Early Learning Scholarships Program Evaluation Report

Appendix C:
Minnesota State Early Learning Scholarships: Evaluation Report on Child Outcomes

SRI Education

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Minnesota State Early Learning Scholarships: Evaluation Report on Child Outcomes

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Executive Summary

Minnesota's Early Learning Scholarships Program was established in 2013 with the passage of Minnesota legislative statute, section 124D.165 (Appendix A). The stated purpose of the Scholarships is to increase access to high-quality early childhood programs for 3- to 5-year-old children from low-income families. Similar to Minnesota Early Learning Foundation Scholarships and the state-funded PreK Allowances, piloted in 2008–2012, and Race to the Top-Early Learning Challenge Scholarships, awarded during 2012–2016, Scholarships are awarded to high-need families to enable children to attend quality early learning and development (ELD) programs with the goal of improving their school readiness.

Scholarships are distributed through two modalities, Pathway I and Pathway II, and are tied to the state's Parent Aware Quality Rating and Improvement System. To qualify for a Scholarship, families must reside in Minnesota and have an income that is equal to or less than 185% of the federal poverty level in the current calendar year or be able to document their participation in another eligible public assistance program. Children must be 3 or 4 years old on September 1 of the current school year and not yet have started kindergarten.

The Scholarship funding statute requires that the program be subject to an independent evaluation that includes "recommendations regarding the appropriate scholarship amount, efficiency, and effectiveness of the administration, and impact on kindergarten readiness" (Appendix A). This report addresses the Scholarship impacts on kindergarten readiness through analyses designed to answer the following questions:

1. How did Scholarship recipients' outcomes at the completion of the preschool year compare with outcomes for a similar group of children who attended ELD programs rated 1 or 2 stars on the Parent Aware rating system, once child background characteristics and beginning of preschool baseline assessment scores were accounted for?
2. What were the school readiness outcomes at the completion of the preschool year for children who received Minnesota Early Learning Scholarships to attend ELD programs rated 3 or 4 stars on the Parent Aware Quality Rating and Improvement System?

This report also addresses a secondary question about whether children's outcomes were different depending on the Pathway type used to receive the Scholarship.

To answer the research questions, the evaluation team implemented a quasi-experimental pre-post design using a sample of 4-year-olds receiving Scholarships to attend 3- and 4-star-rated ELD programs and a comparison group of children attending 1- or 2-star-

rated programs. This comparison allowed the evaluation team to test one of the tenets of the Scholarship model: children attending highly rated (3- and 4-star Parent Aware rated) programs will attain better school readiness outcomes than children who attend lower rated (1- and 2-star Parent Aware rated) ELD programs. The comparison sample was drawn from children participating in the Parent Aware Validation Study concurrently conducted by Child Trends as part of the evaluation of Minnesota's Race to the Top Early Learning Challenge grant. The final analytic sample was 264 Scholarship and 154 comparison children.

To compare the outcomes of the two groups of children, we conducted weighted regression analyses for a battery of child assessments. The battery consisted of direct assessments and teacher-report assessments that cover a range of school readiness domains including: (1) early language and literacy, (2) early numeracy and math, (3) social and emotional competence, and (4) approaches to learning, including executive functioning. Our overall approach to data analysis included multiple imputation of missing demographic characteristics and pretest scores, and propensity score weighting to produce accurate estimates of the effects of attending a 3- or 4-star-rated ELD program. The results of these analyses showed that children receiving Scholarships to attend 3- and 4-star programs had significantly better outcomes on two components of early literacy skills, print knowledge and phonological awareness, compared with children attending 1- and 2-star Parent Aware rated programs. They also had significantly higher teacher-rated anxiety. On all other school readiness measures (i.e., early math, social competence, and approaches to learning), the two groups of children did not differ. Additional secondary analyses examined the within-group changes in mean scores between fall and spring for each of the two groups of children separately. These analyses test whether the average scores were better in the spring compared to fall. These analyses do not take into account the demographic characteristics or the pretest scores of the children. The results showed that for the Scholarship group, spring scores were significantly better than fall scores on six of the nine measures. For the comparison group, spring scores were significantly better than fall scores for three of the nine measures.

Limitations of the findings also are discussed.

Introduction

Minnesota's Early Learning Scholarships Program

Minnesota's Early Learning Scholarships Program was established in 2013 with the passage of Minnesota legislative statute, section 124D.165 (Appendix A). The stated purpose of the Scholarships is to increase access to high-quality early childhood programs for 3- to 5-year-old children from low-income families. Similar to Minnesota Early Learning Foundation Scholarships and the state-funded PreK Allowances, piloted in 2008–2012, and Race to the Top-Early Learning Challenge Scholarships, awarded during 2012–2016, Scholarships are awarded to high-need families to enable children to attend quality early learning and development (ELD) programs with the goal of improving their school readiness.

Scholarships are distributed through two modalities, Pathway I and Pathway II, and are tied to the state's Parent Aware Quality Rating and Improvement System.[1]

1. Pathway I Scholarships are awarded to qualifying families for up to 12 months, and they follow the child in that they are paid directly to whichever ELD program the family chooses, as long as the program participates in the Parent Aware rating system.[2] These can include school-based prekindergarten programs, Head Start, and other center-based or family child care (FCC) programs.
2. Pathway II Scholarships are awarded to qualifying families through eligible 4-star Parent Aware-rated programs that have applied for funding. These can include school-based prekindergarten programs, Head Start, and other center-based or family child care programs.[3]

To qualify for a Scholarship, families must reside in Minnesota and have an income that is equal to or less than 185% of the federal poverty level in the current calendar year or be able to document their participation in another eligible public assistance program. Children must be 3 or 4 years old on September 1 of the current school year and not yet have started kindergarten. The funding statute also has eligibility provisions for children under 3 years old who are attending the same ELD program as an older sibling already receiving a Scholarship or whose parent is under age 21 and is pursuing a high school or general education equivalency diploma.

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[1] ELD programs are rated on a scale of 1 to 4 stars, with 4 stars representing the highest ELD program quality.

[2] Beginning July 1, 2016, this criterion will change in that Scholarships can be used to attend only programs rated 3 or 4 stars.

[3] Although all 4-star programs are eligible to apply, our data showed that the majority of programs awarding Pathway II Scholarships were school-based and Head Start programs (69% combined).

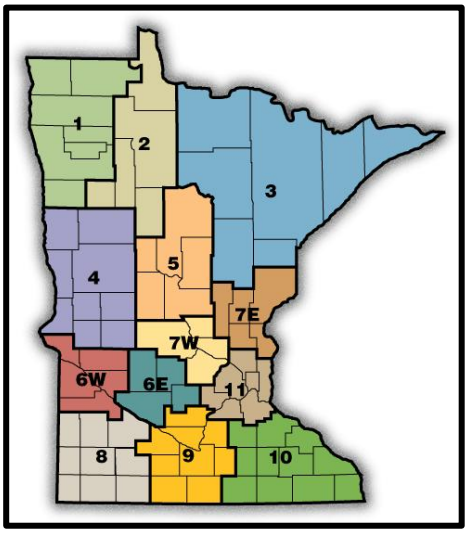
Scholarships are paid to ELD programs in amounts tiered by Parent Aware star rating. They had been capped at $5,000 per qualifying child for fiscal years 2014 and 2015; for fiscal year 2016 (beginning July 1, 2015), the maximum amount was raised to $7,500 per Scholarship for 4-star rated programs. Any program accepting Scholarships must use the revenue to supplement and not supplant federal funding (Appendix A).

Priority for Scholarships is based on family income, geographic location, and whether a child's family is on a waiting list for a publicly funded program providing early education or child care services. Once awarded a Scholarship, children can continue to receive funding each year until they are eligible for kindergarten. The terms of the Scholarship also mandate that recipients complete developmental screening within 90 days of first attending an eligible ELD program (Appendix A; Minnesota Department of Education, n.d.).

Because of a budget surplus, Minnesota was able to increase its investment in Scholarships for fiscal year 2016 to almost twice the amount of the previous year, with $48 million allocated (Lieberman & Bornfreund, 2015). The Minnesota Department of Education estimates that 5,700 Scholarships per year will be awarded throughout the state, representing about 11% of the eligible children in Minnesota (Minnesota Department of Education, n.d.).

Scholarships are administered through the state's 13 Economic Development Regions (Exhibit 1).

Exhibit 1. Minnesota's Economic Development Regions



Evaluation Questions

The Scholarship funding statute requires that the program be subject to an independent evaluation that includes "recommendations regarding the appropriate scholarship amount, efficiency, and effectiveness of the administration, and impact on kindergarten readiness" (Appendix A). This report addresses the Scholarship impacts on kindergarten readiness through analyses designed to answer the following questions:

1. How did Scholarship recipients' outcomes at the end of the preschool year compare with outcomes for a similar group of children who attended ELD programs rated 1 or 2 stars on the Parent Aware rating system, once child background characteristics and beginning of preschool baseline assessment scores were accounted for?
2. What were the school readiness outcomes at the end of preschool for children who received Minnesota Early Learning Scholarships to attend ELD programs rated 3 or 4 stars on the Parent Aware Quality Rating and Improvement System?

The report also addresses a secondary question about whether the outcomes were different depending on the Pathway type used to receive the Scholarship (described below).

Methods

To answer the research questions, the evaluation team implemented a quasi-experimental pre-post design using a sample of 4-year-olds receiving Scholarships to attend 3- and 4-star-rated ELD programs and a comparison group of children attending 1- or 2-star-rated programs. This comparison allowed the evaluation team to test the hypothesis: children attending highly rated (3- and 4-star Parent Aware rated) programs will attain better school readiness outcomes than children who attend lower rated (1- and 2-star Parent Aware rated) ELD programs. The comparison sample was drawn from children participating in the Parent Aware Validation Study concurrently conducted by Child Trends as part of the evaluation of Minnesota's Race to the Top Early Learning Challenge grant.

Sampling

Early Learning Scholarship Sample

Recruitment of Scholarship recipients for this evaluation began in the summer of 2014. The research team worked closely with Scholarship regional administrators throughout Minnesota to identify children receiving the Scholarship who met two eligibility criteria: (1) the children were 4 years old and would be starting kindergarten in fall 2015, and (2) the parents had consented to participate in the evaluation when completing the Pathway I or Pathway II application (see a copy of the application form in Appendix B).

Regional administrators were asked to share the following information on evaluation-eligible children: (1) child name, (2) parent name, (3) family contact information, (4) child date of birth, (5) child gender, (6) ELD program type, and (7) Scholarship Pathway type.

The evaluation team received information for 5,148 children from the 13 regions. This represented the universe of children who had ever received Scholarships and whose parents had consented to share information with the evaluation. The evaluation team then excluded children who were no longer receiving the Scholarship and those who were not age-eligible [4] because we wanted to assess only children who were in their final year of preschool and would continue on to kindergarten in fall 2015. That group consisted of 2,100 children. The number of 4-year-old children and percentages by region and Pathway are shown in Exhibit 2.

Exhibit 2. Number and percentages of Scholarship recipients, by Pathway type and region

Region	Total Percent	Total Number	Pathway I Percent	Pathway I Number	Pathway II Percent	Pathway II Number
1	2	45	60	27	40	18
2	1	22	27	6	73	16
3	4	77	60	46	40	31
4	5	112	47	53	53	59
5	3	70	46	32	54	38
6-E	2	36	100	36	0	0
6-W	1	12	100	12	0	0
7-E	5	105	35	37	65	68
7-W	2	38	100	38	0	0
8	4	82	50	41	50	41
9	9	181	31	56	69	125
10	12	259	37	95	63	164
11	51	1,061	35	372	65	689
Total	100%	2,100	41%	851	59%	1,249

To accurately represent all eligible scholarship participants, the research team then used a two-stage cluster sampling design to select the sample of children to participate in the child assessments. We first randomly sampled programs that the children attended, stratified by region and Pathway within region, using the proportions of the age-eligible children from Exhibit 2. Then children within programs were randomly selected, with a maximum of six

[4] Selected children were at least 4.0 years old and less than 5.2 years old on September 1, 2014.

per Pathway type in Region 11 and a maximum of four in all other regions.[5] Using this strategy, we selected an initial sample of 277 children attending 112 programs, with the goal of assessing 250 children.

The evaluation team anticipated that some of the Scholarship children may have moved since receiving the Scholarship and/or would not be available to participate in the assessments when the assessors scheduled the visits to their programs. In anticipation of needing additional children to act as substitutes for those unavailable children from the initial sample, the evaluation team developed a ranked list of additional children from each of the participating programs who could be assessed (all the remaining 269 4-year-old children who were attending the participating programs). As assessments proceeded, more replacement children from specific regions were needed (e.g., for programs with only one or a few children, those specific children may not have been available for the assessments), so the research team contacted the Scholarship administrators to request an additional sample of children from those regions and Pathway types.[6] Scholarship administrators identified an additional 174 new Scholarship recipients who were added to the replacement list. Thus, the pool from which the final sample of participants was drawn consisted of 720 children throughout the state.

Researchers mailed a letter to the ELD programs serving the children in the sample informing them about the data collection activities and the purpose of the evaluation because assessments were to take place on the program premises. Researchers also mailed a letter to all the families of children in the sample, both priority and replacement groups, informing them that the children had been randomly selected to participate in an evaluation of the Scholarships but that the family could opt out at any time. Ten families chose to opt out of the evaluation.

