

Moderators of Cognitive and Social Development through Kindergarten for At-Risk Participants in a School Readiness Program

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Introduction

As the number of states and school districts implementing pre-kindergarten programs to improve school readiness increases, it is important to examine the outcomes for children who attend such programs as well as factors moderating these effects. The current study assessed the cognitive and social development of children who participated in More at Four, a statewide school readiness program designed for at-risk children. Two cohorts of children were each followed over a two-year period, during pre-kindergarten and kindergarten. Children's growth in cognitive and behavioral skills was examined, as well as moderators of that growth, including individual factors (children's level of cumulative risk) and experiential factors (the quality of classroom practices).

More at Four Program Description

The North Carolina More at Four Pre-kindergarten Program, a statewide initiative for at-risk 4-year-olds begun in 2001-2002, is designed to help children be more successful when they enter school. More at Four operates through the existing service delivery systems, providing funding for classroom-based educational programs at a variety of sites, including public schools, community child care programs (both for-profit and nonprofit), and Head Start. Children are selected into the program based on poverty status and other risk factors (limited English proficiency, identified disabilities, chronic health conditions), with a primary focus on children who have never been served in a pre-kindergarten program. Classrooms are required to meet a variety of program guidelines and standards including licensing levels, curriculum, teacher qualifications, and teacher-child ratios.

Major Research Questions

The present study utilized longitudinal data from two cohorts of children followed during their pre-k and kindergarten school years to address the following questions:

- What were the longitudinal cognitive and behavioral outcomes through kindergarten for children who attended the More at Four preschool program?
- What moderating factors were associated with better outcomes for children?
 - What was the impact of children's level of risk?
 - What was the impact of the quality of the pre-k classrooms the children attended?

Participants

- Cohort 1 (2003-2005)
 - Children participating in More at Four were recruited from 58 randomly-selected pre-k classrooms (out of 599 statewide).
 - 514 participants in pre-k and 348 in kindergarten.

- Cohort 2 (2005-2007)
 - Children were recruited from 57 randomly-selected pre-k classrooms (out of 952 statewide).
 - 478 participants in pre-k and 400 in kindergarten.

Procedures

- Independent individual assessments of children’s language and literacy skills, math skills, and general knowledge, and teacher ratings of children’s behavioral skills were gathered twice each year, in the fall and spring.
- Children’s cumulative risk level was calculated using a 4-level categorical variable (0, 1, 2, 3-5), based on poverty status (eligible for free lunch=2, reduced-price lunch=1, full-price lunch=0) and the presence or absence (1/0) of other risk factors (limited English proficiency, identified disability, and chronic health condition).
- Observational assessments of the quality of classroom practices in pre-k were conducted mid-year.

Measures

Table 1: Child Outcome Measures and Classroom Quality

Domain	Measure	Skills Assessed	Scoring
Language and Literacy	Peabody Picture Vocabulary Test-III (PPVT-III) ¹	Receptive vocabulary	Standardized measure, Mean=100, SD=15
	Woodcock Johnson-III Tests of Achievement (WJ-III) ² Rhyming (Subtest 21A, Sound Awareness test)	Phonological awareness	Range=0–17
	Naming Letters Task ³	Alphabet knowledge	Range=0–26
	Story and Print Concepts Task ⁴	Early literacy skills including book knowledge, story comprehension, and print awareness	Range=0–14

Table 1: Child Outcome Measures and Classroom Quality

Domain	Measure	Skills Assessed	Scoring
Math	Woodcock Johnson-III Tests of Achievement ² Applied Problems (Test 10)	Ability to solve practical math problems including counting, simple addition, and subtraction	Standardized measure, Mean=100, SD=15
	Counting Bears Task ⁵	Ability to count in one-to-one correspondence	Range=0–40
General Knowledge	Social Awareness Task ⁶	Knowledge of child’s full name, age and birth date	Range=0–6
	Color Bears Task ⁷	Knowledge of 10 basic colors	Range=0–20
Behavioral Skills	Social Skills Rating System (SSRS) ⁸ Social Skills Subscale	Social skills (e.g., “follows your directions”)	Standardized measure, Mean=100, SD=15
	Social Skills Rating System (SSRS) ⁸ Problem Behaviors Subscale	Problem behaviors (e.g., “argues with others”)	Standardized measure, Mean=100, SD=15
Classroom Quality	Early Childhood Environment Rating Scale-Revised (ECERS-R) ⁹	Quality of classroom practices	Range=1.0–7.0

