Effects of the Literacy Express Curriculum (LEC) on Children's Language Development

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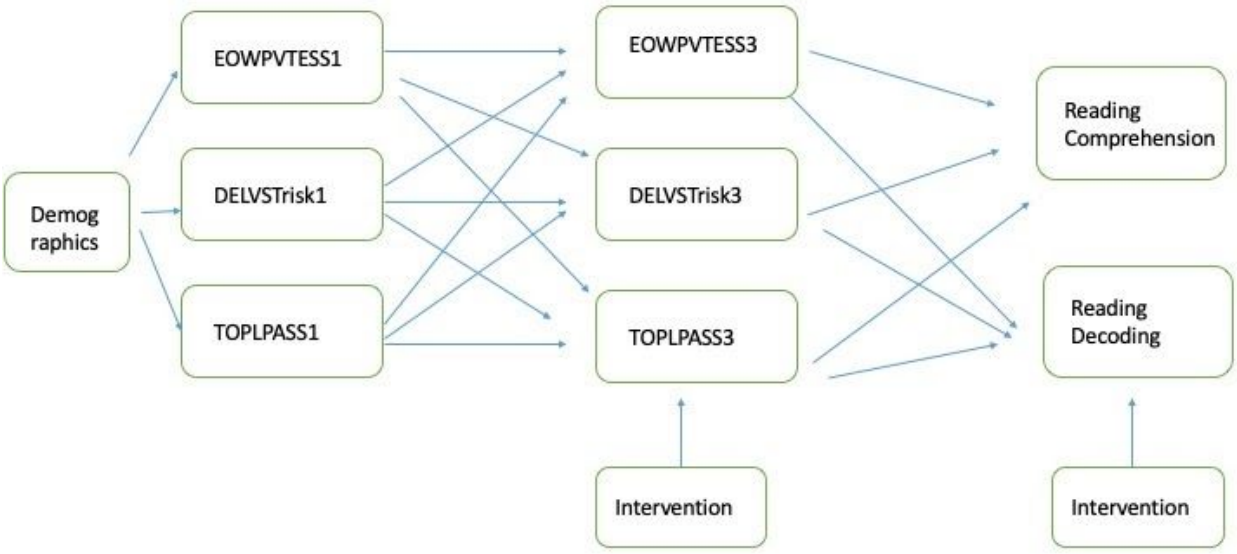
In the U.S., the educational achievement of students of socioeconomic and ethnic minorities has become a focus of growing concerns for educators and researchers. As a result, intervention programs emerged in an attempt to narrow the achievement gap. One study conducted by Lonigan et al. (2015) investigated possible intervention effects on the academic outcomes of white and African American children attending childcare classrooms in low-income areas. In their study, they evaluated the effectiveness of an integrated literacy- and math-focused preschool curriculum and found a positive impact of the curriculum on children's language, phonological awareness, math, and socioemotional development.

Although the previous study showed evidence on the positive effect of the intervention, it did not examine the ethnic differences in the educational outcomes nor the longitudinal trajectory of children's language development. Our study intends to add to Lonigan et al. (2015) by examining the effect of children's ethnicity and demographics on their later literacy skills and investigating the relationship between the curriculum intervention program, preschoolers' language ability, and their reading measures at the end of the first-grade. We hope to gain a better understanding of the underlying factors that would affect children's learning ability and developmental trajectory. In this preliminary report, we conducted a descriptive data analysis on our measurements as well as graphed distributions of the main variables and discussed some insights. In the current study, we used ANOVA to understand the ethnicity differences in language and literacy measures. We plan to use a Structural Equation Model (SEM) to examine the longitudinal effects of the intervention. We hypothesize that basic background information including age, word span, and IQ will predict expressive vocabulary, language development, and

phonological awareness at Wave 1, and all Wave 1 measures will predict the same measures at Wave 3. The intervention is expected to significantly increase all scores of measurements at Wave 3. Lastly, expressive vocabulary, language development, and phonological awareness at Wave 3 will predict reading comprehension and reading decoding ability in Wave 5, with intervention having a significant impact on both measures as well.



Note. This is the tentative plan for our SEM model used in the current study. The intervention should point to all variables in Wave 3 and Wave 5 respectively. Although we have an idea to include all the main variables and the intervention, we are still figuring out which specific paths we would like to explore and how to visualize them.

Method

Design

This study used a longitudinal and cluster-randomized design. Schools were randomly assigned to the Literacy Express Curriculum (LEC) group or the business as usual (BAU) group.

Participants

Participants in this study included 760 students from 110 randomized classrooms with approximately eight students from each classroom. Only 320 children (female = 165) with complete data from Wave 1 to Wave 5 were included in the data analysis. The average age of students was 4.54 years old at baseline. 62% of the participants were African Americans, and 38% were White Americans.