Exhibit 3 shows the composition of the initial sample by region and Pathway type, and the composition of the final sample that was assessed. Assessment targets were met in all regions except 5 and 6-W. A total of 282 children were in the sample that was assessed.

[5] This was done to reduce the number of programs that assessors needed to travel to in Region 11 (the Minneapolis-Saint Paul metropolitan area) because that was where a large percentage of the sample resided and there was less need to represent a greater number of ELD programs.

[6] As the assessment process proceeded, children from the initial sample were at times replaced for reasons including: child no longer attended the program; child no longer received a Scholarship; child was attending kindergarten; child was absent on the day of scheduled assessment; parent or program declined to participate; program no longer was in session; or program not open during the full fall-to-spring assessment window.

Exhibit 3. Numbers of ELD programs and children sampled for participation in child assessments

Region	Original Sample Programs	Original Sample Pathway I	Original Sample Pathway II	Final Sample Programs	Final Sample Pathway I	Final Sample Pathway II
1	3	4	2	4	4	2
2	2	1	2	3	1	2
3	5	6	4	6	6	4
4	7	7	8	9	7	8
5	5	4	5	5	3	6
6-E	3	5	0	6	5	0
6-W	2	2	0	0	0	0
7-E	6	5	9	6	5	9
7-W	2	5	0	2	5	0
8	5	6	5	5	6	5
9	11	7	17	11	7	17
10	12	12	22	15	14	24
11	49	49	90	56	50	92
Total	112	113	164	128	113	169
Combined total			277			282

Comparison Group Sample

In an effort to maximize resources and reduce evaluation burden, the comparison group for this study consisted of children assessed as part of the Parent Aware Validation Study. Recruitment of these children occurred in three waves between fall 2012 and fall 2014. The first cohort was recruited from programs undergoing the full rating process,[7] but as that proved too burdensome for the programs, the subsequent two cohorts were recruited from programs that had already received a Parent Aware rating.

Researchers contacted approximately 590 fully rated programs to request their participation in the Parent Aware Validation Study. Child care center classrooms serving 4-year-old children in their last year before kindergarten were selected to participate in the child assessment component of the evaluation activities. Family child care (FCC) providers were asked to participate in the child assessments if they served any 4-year-old children.

[7] The full rating process is the one by which nonaccredited center-based and nonaccredited family child care homes can receive a rating. This process takes 6–12 months on average. This is in contrast to the Accelerated Pathway to Rating, the process by which accredited child care centers, accredited family child care homes, Head Start, Early Head Start, Early Childhood Special Education programs, and school-based school readiness programs can become rated. The accelerated Pathway takes 6–8 weeks on average (Lieberman & Bornfreund, 2015).

Providers were asked to distribute consent forms to families of all 4-year-old children in the classroom or program. Up to six children per child care center classroom and up to two children per FCC with returned consent forms were then assessed. In a handful of cases where an excess of consent forms were returned, up to two additional children were assessed to account for possible attrition in the sample from fall to spring. In these cases, researchers also prioritized assessing children whose families were receiving a child care subsidy.

Among the 1,181 total children assessed as part of the Parent Aware Validation Study, 159 children who attended 1- or 2-star fully rated ELD programs were used as the comparison group for this Scholarship evaluation. This included 95 children from 26 1- and 2-star Parent Aware rated child care centers and 64 children from 31 1- and 2-star Parent Aware rated FCCs.

Data Collection Procedures

Children were recruited to participate in an assessment at their Parent Aware-Rated program led by a trained assessor. The child assessments took place in the fall and again in the spring at the ELD programs. Assessments may have occurred in the classroom, the hallway, or an empty office or at the kitchen table at FCCs. Assessors were trained to ask whether the assessment could take place in a location as free of distractions as possible. When assessments took place in the classroom, assessors were trained to face the instruction/play area, thereby reducing distractions for the child. The direct assessment lasted about 25–30 minutes in the fall and about 35–40 minutes in the spring.

The order of the assessment battery was identical for each child, and it always began with the preLAS Language Proficiency Assessment™ as an English language proficiency screener to determine whether the child could be assessed in English (Duncan & Avila, 1998). Assessors administered the preLAS subtest called Art Show, which is a measure of expressive language. A child who passed Art Show proceeded with the full assessment battery in English. If a child did not pass Art Show, the assessor administered a second preLAS subtest called Simon Says, which is a measure of receptive language. If the child passed Simon Says, the assessor proceeded to administer the full child assessment battery in English. If the child did not pass Simon Says, the assessor administered an abbreviated battery consisting of the Individual Growth and Development Indicators (IGDI) and a body mass index (BMI) measurement. Children received a book after each direct assessment (fall and spring).

In addition to the direct assessments, the child's primary teacher/provider was asked to complete a series of questions about the children's social-emotional development. These checklists took about 3–5 minutes to complete for each child. Teachers and providers were given a $5 gift card for each checklist they completed. Exhibit 4 presents descriptions of all the measures.

Child Assessment Measures

The assessment battery consisted of direct child assessment and teacher-report assessments to cover all domains of school readiness (see Exhibit 4). Taken together, the battery measured the following constructs: (1) early language and literacy, (2) early numeracy and math, (3) social and emotional competence, and (4) approaches to learning, including executive functioning. The battery of measures provided a picture of the group's school readiness that could be used to demonstrate group gains during the preschool year. The battery of direct assessments comprised

- preLAS (English language screener) – Art Show, Simon Says. The preLAS was used as a screener for English language ability.
- Early Literacy Individual Growth and Development Indicators (EL-IGDIs) – Picture Naming. This task measures how many pictures a child can name in a minute and is typically used as a screening tool to identify and refer children to supportive services.
- Test of Preschool Early Literacy (TOPEL) – Phonological Awareness and Print Knowledge.[8] Early literacy was measured by the TOPEL (Lonigan, Wagner, Torgesen, & Rashotte, 2007)a standardized measure with a mean score of 100 and a standard deviation of 15. Two subtests were administered: Phonological Awareness (breaking up words by sounds) and Print Knowledge (naming letters and sounds).
- Woodcock-Johnson III – Applied Problems.[9] Numeracy and math skills were measured by the WJ III (Woodcock, McGrew, & Mather, 2001). Applied Problems measures mathematics problem solving including simple counting, addition, and subtraction. The WJ III is a standardized measure with a mean score of 100 and a standard deviation of 15.
- Peg tapping test of executive functioning. Peg tapping was included on the advice of assessment experts because executive functioning (e.g., self-regulation, inhibitory control, working memory) is related to academic achievement. As children's executive functioning develops over time, they respond more quickly and accurately to the examiner's prompts during assessment. Raw scores range from 0 to 16, and mean scores rise as children mature. For example, the mean raw score for a representative sample of 4 year olds was 4.75 while the mean for 4.5 year olds was 6.02 (Meador, Turner, Lipsey, & Farran, 2013).

Two teacher-report measures also were used to provide assessments of children's social-emotional competence and approaches to learning (attention/ persistence):

[8] The TOPEL scores are converted into standard scores, which are norm-referenced scores.
[9] The WJ Applied Problems scores are converted into standard scores, which are norm-referenced scores.

- Social Competence and Behavior Evaluation (SCBE-30). A teacher report checklist measure consisting of 30 questions that provides an assessment of preschool emotional adjustment and social competence. Three subscales are measured: Social Competence (emotionally mature, prosocial behaviors), Anger-Aggression (oppositional behaviors, poor frustration tolerance), and Anxiety-Withdrawal (anxious, depressed). Each subscale consists of 10 items rated on a 6-point scale indicating how frequently a child engages in a behavior (1 = *Never* to 6 = *Always*). Each subscale has a total of 60 possible points, with higher scores indicating increased behaviors in social competence, anger-aggression, or anxiety-withdrawal (note that lower scores are more desirable in Anger-Aggression and Anxiety-Withdrawal). This is not a norm-referenced assessment; scores are calculated by summing the scores for each item in a subscale. SRI compared the scores for children with Scholarships to scores for a representative sample of children published by the authors of the measure in order to determine the percentage of children with problematic scores (determined separately for boys and girls) (LaFreniere & Dumas, 1996).
- The Preschool Learning Behaviors Scale (PLBS) – Approaches to Learning. The PLBS Persistence subscale is a teacher report checklist measure that assesses children's observable approaches to learning, specifically, attention/persistence. The PLBS consists of 29 items concerning children's behavior (e.g., "pays attention to what you say"), for which teachers mark 1 = *most often applies*, 2 = *sometimes applies*, or 3 = *doesn't apply*. The Attention/Persistence subscale uses 9 of these items, for a possible raw score total of 27. The raw score was then converted to a T-score based on the author's guidelines. In a representative sample, the mean T-score is 50 with a standard deviation of 10.

In addition to the above measures, which were assessed in both the fall and the spring, children also were administered the Bracken School Readiness Assessment (BSRA) in the spring only. This is a screening tool that assesses children's understanding of five concept areas that they will encounter in kindergarten: colors, letters, numbers/counting, sizes/comparisons, and shapes. This measure is reported as a standardized score that has a mean of 100 and a standard deviation of 15. This measure was included in the spring only as an indicator of children's knowledge of concepts that are traditionally associated with kindergarten readiness. Similarly, height and weight measurements were taken to compute BMI to provide a measure of child physical health. A normal or healthy weight is based on a BMI between the 5th and 85th percentile of the Centers for Disease Control (CDC) growth chart for a child's age and sex.[10] BMI is conceptualized not as a child outcome impacted by the scholarship, but rather as a way to describe children's health at the beginning and end of the study.

[10] See: http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

Exhibit 4. Description of child assessment measures

Assessment Measure	Construct	Description	Reference
preLAS Language Proficiency Assessment™*	Language screening tool*	Direct assessment of English language proficiency. Art Show: Expressive language; identify objects and describe a purpose of the object. Simon Says: Receptive language; execute simple commands.	Duncan, S. E., & Avila, E. A. (1998). *pre*LAS. Monterey, CA: CTB McGraw Hill.
Individual Growth and Development Indicators (IGDI) – Picture Naming	Early language and literacy	Direct assessment of vocabulary: The number of pictures a child can name in a minute (vocabulary).	Early Childhood Research Institute on Measuring Growth and Development. (1998, April). *Research and development of individual growth and development indicators for children between birth to age eight* (Technical report #4). Minneapolis, MN: Center for Early Education and Development.
Test of Preschool Early Literacy (TOPEL)	Early language and literacy	Direct assessment of Print Knowledge (identify letters and words), Phonological Awareness (word elision and blending).	Lonigan, C. J., Wagner, R. K., Torgeson, J. K., & Rashotte, C.A. (2007). *Test of Preschool Early Literacy (TOPEL)*. Austin, TX: PRO-ED.
Woodcock-Johnson Tests of Achievement (WJ III)	Early numeracy and math	Direct assessment of Applied Problems (counting, addition, subtraction), Quantitative Concepts (identifying numbers, shapes, sequences).	Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson Tests of Achievement* (3rd Ed.). Itasca, IL: Riverside Publishing.
Social Competence and Behavior Evaluation (SCBE-30)	Social and emotional competence	Teacher report on following behaviors: Social Competence (pro-social behaviors), Anger-Aggression (oppositional behaviors), Anxiety-Withdrawal (anxiety, depression).	LaFreniere, P. J., & Dumas, J. E. (1996). Social Competence and Behavior Evaluation in children ages 3 to 6 year: The short form (SCBE-30). *Psychological Assessment, 8*(4), 369-377.
Preschool Learning and Behavior Scale (PLBS)	Approaches to learning (attention/ persistence)	Teacher report on attention/persistence.	McDermott, P. A., Leigh, N. M., & Perry, M. A. (2002). Development and validation of the Preschool Learning Behaviors Scale. *Psychology in the Schools*, *39*, 353–365.
Peg Tapping	Approaches to learning (executive functioning)	Direct assessment of executive functioning: Child is instructed to tap once when examiner taps twice and tap twice when examiner taps once.	Diamond, A., & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to "Do as I say, not as I do." *Developmental Psychobiology, 29,* 315–334. Meador, D.N., Turner, K. A., Lipsey, M. W., & Farran, D. C. (2013). *Administering measures from the pri learning-related cognitive self-regulation study*. Nashville, TN: Vanderbilt University, Peabody Research Institute.
Height and weight measurement	Health	BMI is calculated using height and weight with norms by age and gender.	Centers for Disease Control and Prevention (2015) *About child and teen BMI*. Retrieved from http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
Bracken School Readiness Assessment	School readiness screening tool	Composite measure of children's knowledge of 5 concept areas encountered in kindergarten: colors; letters; counting/numbers; size/comparison; shapes	Bracken, B. A. (2007). *Bracken school readiness assessment - third edition (BSRA-3)*. San Antonio, TX: Pearson.

*The preLAS is an English language proficiency screening tool and was not used in outcome analyses.

Data Analysis

To compare the child outcomes for the two groups, we conducted weighted regression analyses for each of the child outcomes using an imputed dataset. The overall approach to the data analysis involved these steps.