Analysis

Child outcomes were analyzed with a series of longitudinal growth models. Separate analyses were conducted for each measure using a mixed model approach to account for repeated measures within children and multiple children within classes. Covariates included: cohort (1 vs. 2); grade (pre-k vs. kindergarten); assessment variations (age at first assessment, time between assessments/enrollment); More at Four dosage; child characteristics (gender, cumulative risk factor score, English proficiency level); and pre-k classroom quality (ECERS-R total child items score). As a precaution against Type I error, all analyses included adjustments to the p-values using the Benjamini and Hochberg¹⁰ correction for multiple comparisons.

Results

LONGITUDINAL GROWTH

Children showed significant growth over the two years in almost all areas of cognitive and behavioral skills, including standardized scores of receptive language and applied math skills. Teacher ratings of problem behaviors did not change over time. (See Table 2.)

MODERATING FACTORS

Cumulative Risk. Risk level was a significant moderator. Children at greatest risk generally scored lower than other children but exhibited steeper growth curves in many areas, including language and literacy skills, math skills, and general knowledge. These differences were primarily due to greater growth during pre-k for some skills (receptive language, applied problems, color knowledge) and during kindergarten for others (letter naming, counting). For rhyming, a higher-level language/literacy skill, children at greatest risk exhibited a lower rate of growth, primarily in pre-k. (See Figures 1–7.)

Classroom Quality. The quality of classroom practices was fairly high, with a mean of 4.8 (SD=0.8, range=2.8-6.3). No consistent longitudinal effects for classroom quality were found. Children in higher quality preschool classrooms showed greater growth in social skills during pre-k, but less growth in letter knowledge during pre-k and less growth in rhyming skills in kindergarten.

Conclusions

Children's patterns of longitudinal development through kindergarten suggest that participation in the pre-k program was associated with sustained growth over time, after adjusting for other relevant factors. Children made substantial gains over this time, during both the pre-k and the kindergarten years, across all domains of language and literacy skills, math skills, general knowledge, and behavioral skills. For some of these skills with age-standardized measures (receptive language, applied math problems, social skills), their scores indicated that children progressed at an even greater rate than would be expected for normal developmental growth. For many of these skills, children made greater gains in pre-k than kindergarten. For a few of these measures (social awareness and color knowledge), children had mastered these skills (scoring

close to the maximum) by the end of pre-k or beginning of kindergarten, which limited the possible room for growth in kindergarten. For other measures, these results suggest that children's earlier experiences in pre-k may have provided an initial exposure to information that offered a more rapid period of growth, which then slowed slightly in kindergarten.

In looking at the effects of children's cumulative risk factor levels, not surprisingly, children at greater risk, especially those in the highest risk category, entered More at Four with lower scores and continued to score lower in most language and cognitive skills. However, these children made greater gains from pre-k through kindergarten in many key school readiness and early academic skills. Even though these higher-risk children were entering pre-k at a deficit, they were gaining at a similar or even greater rate, and in some cases, even catching up to other children (e.g., letter knowledge, color knowledge). The one exception was phonological awareness, a higher-order pre-reading skill, where higher-risk children gained at a slower rate than those at lower risk.