Measures

Nonverbal Cognitive Ability. Nonverbal cognitive ability was measured by the Pattern Analysis subset of the Stanford-Binet IQ test (SB–IV; Thorndike, Hagen, & Sattler, 1986). The Pattern Analysis subset required children to complete shape puzzles and then replicate more complex visual patterns by manipulating blocks. Raw scores were translated to standard scores for analysis. The average IQ falls under the range of 90 to 109. The test had good internal consistency for the age group in our sample ($\alpha > .85$).

Word Span. Word span was measured by the Verbal Rote Memory subset of the Preschool Comprehensive Test of Phonological and Print Processing (Pre-CTOPP; Lonigan, Wagner, Torgesen & Rashotte, 2002). Children were asked to repeat lists of familiar English words. The scores indicated the number of items they answered correctly.

Language Development. Language development was measured by the Diagnostic Evaluation of Language Variations-Risk Screener (DELV-RISK; Seymour, Roeper, & de Villiers, 2003), which could distinguish children with normal language development from those with a language disorder or delay. The unbiased test required children to verbally answer a question based on the given context. DELV-RISK consists of 17 items of three types: morphosyntactic, wh-question movement, and non-word repetition. The scores ranged from 0 to 17, with higher scores indicating higher risks of having a language delay. It has good construct validity (rs = .15 to .70) with other measures of language development.

Expressive Vocabulary. Expressive vocabulary was measured by the Expressive One-Word Picture Vocabulary Test (EOWPVT; Brownell, 2000). Participants were shown a series of pictures depicting actions, objects, and concepts and were asked to name the given illustration. Raw scores were translated to standard scores for analysis. Internal consistency scores for 2 to 5-year-old children range from .96 to .98.

Word Elision and Blending Abilities. Word elision and blending abilities were measured by Phonological Awareness subtests from the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007). The subscale had 27 items, with 12 items asking children to say a word after dropping out specific sounds (elision) and 15 items asking children to combine separate sounds to form a word (blending). Raw scores were translated to standard scores for analysis. Internal consistencies were satisfying for 3-, 4-, and 5-year-old children (αs = .89 - .95).

Reading Decoding. Reading decoding ability was measured by the Letter-Word Identification subtest of Woodcock-Johnson III Achievement Tests (WJIII; Woodcock, Mather,

McGrew, & Wendling, 2001). Children were asked to identify and say the letters and words they saw. Raw scores were translated to standard scores for analysis.

Reading Comprehension. Reading comprehension was measured by the Passage Comprehension subtest of WJIII (Woodcock et al., 2001). This test asked participants to comprehend the meaning of a short passage, and as the task proceeded, to fill in a missing keyword that integrated the short passage. Raw scores were translated to standard scores for analysis.

Procedures

Center directors provided consent for their centers in Texas and Florida to participate in the study. Classrooms at preschool centers were randomly assigned to the Literacy Express Curriculum (LEC) group or the business as usual (BAU) group. All lead teachers and classroom aides provided informed consent to participate. Informed consent was also collected from the children's guardians.

Before the intervention, participants' background information including age, gender, ethnicity, intelligence, and word span were recorded. At the beginning of the intervention year (Wave 1), all children completed tests that measured language development, expressive vocabulary, and phonological awareness. Developed by Lonigan, Clancy-Menchetti, Phillips, McDowell, & Farver (2005), the Literacy Express Curriculum aimed to facilitate preschool children's learning on language, phonological awareness, and print knowledge. The curriculum consisted of 10 thematic units that covered a comprehensive domain of early learning, including language and literacy, science and math, and motor schools. Students in the intervention group were offered explicit and highly scaffolded instruction in both whole-class activities and

teacher-directed small-group activities. At the end of the intervention year (Wave 3), all participants completed the same measurements as they did at Wave 1. In the follow-up study, researchers reached out to participants at the end of their first-grade year (Wave 5) and administered subscales of WJIII Achievement Tests that measured reading decoding and comprehension abilities.

