores collected Fall 98, Spring 99, and Spring 2000), while controlling for income level, parent education level, and family structure, we used MPLUS Version 2.12, (Muthen & Muthen, 2002) to conduct Latent Curve Analysis (LCA). According to Curran (2000), latent curve analysis is a highly structured type of structural equation model, since it incorporates information about both covariance and mean structures of observed measures. LCA uses the observed repeated measures to define one or more underlying latent growth factors. Figures 4, 5, and 6 in Appendix A describe the models with path coefficients tested with LCA.

The three LCAs have yielded different findings to describe the growths in three different subject areas. If we fix the intercepts at three data points (Fall 98, Spring 99, and Spring 2000) as 1, and fix the rate of change for the first data point as 0, and the second data point as 2, the rate of change at the third data point varies for the three subject areas. The rate of change is 3.3 for reading, 3.1 for math, and 2.6 for general knowledge. Further, the dummy coded ('1' for below poverty level, '0' for at or above poverty level) income level variable had a negative effect on the intercepts, suggesting that the below poverty level characteristic inversely influenced the intercepts.

Apparently the below poverty level characteristic had the strongest negative effect (-3.313) on the knowledge intercept, second strongest negative effect (-3.283) on the reading intercept, and weakest negative effect (-2.083) on the math intercept. Parent education level, however, had a positive effect on all the three intercepts. The values reflect the positive effect of the higher parent education level, since parent education level has been coded with higher value reflecting higher level of parent education. It appears that parent education level had the strongest effect on the reading intercept (.954), the second strongest effect on the knowledge intercept (.935), and the weakest effect on the math intercept (.569). Family structure had a relatively weaker effect on the three intercepts (.608, .06, and 0.396 for reading, math, and general knowledge, respectively).

Income level showed a negative effect on the rate of change for reading (-.807). Parent education level showed weak positive effect on the rate of change for math (.174). Other effects on the rate of change were small.

Table 7, in Appendix B, compares model fit statistics for the models tested. The growth models for reading appear to provide the best-fit statistics. The growth models for knowledge provide the second best-fit statistics. The growth models for math fit well overall, although the fit statistics are not as ideal as the reading and knowledge growth models.

## Discussion and educational significance of the study

We have attempted to model Head Start children's growth in the areas of reading, math, and general knowledge, while controlling the family variables of income level, parent education level, and family structure. We recommend that when predicting academic success longitudinally, we need to control for the family variables, which have been theorized to contribute to academic growth. We further recommend the need to look at specific domains where the Head Start program has been effective in helping economically disadvantaged children. One of the findings of the

current study is that the growth model for math does not fit as well as the growth models for reading and knowledge. The implication is the model might have excluded some important family variables or intervention variables. We suggest that further research in the direction.

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# Table 7: Comparisons of Model Fit Indices

| | Reading Growth Model By Group | | Reading Growth Model By | |
|---|---|---|---|---|
| Group * Parent Education | Reading Growth Model By Group * Type of Family | | | |
| | Reading Growth Model By Group * Parent Education * Type of Family | | | |
| Tests of Model Fit | N=1930 | | N=1930 N=1930 N=1930 | |
| $\chi 2$ | 1.337 | 1.345 | 1.472 1.479 | |
| df | 2 | 3 | 3 4 | |
| p | 0.5093 | 0.7179 | 0.6882 0.8302 | |
| CFI/TLI | 1.000/1.000 | 1.000/1.002 | 1.000/1.000 | |
| | 1.000/1.002 | | | |
| RMSEA | 0.000 | 0.000 | 0.000 0.000 | |
| | Math Growth Model By Group | | Math Growth Model By | |
| Group * Parent Education | Math Growth Model By Group * Type of Family | | Math | |
| Growth Model By Group * Parent Education * Type of Family | | | | |
| Tests of Model Fit | N=1930 | | N=1930 N=1930 N=1930 | |
| $\chi 2$ | 21.829 | 21.849 | 24.76 24.786 | |
| df | 2 | 3 | 3 4 | |
| p | 0.000 | 0.0001 | 0.000 0.0001 | |
| CFI/TLI | 0.994/0.983 | 0.995/0.984 | 0.994/0.981 | |
| | 0.994/0.982 | | | |
| RMSEA | 0.072 | 0.057 | 0.061 0.052 | |
| | Knowledge Growth Model By Group | | Knowledge Growth Model | |
| By Group * Parent Education | Knowledge Growth Model By Group * Type of Family | | | |
| | Knowledge Growth Model By Group * Parent Education * Type of Family | | | |
| Tests of Model Fit | N=1930 | | N=1930 N=1930 N=1930 | |
| $\chi 2$ | 5.209 | 8.105 | 6.421 9.363 | |
| df | 2 | 3 | 3 4 | |
| p | 0.0725 | 0.0435 | 0.0922 0.0524 | |
| CFI/TLI | 0.999/0.998 | 0.999/0.997 | 0.999/0.998 | |
| | 0.999/0.997 | | | |
| RMSEA | 0.029 | 0.030 | 0.024 0.026 | |

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| Organization/Address: Azusa Pacific University<br>901 E. Alosta Ave, Azusa, CA 91702 | Telephone: | FAX: |
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