In general, the quality of the pre-k program was not strongly related to children's outcomes over time, with no clear pattern of effects. The quality of the More at Four classrooms was generally high, which reduces the variability and the likelihood of finding differences in the effects on children. Further, children had varied experiences in kindergarten unrelated to their experiences in pre-k, which may have made it more difficult to find associations over time. The differences in ratings of children's social skills during pre-k, with children in higher quality classrooms making greater progress, may reflect differences in teacher knowledge and expectations in higher versus lower quality classrooms. The other differences that were found, less progress on letter knowledge in pre-k and less growth on rhyming in kindergarten, could represent a less direct focus on such skills in higher quality classrooms.

These results suggest that the pre-k experiences provided in More at Four helped prepare these at-risk children for school and enabled them to continue to progress, often at a greater than expected rate, in kindergarten. Given the implications of the impact of early school success on children's continued positive trajectories, these findings suggest that experiences such as those provided in the More at Four program may offer an important and ameliorative experience for children who otherwise may not have such opportunities during the pre-k year.

Table 2. Longitudinal Child Outcome Scores

Domain	Outcome (Possible Range)	Pre-K		Kindergarten		Growth over Time ^{a,b}		
		Fall n=869-991	Spring n=836-879	Fall n=625-747	Spring n=641-720	Pre-K Growth	K Growth	Total Growth
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)			
Language and Literacy	Receptive Language PPVT-III (Standardized Score)	83.3 (20.1)	88.4 (18.5)	92.6 (16.8)	94.7 (15.0)	***	***	***
	Rhyming WJ-III (0-17)	1.9 (2.7)	4.1 (4.0)	6.2 (4.3)	8.6 (4.4)	***	***	***
	Story and Print Concepts (0-14)	3.0 (2.3)	4.8 (2.6)	6.9 (2.5)	8.8 (2.5)	***	***	***
	Naming Letters (0-26)	6.3 (8.3)	15.2 (9.6)	20.6 (7.6)	24.8 (3.8)	***	***	***
Math	Applied Problems WJ-III (Standardized Score)	92.1 (15.5)	94.0 (14.1)	96.3 (12.3)	99.5 (11.4)	***	***	***
	Counting Task (0-40)	11.2 (8.1)	18.9 (11.1)	26.1 (12.0)	34.3 (9.3)	***	***	***
General Knowledge	Social Awareness (0-6)	3.5 (1.8)	4.3 (1.5)	4.7 (1.3)	5.3 (1.0)	***	***	***
	Color Knowledge (0-20)	16.0 (5.8)	18.7 (3.0)	19.6 (1.5)	19.8 (0.8)	***	NS	***
Classroom Behavior	Social Skills SSRS (Standardized Score)	100.6 (15.5)	108.6 (15.0)	101.7 (14.7)	107.1 (15.0)	***	***	***
	Problem Behaviors SSRS (Standardized Score)	98.4 (12.5)	98.4 (12.5)	97.9 (12.8)	98.5 (13.2)	NS	NS	NS

^a * $p < .05$, ** $p < .01$, *** $p < .001$, NS=nonsignificant.

^b Significance levels indicate results of the parameter estimates for the adjusted gains over time based on longitudinal growth model estimations.