- The research team conducted descriptive statistical analysis examining child demographic characteristics (i.e., child gender, race/ethnicity, primary home language) using raw, unimputed data. In the Findings section, we report means, standard deviations, and sample sizes for baseline demographic characteristics for children in the Scholarship and comparison groups.
- The team used multiple imputation[11] to "backfill" missing data for those children who did not have some of the demographic data or pretest data. This was done because children who are missing any one of the covariate (or predictor) variables (i.e., demographic characteristics or pretest scores) are dropped from the regression analyses through listwise deletion. In order to keep these children from being lost, the statistical technique of multiple imputation is used, in which all of the existing data is used to generate estimates of the missing values. Doing this reduces bias (since children who are missing data may be systematically different from those who are not) and increases representativeness of the final sample used in the analysis. In order to be included in the imputed dataset and subsequent regression analyses, children had to have posttest scores and at least one baseline demographic characteristic and one pretest score. Children who did not meet these criteria were dropped from the multiple imputation and regression analyses.[12] The team used this technique to address missing baseline demographics and pretest data but *not* missing posttest data, as is recommended by What Works Clearinghouse (What Works Clearinghouse, 2008). Multiple imputation inference has three distinct phases:
  - The missing data are filled in five times to generate five complete data sets.
  - The five complete data sets are analyzed by using descriptive and regression procedures.
  - The results from the five complete data sets are combined for subsequent inferential analyses.[13]

[11] Imputation was done using SAS PROC MI procedure with expectation-maximization statement.
[12] Imputation was run on the overall sample altogether, not separately by group, and included a third group of children receiving Minnesota Race to the Top-Early Learning Challenge Scholarships whose outcomes will be compared with those of children in the comparison group in a separate and forthcoming report.
[13] Inferential analyses were conducted using SAS PROC MIANALYZE.

The descriptive analyses were conducted using both unimputed and imputed data sets and the two sets of descriptive analyses were similar. Additional information about the imputation is contained in Appendix C.

- Propensity score weighting methods were used to statistically equalize the mean values of potentially confounding observed covariates (e.g., child demographic characteristics and pretest scores) in the two groups we were comparing, assuring that differences in outcomes were true differences and not the result of differences in the covariates. The propensity weight is the predicted probability of participating in the treatment group (for example, the scholarship program) based on a set of potentially confounding covariates using logistic regression.[14] The weighting created balance between the comparison and Scholarship groups for each outcome on the child background characteristics and pretest scores and thus estimated the effect on child outcomes of attending a 3- or 4-star-rated ELD program. Additional information about the propensity score weighting methods is in Appendix D.
- Weighted multiple regression models were used to test the difference between the Scholarship and comparison groups on each of the child outcomes. This analysis used the data set with imputed covariates and pretest scores and propensity score weights to produce accurate estimate of the effect of attending a 3- or 4-star-rated ELD program. The coefficient associated with group membership can be interpreted as the measure of the difference in child outcomes between Scholarship and comparison groups, adjusted for the estimated propensity of being in the Scholarship group and other child background characteristics and pretest scores. Additional information about the regression model and baseline characteristics is in Appendix C and D.

Final Analytic Sample

The final analytic sample was 264 Scholarship and 154 comparison children. This was reduced from the 282 Scholarship and 159 comparison group children for whom child assessment data were available because some Scholarship children were removed from the sample due to their attending 1- or 2-star programs, and others (both Scholarship and comparison children) were not included in the regression data analyses because they did not meet the criteria used in the multiple imputation (i.e., child had to have at least one pretest score and one demographic characteristic to be included in the multiple imputation).

[14] The propensity weight gives the probability that a child in the comparison group would have been in the Scholarship group if background characteristics and pretest scores in the two groups had been equal. For example, if the Scholarship group was composed primarily of boys with low pretest scores, a girl with high pretest scores in the comparison group would be given a low propensity weight (i.e., it is unlikely she would have been in the Scholarship group) and she would not weigh heavily in equating the comparison with the Scholarship group.

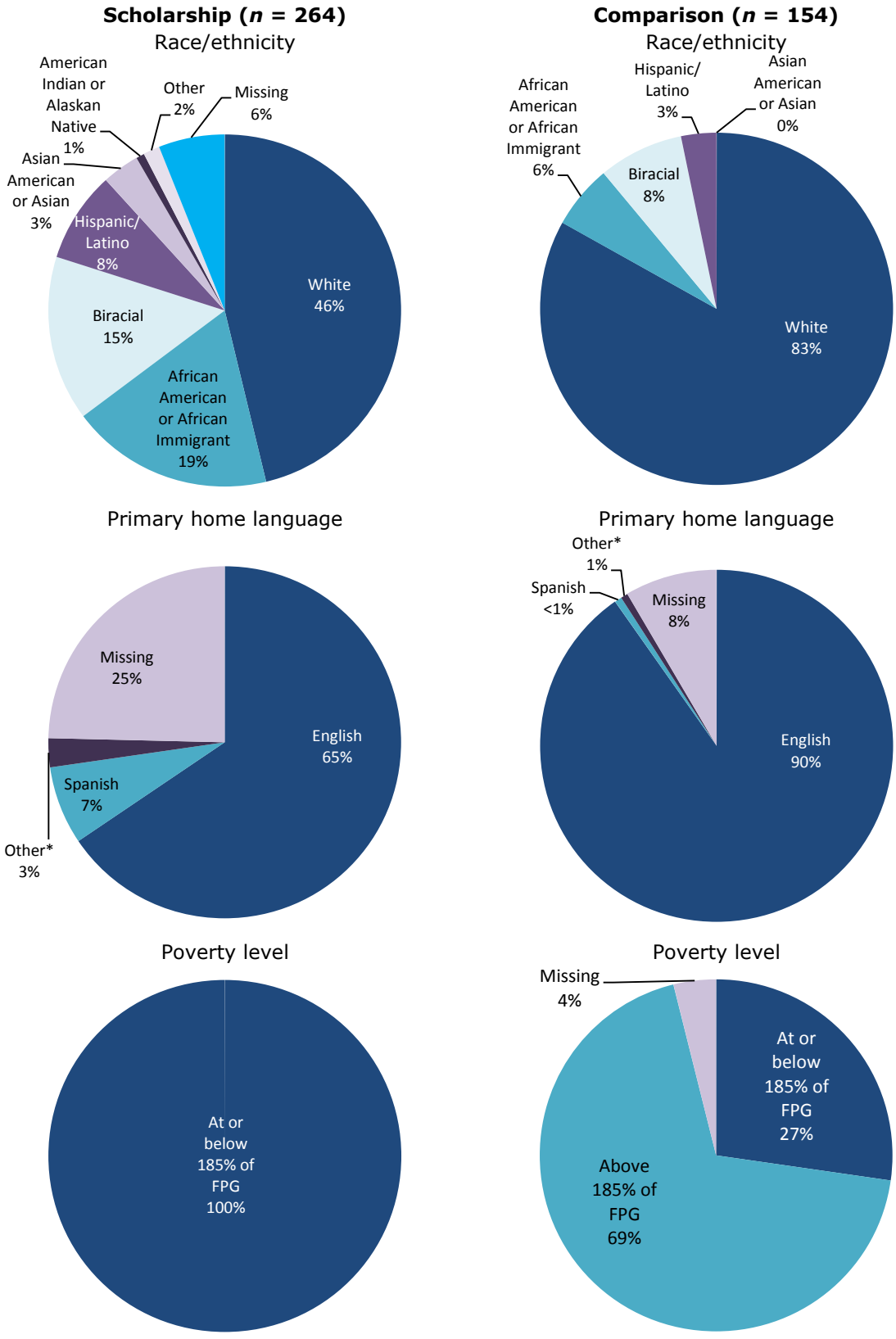
Findings

Characteristics of Children

The research team obtained child background information (e.g., gender, race/ethnicity, home language) for the Scholarship group from their applications for the Scholarship and for the comparison group from their consent forms for enrolling in the Parent Aware Validation Study. An analysis of these data showed that children receiving Scholarships were more ethnically and linguistically diverse and were more likely to come from low-income families than the children in the comparison group (see Exhibit 5).

- More children receiving Scholarships were female (52%) than in the comparison group (46%).
- Fewer than half of Scholarship recipients were white (46%), compared with more than three-quarters of the children in the comparison group (83%). Nearly one-fifth of Scholarship recipients were African American or African immigrants (19%), and another 15% were biracial.
- About two-thirds of Scholarship recipients (65%) had English as their primary home language (with 25% missing data), compared with 90% of the comparison group (with 8% missing data).
- Because of income eligibility requirements for the Scholarships, all Scholarship recipients were at or below 185% of the Federal Poverty Guideline (FPG), compared with only one-fourth of the comparison group (27%).

Exhibit 5. Demographics of children, by group (unimputed data)



Note: Language category "Other" includes Hmong, Somali, and other languages.

Characteristics of Programs Attended by Assessed Children

The intent of the Scholarship program is for children to use the funds to attend a highly-rated ELD program as rated by the Parent Aware rating system. All Scholarship recipients did attend a 3- or 4-star Parent Aware rated program (Exhibit 6). A small number of Scholarship recipients attended programs rated only 1 or 2 stars, and their assessment data were removed from the data set for the analyses presented in the next section. By design, all children in the comparison group attended a 1- or 2-star Parent Aware rated program.

There was a difference in the type of rating process used for the programs that children in each group attended. The 1- and 2-star-rated programs attended by all children in the comparison group all went through the full rating process, whereas very few children receiving Scholarships attended a program that completed the full rating process (5%). Most Scholarship recipients (89%) attended a program that went through the accelerated Parent Aware rating process.

Exhibit 6. Parent Aware ELD program rating characteristics

	Scholarship Percent	**Scholarship** Number	**Comparison** Percent	**Comparison** Number
Program rating				
One star	0	0	19	29
Two stars	0	0	81	125
Three stars	1	3	0	0
Four stars	99	261	0	0
Program rating type				
Accelerated rating	89	251	0	0
Full rating	11	13	100	154
Total	**100%**	**264**	**100%**	**154**

There were also distinct differences in the types of programs children in each group attended (Exhibit 7). Children in the comparison group attended community-based child care centers (60%) or family child care programs (40%) exclusively. In contrast, about half of Scholarship recipients attended Head Start (21%) and other school-based prekindergarten programs (35%), program types in which no children in the comparison group were enrolled. Another 43% attended community-based child care centers and less than 1% attended a family child care program.

Exhibit 7. Children in each type of ELD program type, by group

	Scholarship Percent	Scholarship Number	Comparison Percent	Comparison Number
Community-based child care center	43	114	60	93
Family child care	<1	2	40	61
Head Start	21	56	0	0
School Readiness	35	92	0	0
Total	**100%**	**264**	**100%**	**154**

Child Outcome Findings

Child outcome analyses were conducted using the imputed dataset with the analytic sample of 264 Scholarship and 154 comparison children. Overall, using weighted regression analyses, we found that once (1) missing demographics and pretest scores were imputed, (2) propensity score weighting was applied to equate the two groups, and (3) demographics and pretest scores were taken into consideration,

- Scholarship children who had attended 3- and 4-star-rated programs had better TOPEL Print Knowledge and TOPEL Phonological Awareness scores than comparison children who attended 1- and 2-star-rated programs. Scholarship children also had higher anxiety than comparison children.
- There were no statistically significant differences between the two groups on the other child outcomes.

Additional details about the analyses are described in the next sections.

Child Outcomes for Scholarship and Comparison Group Overall

Exhibit 8 presents imputed unweighted demographics for the Scholarship and comparison groups. Exhibit 9 shows imputed unweighted pretest scores for the two groups. In other words, missing pretest scores and demographic data were accounted for using multiple imputation, but the comparison group was not yet statistically equated with the Scholarship group through propensity score weighting.

The imputed demographics in Exhibit 8 approximate the unimputed demographics in Exhibit 5, as they would be expected to. Exhibit 9 shows that the mean pretest scores of the comparison group were higher than those of the Scholarship group on most assessments

where a higher score is a more positive outcome (e.g., IGDI, TOPEL, WJ).[15] This indicates that the comparison group started the preschool year with higher skill levels and was most likely a lower risk group of children.

Exhibit 8. Descriptive analysis of demographic characteristics, by group (imputed data)

	Scholarship Percent	Scholarship Number	Comparison Percent	Comparison Number
Gender				
Male	48	264	54	154
Race/ethnicity[a]				
White	49	264	83	154
Biracial	17	264	8	154
At or below 185% FPG[b]				
Yes	100	264	30	154
Primary home language[c]				
English	88	264	99	154

[a]The reference group for this variable was all other race/ethnicity categories combined (aside from white and biracial). They were combined because the individual group sizes were not large enough to function in the subsequent regression models.

[b]This variable was dropped from subsequent regression models because there is no variability for the Scholarship group.

[c]The reference group for this variable was all other non-English languages. They were combined because the individual group sizes were not large enough to function in the subsequent regression models.

[15] For two of the assessments, SCBE Anger-Aggression and SCBE Anxiety-Withdrawal, a lower score is a more positive outcome.

Exhibit 9. Descriptive analysis of pretest scores, by group (imputed data)

	Scholarship *M* (*SD*)	Scholarship Number	Comparison *M* (*SD*)	Comparison Number
Literacy and language				
IGDI	21.0 (7.0)	264	23.5 (6.9)	154
TOPEL Print Knowledge	97.8 (14.9)	264	103.4 (13.7)	154
TOPEL Phonological Awareness	92.3 (17.8)	264	99.3 (16.3)	154
Early numeracy and math				
WJ Applied Problems	102.7 (11.5)	264	108.1 (11.1)	154
Socio-emotional competence				
SCBE Social Competence	41.3 (10.1)	264	44.4 (10.0)	154
SCBE Anger-Aggression	18.2 (9.4)	264	18.9 (8.9)	154
SCBE Anxiety-Withdrawal	16.8 (5.9)	264	16.2 (5.8)	154
Approaches to learning				
PLBS Attention and Persistence	50.4 (10.5)	264	51.5 (10.2)	154
Peg tapping (executive functioning)	10.3 (5.1)	234	11.4 (4.5)	154
Health (BMI)	**Percent**	**Number**	**Percent**	**Number**
Underweight	6	264	7	154
Normal weight	62	264	71	154
Overweight or obese	31	264	22	154

Exhibit 10 shows unweighted posttest scores[16] of the Scholarship and comparison groups. The comparison group ended the preschool year with mean posttest scores higher than those of the Scholarship group on most assessments where a higher score is a more positive outcome, although both groups generally showed growth over the year.