Figure 1: Growth in Receptive Language Skills (PPVT-III) by Risk Level

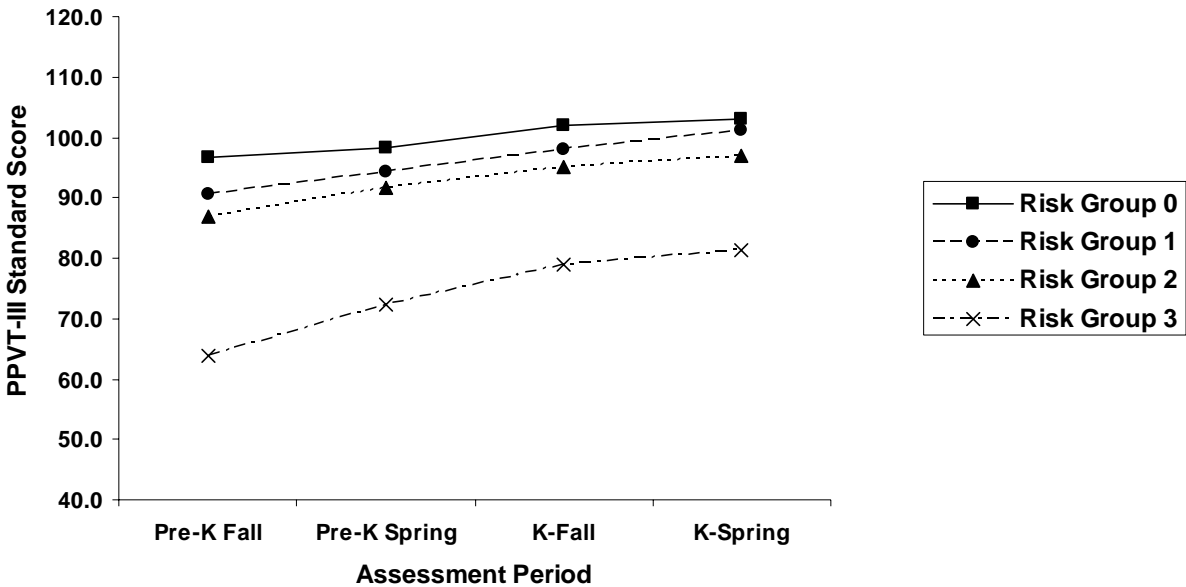


Figure 2: Growth in Letter Knowledge (Naming Letters Task) by Risk Level

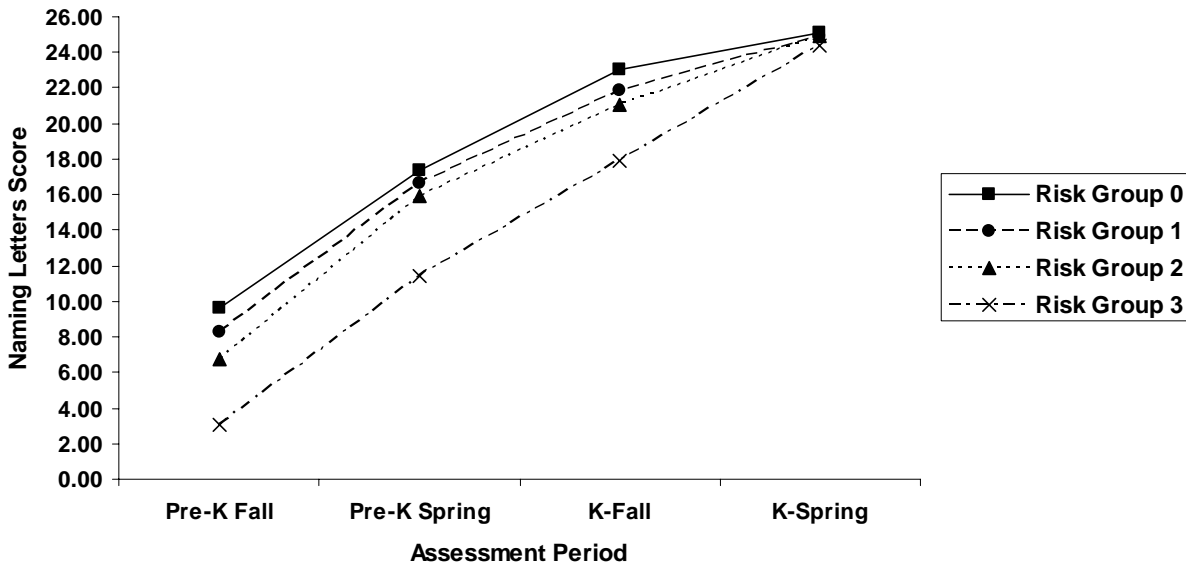