Exhibit 10. Descriptive analysis on posttest scores, by group

	Scholarship M (*SD*)	Scholarship Number[a]	Comparison M (*SD*)	Comparison Number
Literacy and language				
IGDI	24.0 (7.3)	234	27.2 (6.5)	128
TOPEL Print Knowledge	100.6 (14.0)	233	106.3 (13.4)	128
TOPEL Phonological Awareness	99.7 (17.5)	224	103.5 (16.4)	127
Early numeracy and math				
WJ Applied Problems	103.5 (11.5)	234	109.6 (12.0)	128
Socio-emotional competence				
SCBE Social Competence	43.1 (10.4)	239	44.7 (10.1)	129
SCBE Anger-Aggression	17.8 (9.1)	240	18.9 (8.0)	129
SCBE Anxiety-Withdrawal	17.0 (7.0)	240	16.3 (5.5)	129
Approaches to learning				
PLBS Attention and Persistence	51.1 (10.2)	236	51.5 (9.5)	129
Peg tapping (executive functioning)	12.8 (4.3)	234	13.7 (3.3)	128
Health (BMI)	**Percent**	**Number**	**Percent**	**Number**
Underweight	4	234	6	128
Normal weight	64	234	69	128
Overweight or obese	32	234	25	128

[a]These numbers are shown to remind the reader that analytic samples varied slightly for different outcome measures because posttest outcomes were not imputed. The values in the percent columns reflect the percent of the imputed sample falling into each category.

We also conducted additional secondary analyses to look at the *within-group* changes in mean scores from fall to spring for each outcome for each of the two groups separately. These additional analyses address the question of whether those children assessed in both the fall and the spring had significantly better scores in the spring, looking at the Scholarship group and the comparison group separately. These analyses, using paired t-tests, do not take into account the demographic characteristics or the pretest scores. The results showed that Scholarship recipients demonstrated significant gain on six of the nine

[16] Means and standard deviations presented in Exhibit 10 were generated using the imputed, unweighted dataset and therefore have n's that are five times the original sample size; however *the post-test scores themselves were not imputed* because it is generally not accepted practice to impute outcomes.

measures, whereas the comparison group demonstrated significant gain on three of nine. These findings are described and presented graphically in Appendix D.

Exhibits 11-15 show the results of the full regression models run using the imputed data and propensity score weights with demographics and pretests as covariates and group status (Scholarship versus comparison) to predict spring posttest scores for each of the child outcomes. These analyses showed the following:

- By spring, Scholarship recipients had significantly better scores than the comparison group children on the Print Knowledge ($p < .001$) and Phonological Awareness ($p = .01$) subtests of the TOPEL (Exhibit 11). Both effects were small ($d = .2$). For both of these outcomes, Scholarship recipients and their peers in the comparison group were close to the national mean of 100.
  - More Scholarship recipients (17%) than comparison group children (12%) received low scores on Print Knowledge, defined as one standard deviation or more below the national mean.
  - For Phonological Awareness, 19% and 13% of the Scholarship and comparison group, respectively, received low scores, defined as one standard deviation or more below the mean.
- Spring IGDI scores did not differ between Scholarship recipients and children in the comparison group (Exhibit 11). On average, children in both groups were able to name a little over 25 words in one minute, close to the expected score for kindergarteners (26 words per minute).
- Spring scores on early numeracy and math skills (WJ Applied Problems) did not differ significantly between Scholarship recipients and children in the comparison group (Exhibit 12). The average scores for both groups were just above the national mean of 100.
  - Fewer than 3% of children in the Scholarship and comparison groups had low scores, defined as one standard deviation or more below the mean.
- Comparison of the spring outcomes on measures of children's social competence and behaviors showed mixed results (Exhibit 13).
  - The Scholarship recipients and the comparison group did not differ on teacher ratings of social competence or anger and aggression.
  - The Scholarship recipients were rated by teachers as significantly more anxious than the children in the comparison group ($p = .04$), and this effect size was small ($d = .16$).

  - For all three of these social competence and behavior outcomes, relatively few children had scores in the problematic range (low for Social Competence or high for Anger-Aggression and for Anxiety-Withdrawal).
  - More children in the Scholarship group (12%) than the comparison group (5%) received low scores (one standard deviation or more below the mean for age and gender) on the social competence subscale.
  - As both the Anger-Aggression and Anxiety-Withdrawal subtest were reverse scored—that is, higher scores represent worse outcomes—we calculated the percentage of children scoring one standard deviation or more above the national mean in order to capture the proportion of children in each group showing difficulties on these outcomes. For the Anger-Aggression subtest, 11% of both Scholarship recipients and children in the comparison group scored highly. Relatively few children (5% of Scholarship recipients and 4% of comparison group) scored highly on Anxiety-Withdrawal in the spring.
- Mean scores for attention/persistence did not differ between Scholarship recipients and the comparison group (Exhibit 14). Mean attention/persistence scores for both Scholarship and comparison children were close to the normed sample mean of 50.
  - A slightly higher percentage of Scholarship recipients (14%) than comparison group children (11%) performed poorly on this outcome (one standard deviation or more below the mean).
- The Scholarship recipients and the comparison group did not differ on the measure of executive functioning (Exhibit 14).

For spring only, we compared group mean differences on the Bracken assessment. The unimputed mean score for Scholarship recipients (98, SD = 15.4) was lower ($p > .0001$) than the mean for the comparison group (107, SD = 13.7), and both scores were close to the national mean. A higher percentage of Scholarship recipients (18%) than comparison group children (8%) had low scores, defined as one standard deviation or more below the sample mean.

Exhibit 11. Weighted regression models comparing Scholarship recipients and the comparison group: Early literacy outcomes

	IGDI[a] *β*	IGDI *SE*	IGDI *p*	TOPEL: PK[b] *β*	TOPEL: PK *SE*	TOPEL: PK *p*	TOPEL: PA[c] *β*	TOPEL: PA *SE*	TOPEL: PA *p*
Intercept	25.4	0.4	<.001***	99.6	0.7	<.001***	96.8	1.1	<.001***
Scholarship	-0.8	0.6	0.15	3.2	0.9	0.00**	3.8	1.5	0.01*
Pretest	0.7	0.0	<.001***	0.8	0.0	<.001***	0.7	0.1	<.001***
Male	0.5	0.6	0.35	-0.7	0.9	0.46	-1.9	1.5	0.2
White	1.7	0.7	0.02*	4.3	1.1	<.001***	5.9	1.9	0.00**
Biracial	0.5	0.9	0.60	4.8	1.6	0.00**	5.7	2.5	0.02*
Primary language is English	3.6	1.0	0.00**	3.9	1.5	0.01*	5.6	2.5	0.03*
Treatment effect size	n/a			0.2			0.2		
Treatment improvement index	n/a			7			6		

Note. Estimated impact (*β*) and standard errors (*SE*) are the coefficient and standard errors associated with the treatment variable from the weighted multiple regression model. For the effect size and improvement index values reported in the table, a positive number favors the Scholarship group and a negative number favors the comparison group. Effect size measures the change (measured in standard deviations) in an average child's outcome that can be expected if the child is exposed to the intervention (preschool with a 3- or 4- star rating). The improvement index is an alternative presentation of the effect size, reflecting the change in an average student's percentile rank that can be expected if the student is exposed to the intervention. Improvement index is a way to translate the effect size into a meaningful metric in educational research. What Works Clearinghouse (2008) recommends translating the effect size into improvement in percentile rank which is supposed to indicate the expected change in percentile rank for the median comparison children if that child had received the Scholarship and attended a preschool with a 3- or 4-star rating.

Effect size = Estimated impact/pooled standard deviations of the Scholarship and comparison groups.

All the predictors except the Scholarship indicator variable were all centered in the regression model.

[a]IGDI = Individual Growth and Development Indicators test of expressive language.

[b]TOPEL: PK = Test of Preschool Early Literacy Print Knowledge subtest.

[c]TOPEL: PA = TOPEL Phonological Awareness subtest.

*p < .05, **p < .01, ***p < .001.

Exhibit 12. Weighted regression models comparing the Scholarship and comparison groups: Early math outcome

	WJ: AP *β*	WJ: AP *SE*	WJ: AP *p*
Intercept	104.5	0.7	<.001***
Scholarship	0.6	0.9	0.49
Pretest	0.7	0.04	<.001***
Male	-0.5	1.0	0.61
White	5.0	1.1	<.001***
Biracial	3.4	1.6	0.03*
Primary language is English	-0.3	1.5	0.86
Treatment effect size	n/a		
Treatment improvement index	n/a		

See note on Exhibit 20 about the estimates shown in the exhibit.

[a]WJ: AP = Woodcock-Johnson III Applied Problems subtest.

*p < .05, **p < .01, ***p < .001.

Exhibit 13. Weighted regression models comparing the Scholarship and comparison groups: Social competence outcome

	SCBE: SC[a] *β*	SCBE: SC *SE*	SCBE: SC *p*	SCBE: AA[b] *β*	SCBE: AA *SE*	SCBE: AA *p*	SCBE: AW[c] *β*	SCBE: AW *SE*	SCBE: AW *p*
Intercept	42.0	0.6	<.001***	18.7	0.5	<.001***	16.3	0.4	<.001***
Scholarship	1.4	0.8	0.08	0.1	0.7	0.88	1.1	0.5	0.04*
Pretest	0.7	0.0	<.001***	0.7	0.0	<.001***	0.7	0.0	<.001***
Male	-1.8	0.8	0.03*	0.5	0.7	0.51	0.3	0.5	0.52
White	0.9	0.9	0.32	1.2	0.8	0.13	0.8	0.6	0.17
Biracial	0.9	1.2	0.45	0.2	1.0	0.86	-1.2	0.8	0.14
Primary language is English	-1.6	1.7	0.33	0.6	1.5	0.68	-0.3	1.2	0.81
Treatment effect size	n/a			n/a			0.16		
Treatment improvement index	n/a			n/a			6		

See note on Exhibit 20 about the estimates shown in the exhibit.

[a]SCBE: SC = Social Competence and Behavior Evaluation Social Competence subtest.

[b] SCBE: AA = SCBE Anger-Aggression subtest.

[c] SCBE: AW = SCBE Anxiety-Withdrawal subtest.

*p < .05, **p < .01, ***p < .001.

Exhibit 14. Weighted regression models comparing the Scholarship and comparison groups: Approaches to learning outcomes

	PLBS: AP[a] *β*	PLBS: AP *SE*	PLBS: AP *p*	Peg Tapping[b] *β*	Peg Tapping *SE*	Peg Tapping *p*
Intercept	50.5	0.6	<.001***	13.5	0.2	<.001***
Scholarship	0.1	0.8	0.94	-0.6	0.3	0.09
Pretest	0.7	0.0	<.001***	0.4	0.0	<.001***
Male	-0.7	0.8	0.40	0.2	0.3	0.60
White	-1.4	1.0	0.14	0.6	0.4	0.17
Biracial	-1.3	1.2	0.28	-0.5	0.6	0.39
Primary language is English	0.1	2.1	0.98	-1.3	0.6	0.05
Treatment effect size	n/a			n/a		
Treatment improvement index	n/a			n/a		

See note on Exhibit 20 about the estimates shown in the exhibit.

[a]PLBS: AP = Preschool Learning Behavior Scale Attention-Persistence subtest.

[b]Peg-tapping is an executive functioning task.

*p < .05, **p < .01, ***p < .001.

Child Outcomes for Scholarship Recipients by Pathway Type

Children can receive Scholarships through two different Pathways. Using Pathway I, families apply for the Scholarship directly, and, when approved, the funds follow the child to their chosen Parent Aware participating program. Through Pathway II, an ELD program (often a center-based child program, Head Start or a public school-based preschool program) applies for Scholarship funding on behalf of eligible families at the program. In the population of age-appropriate, evaluation-consented Scholarship recipients (*N*= 2,100), more children received Scholarship funding through Pathway II (59%) than through Pathway I (41%). The evaluation's original randomly selected sample matched these proportions, although once some children were dropped from analyses (*n* = 264), Pathway I was slightly underrepresented (36% rather than 41%).

Unimputed demographic information by Pathway is shown in Exhibit 15.

- The Pathway II group had a larger percentage of Hispanic/Latino children than the Pathway I group (11% vs. 3%) and relatedly had a larger percentage of Spanish-speaking children (11% vs. 1%).
- The Pathway I group had a slightly higher percentage of Asian children than the Pathway II group (6% vs. 2%) and slightly higher percentage of White children (55% vs. 46%).