Figure 3: Growth in Math Skills (WJ-III Applied Problems) by Risk Level

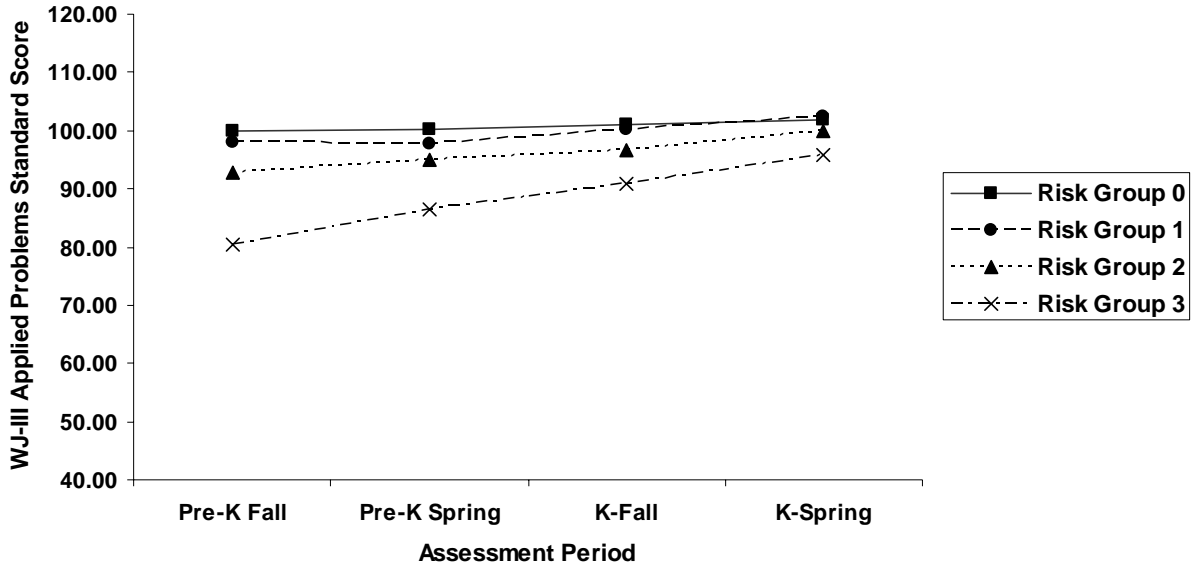


Figure 4: Growth in Counting Skills (Counting Task) by Risk Level

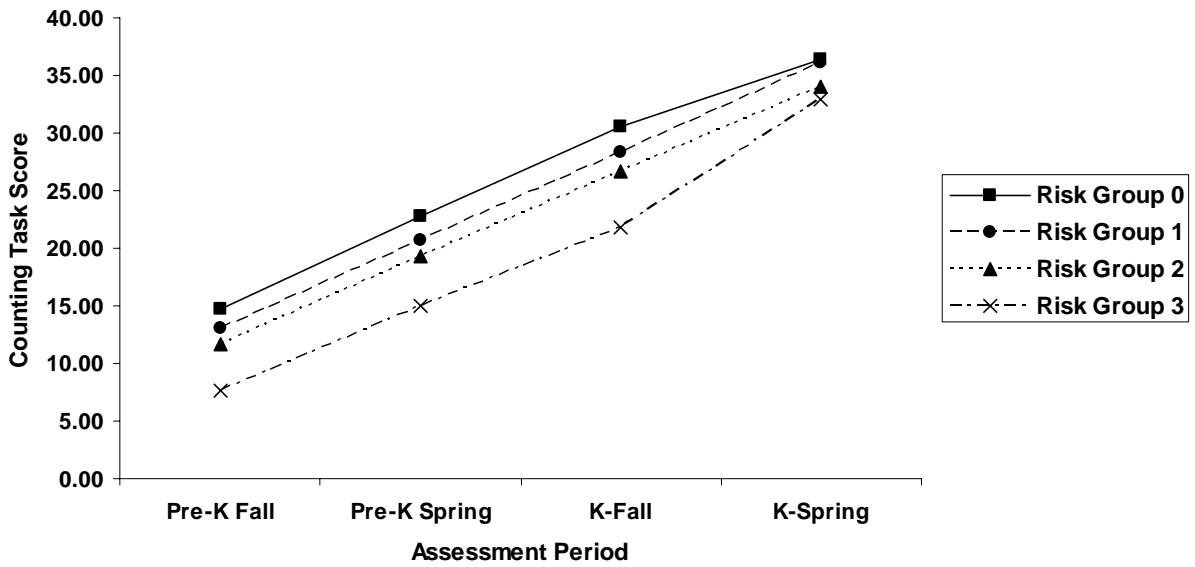


Figure 5: Growth in Social Knowledge (Social Awareness Task) by Risk Level

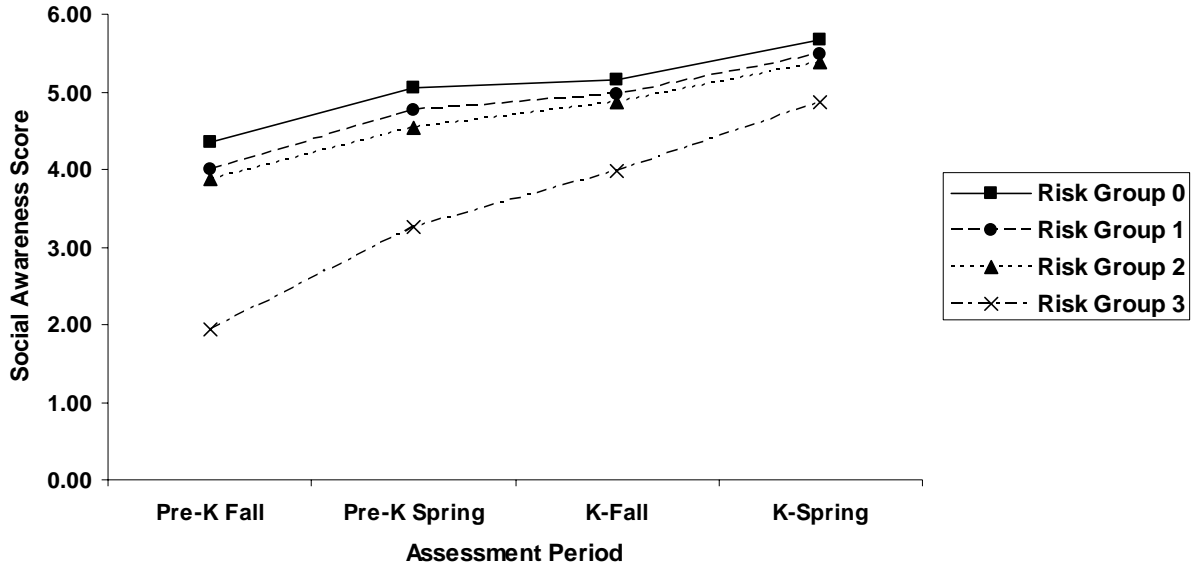


Figure 6: Growth in Color Knowledge (Color Naming Task) by Risk Level