Regression analyses of imputed child assessment data by Pathway type showed no statistically significant differences in outcomes between children attending a 3- or 4-star program through Pathway I or Pathway II, once demographic variables and pretests were controlled for. Given this, only imputed mean pre- and posttest assessment scores are shown (Exhibit 16). The mean pretest scores of the Pathway I group were higher than those for the Pathway II group on most assessments where a higher score is a more positive outcome (e.g., IGDI, TOPEL, WJ). This indicates that the Pathway I group started the preschool year with higher skill levels and was most likely a lower risk group of children. The Pathway I group also ended the preschool year with mean posttest scores that were higher than those of the Pathway II group on most assessments where a higher score is a more positive outcome, although both groups generally showed growth over the year.

Exhibit 15. Demographics for Scholarship recipients, by Pathway type (unimputed data)

	Pathway I Percent	Pathway I Number	Pathway II Percent	Pathway II Number
Gender				
Male	52	49	47	79
Female	48	46	53	90
Race/ethnicity				
African American or African immigrant	19	17	19	32
American Indian or Alaskan Native	1	1	1	1
Asian American or Asian	6	6	2	3
Biracial	14	13	16	27
Hispanic/Latino	3	3	11	19
White	55	49	46	73
Other	0	0	2	4
Missing	6	6	6	10
Primary home language				
English	79	75	58	98
Spanish	1	1	11	18
Other[a]	1	1	3	6
Missing	19	18	28	47
Total	**100%**	**95**	**100%**	**169**

[a]Language category "Other" includes Hmong, Somali, and other languages.

We also conducted additional secondary analyses to look at the *within-group* changes in mean scores from fall to spring for each outcome for the Pathway I and Pathway II groups separately. As described above, these additional analyses address the question of whether the average scores for those children assessed in both the fall and the spring had significantly better scores in the spring, looking at the Pathway I group and the Pathway II group separately. These analyses, using paired *t* tests, do not take into account the demographic characteristics or the pretest scores. The results showed that children in the Pathway I group had made significant gains on five of the nine measures by spring, and children in the Pathway II had made significant gains on six of the nine measures by spring. Additional information is described in Appendix D.

Exhibit 16. Assessment scores for Scholarship recipients, by Pathway type (imputed data)

	Pathway I M (*SD*)	Pathway I Number	Pathway II M (*SD*)	Pathway II Number
IGDI (expressive language)				
Pretest	22.2 (5.7)	95	20.3 (7.6)	169
Posttest	25.5 (6.5)	86	23.2 (7.5)	148
TOPEL Print Knowledge				
Pretest	101.3 (14.9)	95	95.9 (14.5)	169
Posttest	103.5 (13.7)	86	98.9 (14)	147
TOPEL Phonological Awareness				
Pretest	94.7 (17.6)	95	91 (17.7)	169
Posttest	103.2(16.6)	84	97.6 (17.7)	140
WJ Applied Problems (math)				
Pretest	105.8 (12.4)	95	100.9 (10.6)	169
Posttest	105.1 (11.9)	85	102.6 (11.2)	149
SCBE Social Competence				
Pretest	40.8 (10.6)	95	41.6 (9.8)	169
Posttest	41.6 (11)	84	43.9 (10)	155
SCBE Anger-Aggression				
Pretest	19.6 (10.2)	95	17.5 (8.9)	169
Posttest	20.4 (10.9)	84	16.5 (7.7)	156
SCBE Anxiety-Withdrawal				
Pretest	16.9 (6.2)	95	16.7 (5.8)	169
Posttest	17.2 (7.1)	84	16.9 (6.9)	156
PLBS Attention-Persistence				
Pretest	49.8 (11.1)	95	50.7 (10.2)	169
Posttest	50.5 (10.5)	82	51.3 (10)	154
Peg tapping (executive function)				
Pretest	11 (5.3)	95	9.9 (5)	169
Posttest	13.3 (3.5)	85	12.5 (4.7)	149

Discussion

Children receiving Scholarships who attended 3- and 4-star Parent Aware rated ELD programs had significantly better outcomes on two components of early literacy skills, print knowledge and phonological awareness, compared with comparison children attending 1- and 2-star Parent Aware rated programs. They also had significantly higher teacher-rated anxiety. On all other school readiness measures, the two groups of children did not differ (measures of early math, social competence, approaches to learning, health). The results of the weighted regression analyses comparing school readiness outcomes in the spring before entering kindergarten for the two groups also showed that for most outcomes, the child's pretest score was a strong and significant predictor of the posttest score. This is a finding that is regularly seen in studies of the impact of preschool programs on children's learning.

Additional secondary analyses examined the within-group changes in mean scores between fall and spring for each of the two groups of children separately. These analyses test whether the average scores were significantly better in the spring than they had been in the fall. These analyses do not take into account the demographic characteristics or the pretest scores of the children. The results showed that for the Scholarship group, the spring scores were significantly better than fall scores on six of the nine measures. For the comparison group, spring scores were significantly better than fall scores for three of the nine measures.

Weighted regression analyses comparing outcomes for children enrolled in the two Pathway types showed that there were no statistically significant differences in outcomes between children attending a 3- or 4-star programs through Pathway I or Pathway II, once demographic variables and pretests were controlled for. Similar to findings for the Scholarship group overall, secondary analyses of the changes in mean scores between fall and spring for the Pathway I and Pathway II groups separately showed significantly better scores in the spring for five of nine measures for Pathway I children and six of nine measures for Pathway II children.

Overall, these findings demonstrate that children's participation in 3- and 4- star programs resulted in significant improvements in measures of early literacy compared with participation in 1- and 2-star programs, but no differences between the groups were found for other outcomes related to social competence and behavior. Within both groups, children are showing significantly better scores in the spring on some of the outcomes, with Scholarship children having better spring scores on more of the outcomes (six versus three outcomes). Whether Scholarship children received their Scholarship via Pathway I (family applies for Scholarship and chooses ELD program) or Pathway II (program applies for

Scholarship funds to use with eligible children in their program) does not appear to make much difference in the results.

There are several limitations to this study. First, because there were so few 1- and 2-star ELD programs in the Parent Aware Validation Study from which to sample children for the comparison group, we used propensity score weighting instead of propensity score matching to create the well-matched comparison group. The former technique, which utilizes weighting at the group level, may not create as well–matched groups as the latter technique, which utilizes matching at the individual child level. Second, because the samples had so few non-white and non-English speaking children, the study does not provide good information about the impact of the 3- and 4-star ELD programs on more culturally and linguistically diverse populations. The fact that the assessment battery could only be administered in English contributed to this restriction of the sample to some extent.

Finally, the types of ELD programs that the two groups of children attended were very different, and program type could not be examined as a predictor of outcomes because of the disparate distribution in the two groups. That is, none of the comparison group children attended Head Start or school-based prekindergarten programs, whereas about half of the Scholarship recipients did so. In addition, 40% of comparison group children attended family child care programs, whereas less than 1% of Scholarship children did so. Related to these program differences, most Scholarship recipients (89%) attended a program that went through the accelerated Parent Aware rating process, whereas all of the comparison group programs went through the full rating process. These program type differences between the Scholarship and comparison groups could not be factored in the weighted regression analyses because of the lack of variability within group (e.g., not all four program types are represented in sufficient numbers in both groups). Thus, this study cannot address the question of how different program types may influence child outcomes. However, the results of the forthcoming Parent Aware Validation Study should be informative in addressing this type of question.

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Appendices

Appendix A: Early Learning Scholarship Statute

Appendix B: Early Learning Scholarship Application

Appendix C: Additional Information About Data Analysis

Appendix D: Additional Information About Findings

Appendix A: Early Learning Scholarship Statute

124D.165 EARLY LEARNING SCHOLARSHIPS.

Subdivision 1. **Establishment; purpose.** There is established an early learning scholarships program in order to increase access to high-quality early childhood programs for children ages three to five.

Subd. 2. **Family eligibility.** (a) For a family to receive an early learning scholarship, parents or guardians must meet the following eligibility requirements:

(1) have a child three or four years of age on September 1 of the current school year, who has not yet started kindergarten; and

(2) have income equal to or less than 185 percent of federal poverty level income in the current calendar year, or be able to document their child's current participation in the free and reduced-price lunch program or child and adult care food program, National School Lunch Act, United States Code, title 42, sections 1751 and 1766; the Food Distribution Program on Indian Reservations, Food and Nutrition Act, United States Code, title 7, sections 2011-2036; Head Start under the federal Improving Head Start for School Readiness Act of 2007; Minnesota family investment program under chapter 256J; child care assistance programs under chapter 119B; the supplemental nutrition assistance program; or placement in foster care under section 260C.212.

(b) Notwithstanding the other provisions of this section, a parent under age 21 who is pursuing a high school or general education equivalency diploma is eligible for an early learning scholarship if the parent has a child age zero to five years old and meets the income eligibility guidelines in this subdivision.

(c) Any siblings between the ages zero to five years old of a child who has been awarded a scholarship under this section must be awarded a scholarship upon request, provided the sibling attends the same program as long as funds are available.

(d) A child who has received a scholarship under this section must continue to receive a scholarship each year until that child is eligible for kindergarten under section 120A.20 and as long as funds are available.

(e) Early learning scholarships may not be counted as earned income for the purposes of medical assistance under chapter 256B, MinnesotaCare under chapter 256L, Minnesota family investment program under chapter 256J, child care assistance programs under chapter 119B, or Head Start under the federal Improving Head Start for School Readiness Act of 2007.

(f) A child from an adjoining state whose family resides at a Minnesota address as assigned by the United States Postal Service, who has received developmental screening under sections 121A.16 to 121A.19, who intends to enroll in a Minnesota school district, and whose family meets the criteria of paragraph (a) is eligible for an early learning scholarship under this section.

Subd. 3. **Administration.** (a) The commissioner shall establish application timelines and determine the schedule for awarding scholarships that meets operational needs of eligible families and programs. The commissioner may prioritize applications on factors including family income, geographic location, and whether the child's family is on a waiting list for a publicly funded program providing early education or child care services.

(b) For fiscal years 2014 and 2015 only, scholarships may not exceed $5,000 per year for each eligible child. For fiscal year 2016 and later, the commissioner shall establish a target for the average scholarship amount per child based on the results of the rate survey conducted under section 119B.02.

(c) A four-star rated program that has children eligible for a scholarship enrolled in or on a waiting list for a program beginning in July, August, or September may notify the commissioner, in the form and manner prescribed by the commissioner, each year of the program's desire to enhance program services or to serve more children than current funding provides. The commissioner may designate a predetermined number of scholarship slots for that program and notify the program of that number. Beginning July 1, 2016, a school district or Head Start program qualifying under this paragraph may use its established registration process to enroll scholarship recipients and may verify a scholarship recipient's family income in the same manner as for other program participants.

(d) A scholarship is awarded for a 12-month period. If the scholarship recipient has not been accepted and subsequently enrolled in a rated program within ten months of the awarding of the scholarship, the scholarship cancels and the recipient must reapply in order to be eligible for another scholarship. A child may not be awarded more than one scholarship in a 12-month period.

(e) A child who receives a scholarship who has not completed development screening under sections 121A.16 to 121A.19 must complete that screening within 90 days of first attending an eligible program.

(f) For fiscal year 2017 and later, a school district or Head Start program enrolling scholarship recipients under paragraph (c) may apply to the commissioner, in the form and manner prescribed by the commissioner, for direct payment of state aid. Upon receipt of the application, the commissioner must pay each program directly for each approved scholarship recipient enrolled under paragraph (c) according to the metered payment system or another schedule established by the commissioner.

Subd. 4. **Early childhood program eligibility.** (a) In order to be eligible to accept an early learning scholarship, a program must:

(1) participate in the quality rating and improvement system under section 124D.142; and

(2) beginning July 1, 2016, have a three- or four-star rating in the quality rating and improvement system.

(b) Any program accepting scholarships must use the revenue to supplement and not supplant federal funding.

(c) Notwithstanding paragraph (a), all Minnesota early learning foundation scholarship program pilot sites are eligible to accept an early learning scholarship under this section.

Subd. 5. **Report required.** The commissioner shall contract with an independent contractor to evaluate the early learning scholarship program. The evaluation must include recommendations regarding the appropriate scholarship amount, efficiency, and effectiveness of the administration, and impact on kindergarten readiness. By January 15, 2016, the commissioner shall submit a written copy of the evaluation to the chairs and ranking minority members of the legislative committees and divisions with primary jurisdiction over kindergarten through grade 12 education.

History: *2013 c 116 art 8 s 2; 2014 c 272 art 6 s 2,3; 2014 c 312 art 20 s 10-12; 1Sp2015 c 3 art 9 s 6*

Appendix B: Early Learning Scholarship Application

Minnesota Department of Education

PATHWAY I: Early Learning Scholarship Application

This section to be completed by the Regional Administration Office:

Application Identifier #:_____ Child Identifier #:_____

Region:_____ County:_____

District Number and Type:_____ Child Care/Early Education Program Type:_____

Is the Family Income eligible? ☐ Yes ☐ No Is the Parent Under 21 ☐ Yes ☐ No

Number of children receiving scholarships from same program: _____

Participation Consent: ☐ Yes ☐ No Evaluation/Data Consent: ☐ Yes ☐ No

Is Applicant Receiving Interpreting Services? ☐ Yes ☐ No Language:_____

Sections I-IV below (pages 2-8) to be completed by the Parent or Legal Guardian

This application is to be used to apply for the Pathway I - Early Learning Scholarships. This program provides families with scholarships to pay for child care/early education programs to help prepare their children for kindergarten. Scholarships are paid directly to the child care/early education programs chosen by the parent or guardian.

Please refer to application INSTRUCTIONS document for assistance and guidance in completing this application form. If you need assistance, please ask your regional administrator.

All required information is marked with an asterisk (*) in order to determine eligibility. All other information is optional.

SECTION I – APPLICANT INFORMATION

1. Special Services

Do you need an interpreter? ☐ Yes ☐ No

Preferred spoken language:_____.

How did you hear about the Pathway I - Early Learning Scholarship? _____.

Have you received a Pathway I or Pathway II Scholarship recently? ☐ Yes ☐ No ☐ Unsure

If you have moved recently, what county did you live in? County _____

2. Parent/Legal Guardian

First Name*_____ Last Name*_____ Relationship to Child*_____Date of Birth*_____

What is the highest level of education you have completed?

- ☐ Less than high school
- ☐ High School/GED
- ☐ Some college
- ☐ 2-year college degree (Associates)
- ☐ 4-year college degree (Bachelors)
- ☐ Master's degree
- ☐ Doctoral degree
- ☐ Professional degree (MD, JD)

What is your current employment status?

- ☐ Employed Full-Time (FT)
- ☐ Employed Part-Time (PT)
- ☐ Unemployed, Seeking Employment (UE)
- ☐ Unemployed, Not Seeking Employment (NSE)

Home Address*_____ City and ZIP Code*_____ County*_____

Mailing address (if different) _____

Home phone number*_____ Cell phone number*_____ Other phone number_____

Additional Parent Information (if applicable)

First Name_____ Last Name _____ Relationship to Child _____Date of Birth _____

What is the highest level of education you have completed?

☐ Less than high school
☐ High School/GED
☐ Some college
☐ 2-year college degree (Associates)
☐ 4-year college degree (Bachelors)
☐ Master's degree
☐ Doctoral degree
☐ Professional degree (MD, JD)

What is your current employment status?

☐ Employed Full-Time (FT)
☐ Employed Part-Time (PT)
☐ Unemployed, Seeking Employment (UE)
☐ Unemployed, Not Seeking Employment (NSE)

Home Address _____ City and ZIP Code _____ County _____

Mailing address (if different) _____

Home phone number _____ Cell phone number _____ Other phone number_____

3. **Family Size.** Tell us about the family members in your current household.

Parent(s)/legal guardian(s), including yourself	
Children under 18 (including siblings)	
Children over 18 who live with you, are full-time students, and you provide 50 percent or more of their financial support	
If a minor parent living with your parents or relatives, include yourself or any spouse/parent of your children living with you	
Total number of family members*	

4. **Parents Under 21.** Are you a parent *under* age 21 pursuing a high school or general education equivalency diploma and you are requesting a scholarship for a child ages zero through age five?

☐ Yes ☐ No

If yes, you must provide written proof that you are pursuing a high school or general education equivalency diploma. Written proof means a copy of the official letter from the organization (on their letterhead) in which you are currently enrolled and actively participating in classes.

5. **Child Information.** Complete the child information table below and list the children to be considered for a scholarship. Please refer to the INSTRUCTIONS document for more detail regarding the scholarship eligibility requirements. *The Ethnicity/Race identity is optional and intended only for evaluation of the program. This information will not be used to determine eligibility. If you choose to enter the ethnicity and/or race of the eligible children in your household, check all that apply in the last column for each child below.*

CHILD INFORMATION

Child 1					☐Male ☐Female	☐Hispanic/Latino ☐Not Hispanic/Latino	☐Asian ☐American Indian or Alaskan Native ☐Black or African American ☐Native Hawaiian or Pacific Islander ☐White
Child 2					☐Male ☐Female	☐Hispanic/Latino ☐Not Hispanic/Latino	☐Asian ☐American Indian or Alaskan Native ☐Black or African American ☐Native Hawaiian or Pacific Islander ☐White
Child 3					☐Male ☐Female	☐Hispanic/Latino ☐Not Hispanic/Latino	☐Asian ☐American Indian or Alaskan Native ☐Black or African American ☐Native Hawaiian or Pacific Islander ☐White
Child 4					☐Male ☐Female	☐Hispanic/Latino ☐Not Hispanic/Latino	☐Asian ☐American Indian or Alaskan Native ☐Black or African American ☐Native Hawaiian or Pacific Islander ☐White

SECTION II - INCOME VERIFICATION

You have two options for verifying your income. **Choose one** of the two options to apply.

Option 1 – Provide proof that your child/children (listed above) is/are currently participating in one of the following public assistance or publicly funded programs below:

- Minnesota Family Investment Program (MFIP)
- Child Care Assistance Program (CCAP)
- Food Support (SNAP)
- Free and Reduced-Price Lunch Program (FRLP)
- Child and Adult Care Food Program (CACFP)
- Head Start
- Foster Care
- Food Distribution Program on Indian reservations (automatically qualifies for FRLP)

You must provide written documentation type proof of participation (showing participation).

If you do not have written documentation, please complete the Verification Form (attached to the INSTRUCTIONS), follow the directions, and send in with your scholarship application.

This statement is not an eligibility requirement: As the parent/legal guardian, my child/children are not currently participating in any of the above publicly funded programs. My child/children are however on a waiting list at Head Start, School-based or Child Care Assistance Program (CCAP). The site where my child/children are on the waiting list is: _____.

Option 2 – If you chose Option 1 to verify income, skip to Section III. If you did not choose Option 1, please complete the Income Table below.

List all sources of income in the table below. Each member of your household (including yourself, another parent or legal guardian) must be listed. All sources of income require proof of income (evidence). Refer to the INSTRUCTIONS document for more detail on how to fill in the table.

INCOME TABLE

Proof of Income. Attach proof of all income for each family member listed in the income table. Proof of income may include: a recent tax form, W-2 form, two most recent pay stubs, financial aid statement, or a statement from your employer on company letterhead.

SECTION III – EARLY EDUCATION/CHILD CARE PROGRAM CHOICE

You may use your Pathway I - Early Learning Scholarship at any eligible child care/early education program in Minnesota. A program is eligible to receive a scholarship if they are participating in the Parent Aware Ratings program.

Complete the child care/early education program choice table and indicate where you want to use your scholarship, if it is awarded. List the programs in order of priority. Check the box only if the child listed is currently enrolled at the child care/early education program.

CHILD CARE/EARLY EDUCATION PROGRAM CHOICE TABLE

				☐
				☐
				☐
				☐

SECTION IV – AGREEMENT AND CONSENT

As a parent or legal guardian, I understand that if my child receives a Pathway I - Early Learning Scholarship:

My three- to five-year-old child must complete a developmental screening (Early Childhood Screening or preschool screening) within 90 calendar days of attending a child care/early education program using my Early Learning Scholarship, if the developmental screening has not already been done. If my three- to five-year-old child is currently attending an eligible child care/ early education program when they receive a scholarship, my child must complete the screening within 90 calendar days of receiving the scholarship award. The Early Childhood Screening is not a requirement if my child is younger than three-years-old. If my child turns three-years while receiving the scholarship, my child must complete the developmental screening.

As long as state funding is available, my child will be eligible to continue to receive a scholarship until they are age-eligible for kindergarten, but my child may not be awarded more than one scholarship in a 12-month period.

My child must be accepted and subsequently enrolled in a Parent Aware program within ten months of being awarded a scholarship, or the scholarship will cancel and I must reapply in order to be eligible for another scholarship.

I do not have to provide the information requested in this scholarship application, but if I elect to not provide the required information, I acknowledge the Regional Scholarship Administrator cannot approve my child/children to participate in Pathway I - Early Learning Scholarship Program.

AGREEMENT TO COMPLY

_____ By initialing, I agree to comply with the conditions and requirements of the Pathway I – Early Learning Scholarship program and will notify the Early Learning Scholarship Administrator when or if my child/children stop attending the child care/ early education program. I give my consent for regional scholarship administrator/staff to share information from my Pathway I - Early Learning Scholarship application, my eligibility for and the amount of any Early Learning Scholarship that I receive with the child care/early education program that I choose to use my scholarship at. I understand that this information must be shared to determine whether I am eligible for the Pathway I - Early Learning Scholarship and to allow the scholarship to be paid to the child care/early education program on my behalf.

I certify (promise) that the information provided on this scholarship application is true and that all household members and income is reported. I further understand that if I purposely give false information, my child/children may lose scholarship benefits and I may need to reimburse the state for funds paid on my behalf.

CONSENT TO THE RELEASE OF INFORMATION TO MDE

_____ By initialing, I give my consent for Pathway I - Early Learning Scholarship Administrator/staff to share my information with the Minnesota Department of Education (MDE). I understand that my information must be shared so that MDE can evaluate and report on the scholarship program. Refusal to consent to release information to MDE may impact my eligibility to receive a Pathway I - Early Learning Scholarship.

CONSENT TO THE RELEASE OF INFORMATION AND TO PARTICPATE IN EVALUATION

_____ By initialing, I give my consent for Pathway I - Early Learning Scholarship Administrator/staff to share my information with the entity chosen by MDE to evaluate the Pathway I - Early Learning Scholarship Program. I understand that my information must be shared in order for the evaluation to analyze how scholarship funds are spent, how families are informed about the scholarship program, and the impact on the child's development or Kindergarten Readiness. Any public reports that include child information will be aggregated and will not include specific identifying information about any individual child. Refusal to consent to participate in the evaluation does not impact my eligibility to receive a Pathway I - Early Learning Scholarship.

By initialing in one or more of the areas above, I give my consent.

Signature of parent/legal guardian _____ Print Name: _____ Date _____

SECTION V – TENNESSEN WARNING

Minnesota Department of Education, Early Learning Scholarships Program

What information are we requesting?

We are requesting all information on the Pathway I - Early Learning Scholarships program application. This application requests information that may be considered private data under Minnesota law.

Why do we ask you for this information?

Information on this application is required to apply for the Pathway I - Early Learning Scholarships program. We will use the information collected via this application or any additional communications related to this application to determine eligibility for the Pathway I - Early Learning Scholarships program. This information is also necessary to comply with the state law authorizing the Early Learning Scholarships program.

Am I required to provide this data?

There is no legal obligation for you to provide the data requested. However, absent the data requested, the Minnesota Department of Education will not be able to evaluate your child's eligibility for the Pathway I - Early Learning Scholarships program.

Who else may see this information?

A third-party entity will evaluate the effectiveness of the Early Learning Scholarships program for the Minnesota Department of Education. That entity is bound by Minnesota's data practices and privacy laws and may not share your data with any other private entities but will share its evaluation with the Minnesota Department of Education. We may also give the data you've provided to the legislative auditor, the Minnesota Department of Human Services and any law enforcement agency or other agency with the legal authority to access the information, and anyone authorized by a court order.

How else may this information be used?

We can use or release this information only as stated in this notice unless you give us your written permission to release the information for another purpose or to release it to another individual or entity. The information may also be used for another purpose should the United States Congress or the Minnesota Legislature pass a law allowing or requiring us to release the information or to use it for another purpose.

How long will my data be kept?

Your data will be maintained for a minimum of seven years.

Appendix C: Additional Information About Data Analysis

Appendix C: Additional Information About Data Analysis

This appendix contains additional information about the data analysis methodology.

Multiple Imputation of Missing Baseline Covariates and Pretest Assessment Scores

Some covariate or pretest data were missing for 15% of Scholarship group children and 20% of comparison group children (for one or more variables).[1] Complete-case analysis using an unimputed data set has substantial weaknesses when considerable data are missing. First, listwise deletion limits the statistical power of the tests conducted because it uses a reduced sample size with complete cases (Allison, 2001; Olinsky, Chen, & Harlow, 2003; Roth, 1994). Second, if there is systematic difference between the complete cases and incomplete cases, the statistical inference from complete-case analysis may not be applicable to the population of all cases.

Multiple imputation was used as an alternative technique for dealing with missing data in an attempt to eliminate this bias. Missing data on baseline covariates and pretest measures were imputed using the EM (expectation-maximization) algorithm. All children with at least one baseline covariate and at least one pretest score were included in the multiple imputation.[2] The SAS PROC MI procedure with EM statement was used for multiple imputation. Multiple imputation inference involves three distinct phases:

1. The missing data are filled in five times to generate five complete data sets.
2. The five complete data sets are analyzed by using descriptive and regression procedures.
3. The results from the five complete data sets are combined for subsequent inferential analyses using SAS PROC MIANALYZE.

Propensity Score Weighting

Propensity score techniques are quasi-experimental approaches developed to approximate findings from randomized controlled trials (Becker & Ichino, 2002). They have been increasingly used in observational studies with cohort designs to reduce selection bias in estimating treatment or intervention effects when randomized controlled trials are not feasible or ethical (Rosenbaum & Rubin, 1983, 1984, 1985).

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[1] For the Scholarship group, child gender, race/ethnicity, and home language were obtained from families' applications for the EL Scholarship and were at times incomplete. For the comparison students, these background characteristics were obtained through voluntary questions on the form used to enroll and obtain consent for them to participate in the Parent Aware Validation Study. Some direct assessment data were missing because of an inability to initiate or complete testing of children, and some indirect assessments were missing because not all teachers completed all forms.

[2] Imputation was run on the overall sample altogether, not separately by group, and included a third group of children receiving Minnesota Race to the Top-Early Learning Challenge Scholarships whose outcomes will be compared with children in the comparison group in a separate and forthcoming report.