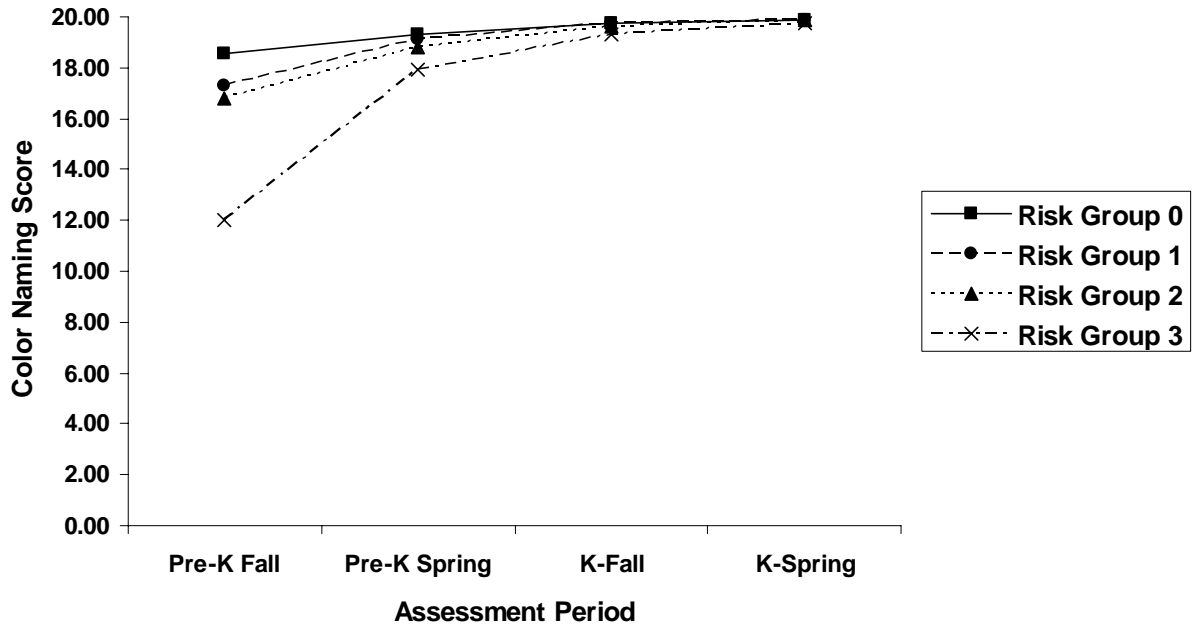
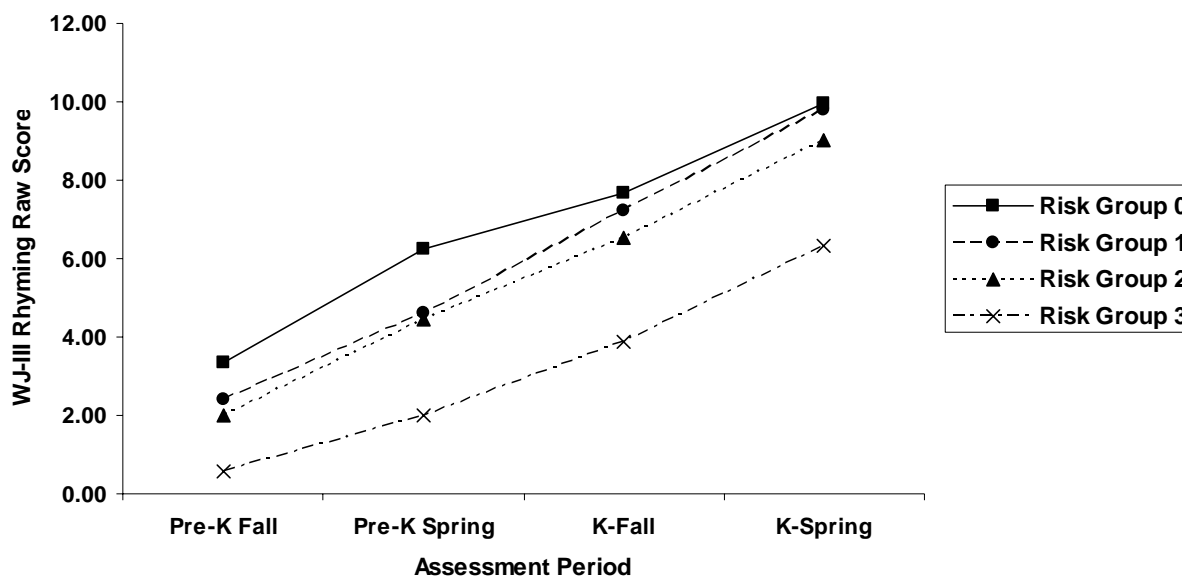


Figure 7: Growth in Phonological Awareness (WJ-III Rhyming) by Risk Level



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