Propensity score weighting methods were used to test the difference between the Scholarship and comparison groups on child posttest scores. The propensity score is the predicted probability of participating in a treatment group based on a set of potentially confounding covariates (e.g., child background characteristics and pretest scores) using logistic regression. Propensity scoring attempts to equalize the mean values of potentially confounding observed covariates in the two groups being compared, ensuring that differences in outcomes are not the result of differences in the mean values of those covariates.

The impact analysis was adjusted for confounds using inverse propensity score estimators, as recommended by Rosenbaum and Rubin (1983). Specifically, for contrasting Scholarship and comparison groups, the weight for Scholarship group children was set at 1.0 and the weight for comparison group students was equal to pi/(1-pi), where pi is the propensity score for the i-th comparison student. The weighting created balance between the comparison and Scholarship groups on observed covariates and thus estimated the effect on child outcomes of attending a 3- or 4-star-rated ELD program. Weighting was selected over other approaches such as matching because it retains all sample members in the analysis and does not reduce sample size. After propensity score weighting for comparison students, we examined the standardized mean score—Hedges's *g* (the difference in means for the treatment and comparison groups divided by a pooled standard deviation)—to ensure that they were less than 0.25, thereby ensuring covariate balance (What Works Clearinghouse, 2008).

Weighted Multiple Regression to Compare Group Differences

Weighted multiple regression models were used to test the difference between the Scholarship and comparison groups on each of the child outcomes. The coefficient associated with group membership can be interpreted as the measure of the difference in child outcomes between Scholarship and comparison groups, adjusted for the estimated propensity of being in the Scholarship group and other child background characteristics.

The regression model was as follows:

$Y = \beta_0 + \beta_1 \text{Pretest} + \beta_2 \text{ELS} + \beta_3 \text{COV}$, where Y is posttest score; Pretest is the pretest score; ELS = 1 for the Scholarship group and ELS = 0 for the comparison group, and COV is student covariates. Propensity score weights were used in the multiple regression models.

To indicate the magnitude of the difference between Scholarship and comparison groups, this study reports regression-adjusted effect sizes (ES) (What Works Clearinghouse, 2008). The regression-adjusted ES is calculated by dividing the coefficient associated with intervention's effect from the regression model by the pooled within-group standard deviation of the outcome at the student level (What Works Clearinghouse, 2008). Effect size indicates the strength of the intervention effect, which also takes into account differences in variability across measures.

Appendix C References

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Appendix D: Additional Information About Findings

Appendix D: Additional Information About Findings

Baseline Equivalence

As described earlier, the goal of propensity score weighting is to control for the differential probability of being in the Scholarship and comparison groups. In order to ensure that the groups were adequately matched through propensity score weighting, we examined the standardized mean score (Hedge's g) to determine that they were less than 0.25. As shown in Exhibit D-1, standardized mean scores were below 0.25, indicating that covariate balance had been achieved.

Exhibit D-1. Baseline equivalence after propensity score weighting on demographic characteristics and pretest scores, by group

	Scholarship M (*SD*)	Scholarship Number	Comparison M (*SD*)	Comparison Number	Standardized Difference[c]
Gender					
Male	0.5 (0.5)	224	0.4 (0.7)	127	0.07 – 0.13
Race/ethnicity[a]					
White	0.5 (0.5)	224	0.4–0.5 (0.7)	127	0.06 – 0.12
Biracial	0.2 (0.4)	224	0.1 (0.4 – 0.5)	127	0.06 – 0.14
Primary home language[b]					
English	0.9 (0.3)	224	0.7–0.8 (0.5 – 0.6)	127	0.25 – 0.41
Health					
Body mass index	2.2 (0.6)	234	2.2 (0.7)	128	0.01
Literacy and language					
IGDI	21 (6.9)	234	19.4 (11.8)	128	0.18
TOPEL Print Knowledge	97.7 (15.2)	233	97 (20)	128	0.05
TOPEL Phonological Awareness	92.9 (17.7)	224	92.1 (24.8)	127	0.04
Early numeracy and math					
WJ Applied Problems	102.3 (11.3)	234	101.6 (14.5)	128	0.06
Socio-emotional competence					
SCBE Social Competence	41.4 (10.1)	239	42.2 (12.1)	129	-0.07
SCBE Anger-Aggression	17.7 (8.6)	240	17.9 (10.1)	129	-0.03
SCBE Anxiety-Withdrawal	16.5 (5.8)	240	16.9 (7.7)	129	-0.06
Approaches to learning					
PLBS Attention and Persistence	50.6 (10.5)	236	50.3 (12.3)	129	0.03
Peg-tapping (executive functioning)	10.5 (5)	234	9.4 (7.5)	128	0.18

[a]The reference group for this variable was all other race/ethnicity categories combined (aside from white and bi-racial). They were combined because the individual group sizes were not large enough to function in the subsequent regression models.

[b]The reference group for this variable was all other non-English languages. They were combined because the individual group sizes were not large enough to function in the subsequent regression models.

[c]Standardized difference is calculated by Cohen's d effect size (i.e. the difference between two groups means, divided by the pooled standard deviations of the treatment and control group).

Growth in Child Outcomes for Scholarship Group and Comparison Group

Both the Scholarship group and the comparison group were analyzed separately to determine whether the children were showing significantly better scores in the spring compared with the fall scores on the child outcome measures. These analyses only included those children who had both pretest and posttest data on each outcome measure.

As shown in Exhibit D-2, Scholarship recipients showed significantly better scores in spring on six of the nine measures, whereas the comparison group showed significantly better scores in spring on three of nine. The results shown in Exhibit D-2 in this exhibit use unimputed data because the statistical test used is a pre-post paired t-test comparing means for each assessment score *within* each group separately and covariates are not included in these analyses. As seen by the generally positive slopes of many of these graphs, children in both groups had better spring scores for several outcomes. Specifically, as shown in Exhibits D-3 to D-11,

- Children in the Scholarship had significantly better scores in spring on 6 outcomes: expressive language (IGDI) ($p < .001$), executive functioning (peg tapping) ($p < .001$), both TOPEL subtests (Phonological Awareness and Print Knowledge) ($p < .001$), early math (WJ Applied Problems) ($p = .04$), and teacher-rated social competence (SCBE Social Competence) ($p < .001$). By the end of the preschool year, spring scores were close to the norming sample means for each of the standardized outcomes.
- Children in the comparison group had significantly better scores in spring on 3 outcomes significant growth in expressive language (IGDI) ($p < .001$), executive functioning (peg tapping) ($p < .001$), and the TOPEL Phonological Awareness subtest ($p < .01$). Comparison children's scores on the TOPEL Phonological Awareness subtest was also similar to the norming sample means.
- Neither group of children showed significantly better scores in spring on attention-persistence (a positive outcome) nor on anxiety or anger-aggression (negative outcomes).

Exhibit D-2 Mean change in assessment scores from fall to spring, by group

	Number[a]	Fall Score *M (SD)*	Spring Score *M (SD)*	Change *M (SD)*	Pr > |t|
IGDI (expressive language)					
Scholarship	233	21.0 (6.9)	24.0 (7.3)	3.0 (6.2)	<.001[b]
Comparison	125	23.6 (6.5)	27.3 (6.6)	3.7 (6.0)	<.001[b]
TOPEL Print Knowledge					
Scholarship	226	97.9 (15.1)	101.0 (13.9)	3.0 (9.0)	<.001[b]
Comparison	123	105.2 (13.5)	106.6 (13.1)	1.4 (9.2)	0.09
TOPEL Phonological Awareness					
Scholarship	218	93.4 (17.5)	100.4 (17.1)	7.0 (14.7)	<.001[b]
Comparison	122	100.6 (15.9)	103.8 (16.2)	3.2 (14.8)	.02[b]
WJ Applied Problems (math)					
Scholarship	226	102.6 (11.2)	103.8 (11.5)	1.2 (9.0)	0.04[b]
Comparison	123	109.2 (10.8)	109.6 (11.8)	0.4 (9.3)	0.61
SCBE Social Competence					
Scholarship	225	41.6 (10.1)	43.3 (10.2)	1.7 (7.4)	<.001[b]
Comparison	128	45.5 (9.3)	44.7 (10.0)	-0.7 (7.8)	0.30
SCBE Anger-Aggression					
Scholarship	228	17.5 (8.6)	17.9 (9.2)	0.3 (7.0)	0.47
Comparison	129	17.9 (7.7)	18.9 (8)	0.9 (5.8)	0.08
SCBE Anxiety-Withdrawal					
Scholarship	229	16.5 (5.8)	17.0 (7)	0.5 (5.3)	0.15
Comparison	129	16.0 (5.8)	16.3 (5.5)	0.3 (5.2)	0.55
PLBS Attention-Persistence					
Scholarship	222	50.6 (10.5)	50.9 (10.3)	0.3 (7.8)	0.57
Comparison	127	52.4 (9.7)	51.6 (9.6)	-0.8 (8.1)	0.29
Peg tapping (executive function)					
Scholarship	228	10.6 (5.0)	13.0 (4.1)	2.4 (4.1)	<.001[b]
Comparison	123	11.6 (4.5)	13.8 (3.0)	2.2 (3.8)	<.001[b]

[a]Values in this column represent all the children for whom there were valid pretest and posttest scores, and thus valid change scores.

[b]Statistically significant change in score between fall 2014 and spring 2015.

Exhibit D-3. Fall-spring assessment scores, by group: IGDIs

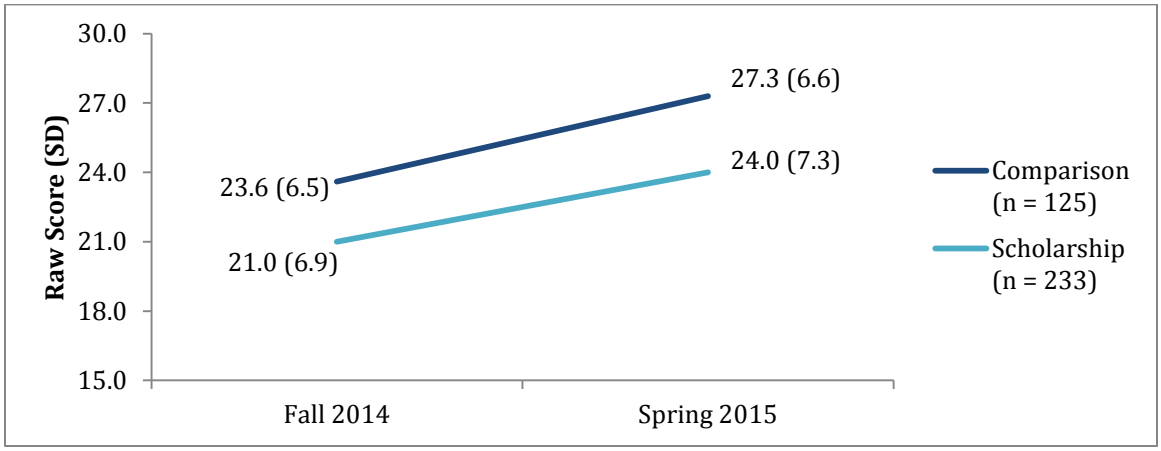


Exhibit D-4. Fall-spring assessment scores, by group: TOPEL Print Knowledge

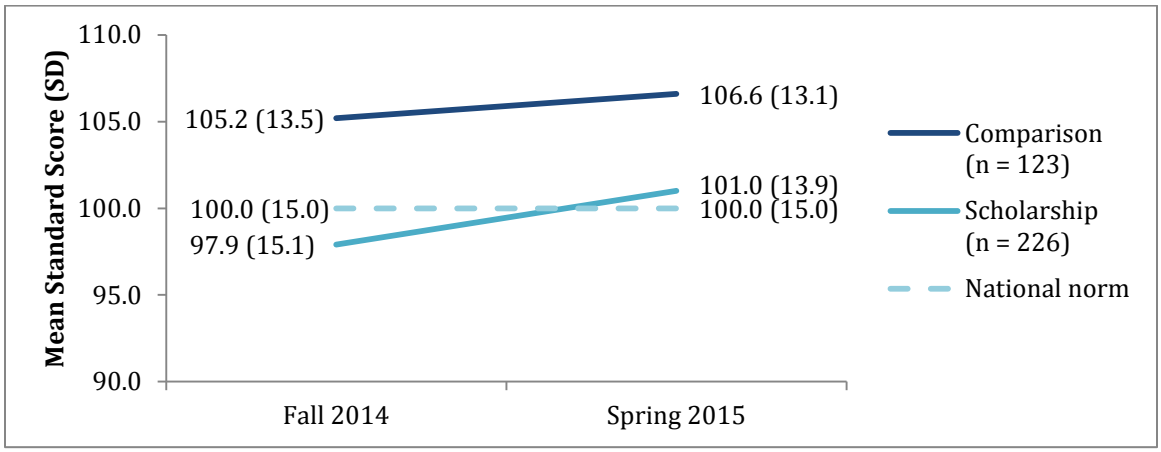


Exhibit D-5. Fall-spring assessment scores, by group: TOPEL Phonological Awareness

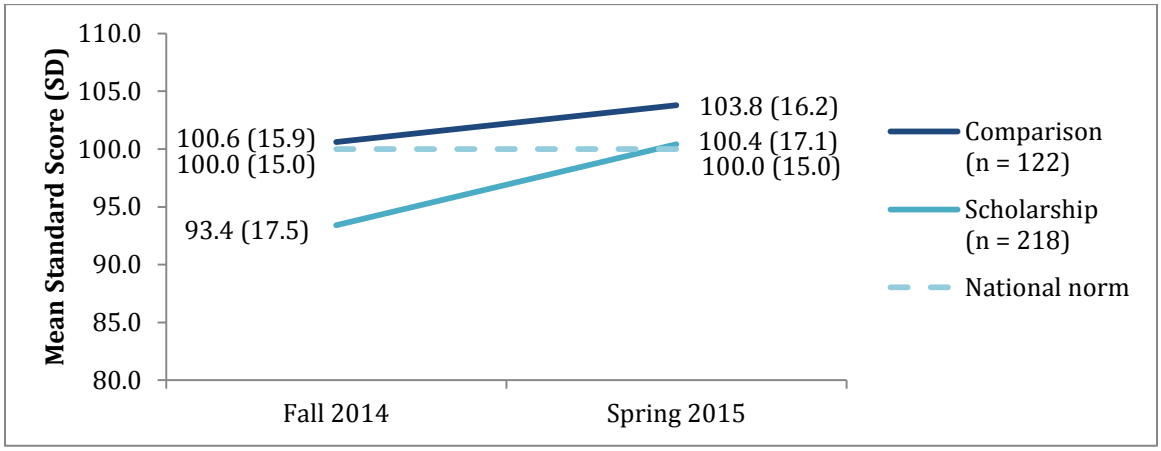


Exhibit D-6. Fall-spring assessment scores, by group: WJ Applied Problems

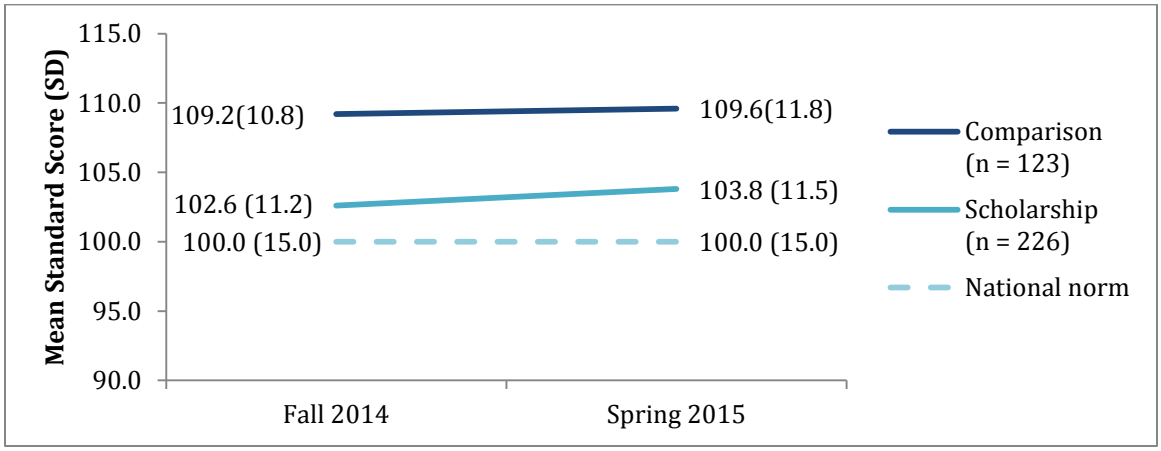


Exhibit D-7. Fall-spring assessment scores, by group: SCBE Social Competence

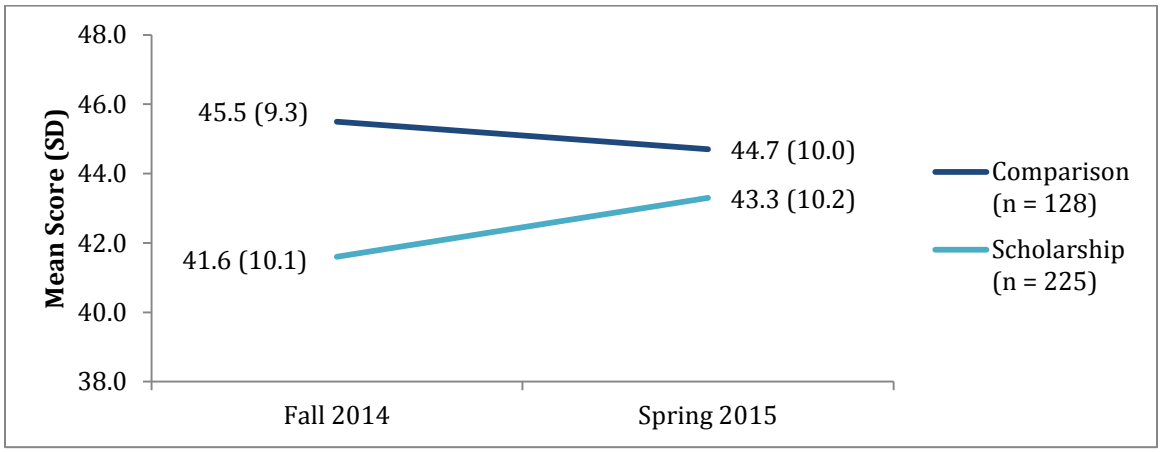


Exhibit D-8. Fall-spring assessment scores, by group: SCBE Anger-Aggression

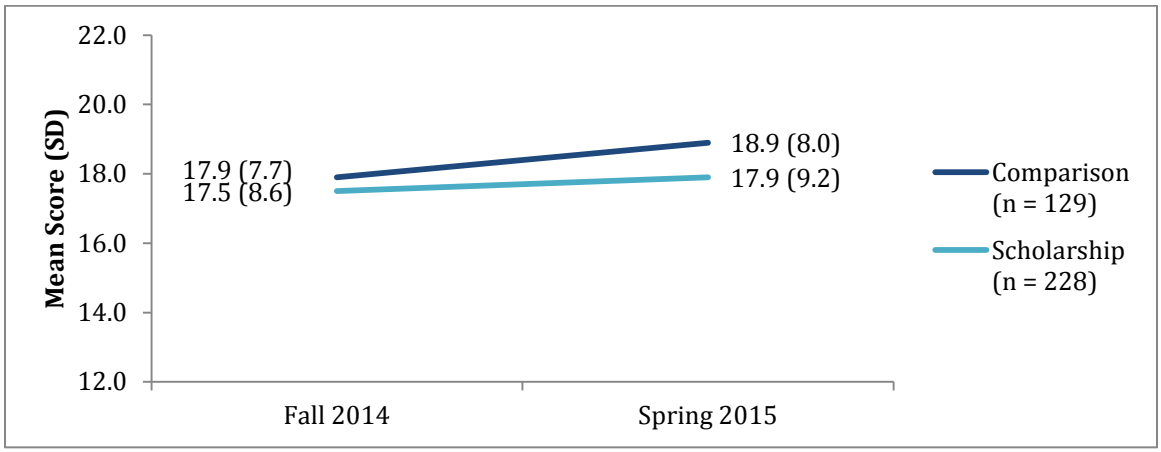


Exhibit D-9. Fall-spring assessment scores, by group: SCBE Anxiety-Withdrawal

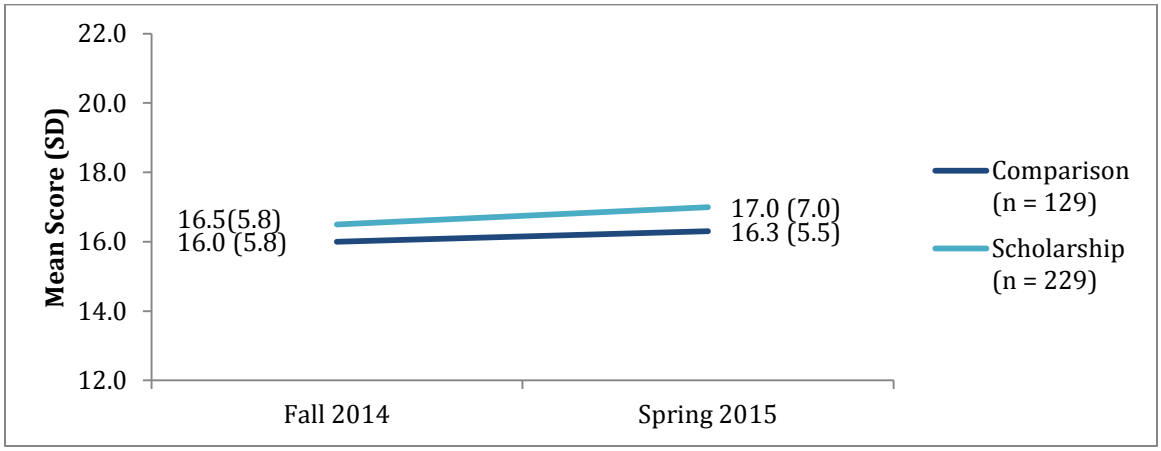


Exhibit D-10. Fall-spring assessment scores, by group: PLBS Attention and Persistence

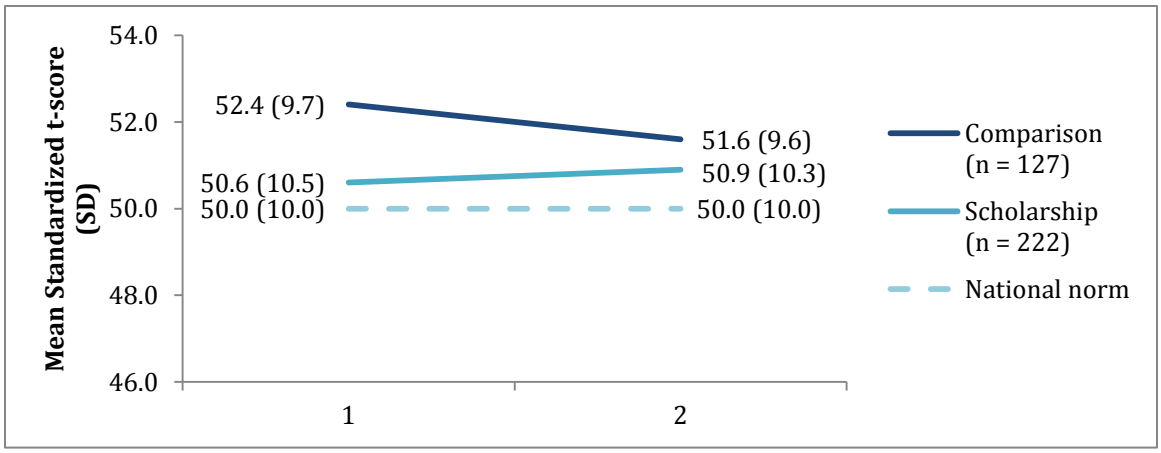
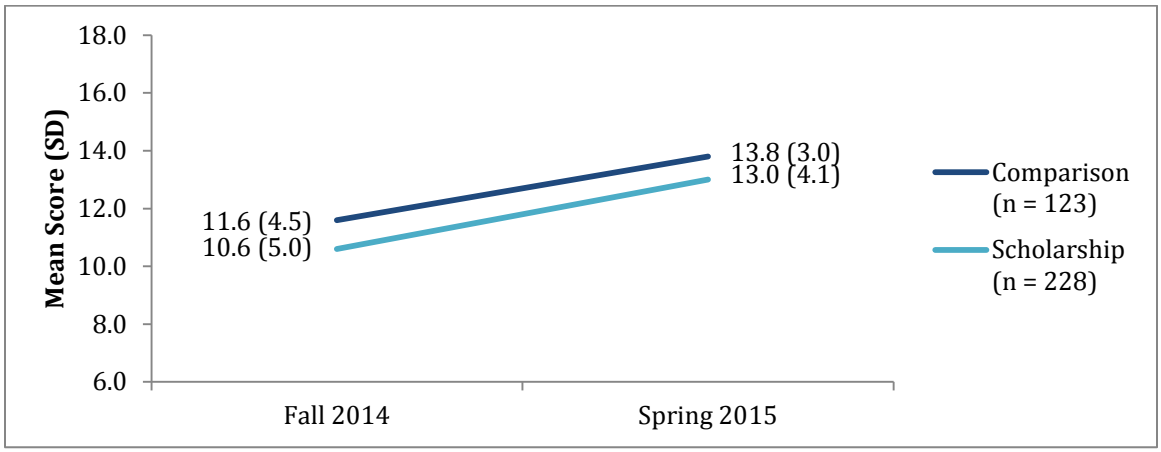


Exhibit D-11. Fall-spring assessment scores, by group: Executive functioning (Peg tapping)



Growth in Child Outcomes for Scholarship Group in Pathway I and Pathway II Groups

Similarly, within the Scholarship group only, children in Pathway I and Pathway II were analyzed separately to determine whether the children were showing significantly better scores in the spring compared with the fall scores on the child outcome measures. These analyses only included those children who had both pretest and posttest data on each outcome measure.

Children in both Pathway groups had better spring scores for several outcomes:

- IGDIs ($p < .0001$ for both)
- TOPEL-Print Knowledge (Pathway I, $p = .03$; Pathway II, $p < .0001$)
- TOPEL-Phonological Awareness ($p < .0001$ for both)
- SCBE-Social Competence (Pathway I, $p = .04$; Pathway II, $p = .001$)
- Peg tapping (executive functioning) ($p < .0001$ for both).

Children in Pathway II also had significantly better scores in spring for the WJ Applied Problems (1.9, $p = .01$), but children in Pathway I did not.

Neither group had significantly better scores for the following social-emotional and approaches to learning outcomes:

- SCBE-Anxiety-Withdrawal
- SCBE-Anger-Aggression
- PLBS (Attention-Persistence).