Preliminary Data Analyses

Descriptive Statistics

Table 1.
Mean, standard deviation and correlation table

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender	0.52	0.5														
2. IQ	86.53	14.05	-0.01													
3. Word Span	9.4	2.16	0.09	0.03												
4. Intervention	0.85	0.36	0.02	-0.08	-0.05											
Time 1																
5. Age1	4.54	0.37	0.05	-.29**	0.08	0.02										
6. DELV Risk	2.94	2.24	-.12*	-0.06	-.30**	-0.1	-.24**									
7. Vocab Test	86.99	13.27	-0.01	.23**	.30**	-0.01	0.05	-.47**								
8. Phonological Awareness	88.19	13.92	.15**	.27**	.27**	.12*	0.08	-.37**	.47**							
Time 3																
9. Age	5.06	0.37	0.05	-.29**	0.07	0.02	.99**	-.23**	0.04	0.07						
10. DELV Risk	1.66	1.84	-0.1	-.13*	-.24**	-0.09	-.15**	.56**	-.37**	-.40**	-.14*					
11. Vocab Test	90.54	14.03	0.01	.27**	.25**	0.03	-0.01	-.49**	.78**	.47**	-0.01	-.38**				
12.Phonological Awareness	97.03	14.59	0.07	.30**	.24**	0.08	0.05	-.40**	.49**	.52**	0.04	-.39**	.52**			
Time 5																
13. Age	7.05	0.42	0.02	-.27**	0.01	0.06	.84**	-.15**	0.02	0.06	.86**	-0.06	0.03	0.02		
14. Letter Word Identification	107.06	13.26	.12*	.29**	.22**	0.04	-.26**	-.27**	.39**	.34**	-.27**	-.20**	.40**	.37**	-.29**	
15. Reading Comprehension	93.2	21.4	.13*	.27**	.24**	.14*	-0.06	-.31**	.38**	.34**	-0.06	-.32**	.40**	.42**	-0.08	.79**

*Note. M and SD are used to represent mean and standard deviation, respectively. Measures across time are standardized. * indicates p < .05. ** indicates p < .01.*

Table 1. Descriptive Statistics

This table provides mean and standard deviations of the variables as well as their correlations.

ANOVA

Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*
IQ Score					
(Intercept)	352016.89	1	352016.89	1797.37	.000
Ethnicity	473.97	1	473.97	2.42	.121
Intervention	461.87	1	461.87	2.36	.126
Error	62084.68	317	195.85		
Word Span					
(Intercept)	4036.98	1	4036.98	873.43	.000
Ethnicity	23.51	1	23.51	5.09	.025
Intervention	4.60	1	4.60	1.00	.319
Error	1460.54	316	4.62		

Table 2. Two-way ANOVA outcomes using background measures as criteria.

	Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*
Time 1	*DELV risk*					
	(Intercept)	672.69	1	672.69	142.61	.000
	Ethnicity	96.29	1	96.29	20.41	.000
	Intervention	14.42	1	14.42	3.06	.081
	Error	1495.32	317	4.72		
	Vocab Test					
	(Intercept)	314009.45	1	314009.45	2082.18	.000
	Ethnicity	8357.66	1	8357.66	55.42	.000
	Intervention	13.73	1	13.73	0.09	.763
	Error	47806.25	317	150.81		
	Phonological Awareness					
	(Intercept)	296716.53	1	296716.53	1688.50	.000
	Ethnicity	5222.34	1	5222.34	29.72	.000
	Intervention	867.92	1	867.92	4.94	.027
	Error	55705.69	317	175.73		

Table 3. Two-way ANOVA outcomes using Wave 1 measures as criteria.

	Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*
Time 3	*DELV risk*					
	(Intercept)	239.12	1	239.12	73.12	.000
	Ethnicity	38.65	1	38.65	11.82	.001
	Intervention	7.95	1	7.95	2.43	.120
	Error	1036.62	317	3.27		
	Vocab Test					
	(Intercept)	329888.61	1	329888.61	1958.22	.000
	Ethnicity	9302.99	1	9302.99	55.22	.000
	Intervention	32.56	1	32.56	0.19	.660
	Error	53234.51	316	168.46		
	Phonological Awareness					
	(Intercept)	371461.18	1	371461.18	1948.51	.000
	Ethnicity	7042.69	1	7042.69	36.94	.000
	Intervention	378.12	1	378.12	1.98	.160
	Error	60432.42	317	190.64		

Table 4.Two-way ANOVA outcomes using Wave 3 measures as criteria.

A significant and independent ethnic group effect was found across all measures except for IQ (see Table 2-4). Neither a significant intervention effect nor an interaction effect (Ethnicity x Interaction) was observed on children's score on DELV risk test, vocabulary test and phonological awareness test at Wave 1 and Wave 3, therefore was also removed from the analyses. Taken together, the results suggested that the intervention had an uniform effect across White and African American children and had not yet shown its positive impact in Wave 3.

Predictor	Sum of Squares	*df*	Mean Square	*F*	*p*
Letter Word ID					
(Intercept)	489300.92	1	489300.92	2832.80	.000
Ethnicity	1233.11	1	1233.11	7.14	.008
Intervention	98.46	1	98.46	0.57	.451
Error	54754.47	317	172.73		
Reading Comprehension					
(Intercept)	314820.90	1	314820.90	716.90	.000
Ethnicity	4196.41	1	4196.41	9.56	.002
Intervention	2651.21	1	2651.21	6.04	.015
Error	139207.31	317	439.14		

Table 5. Two-way ANOVA outcomes using Wave 5 literacy measures as criteria.

As shown in Table 5. there was an ethnic group effect for both literacy measures at Wave 5. A significant intervention effect was only observed on children's reading comprehension ability. No interaction was found and therefore was also removed from the analyses.

Data Visualization

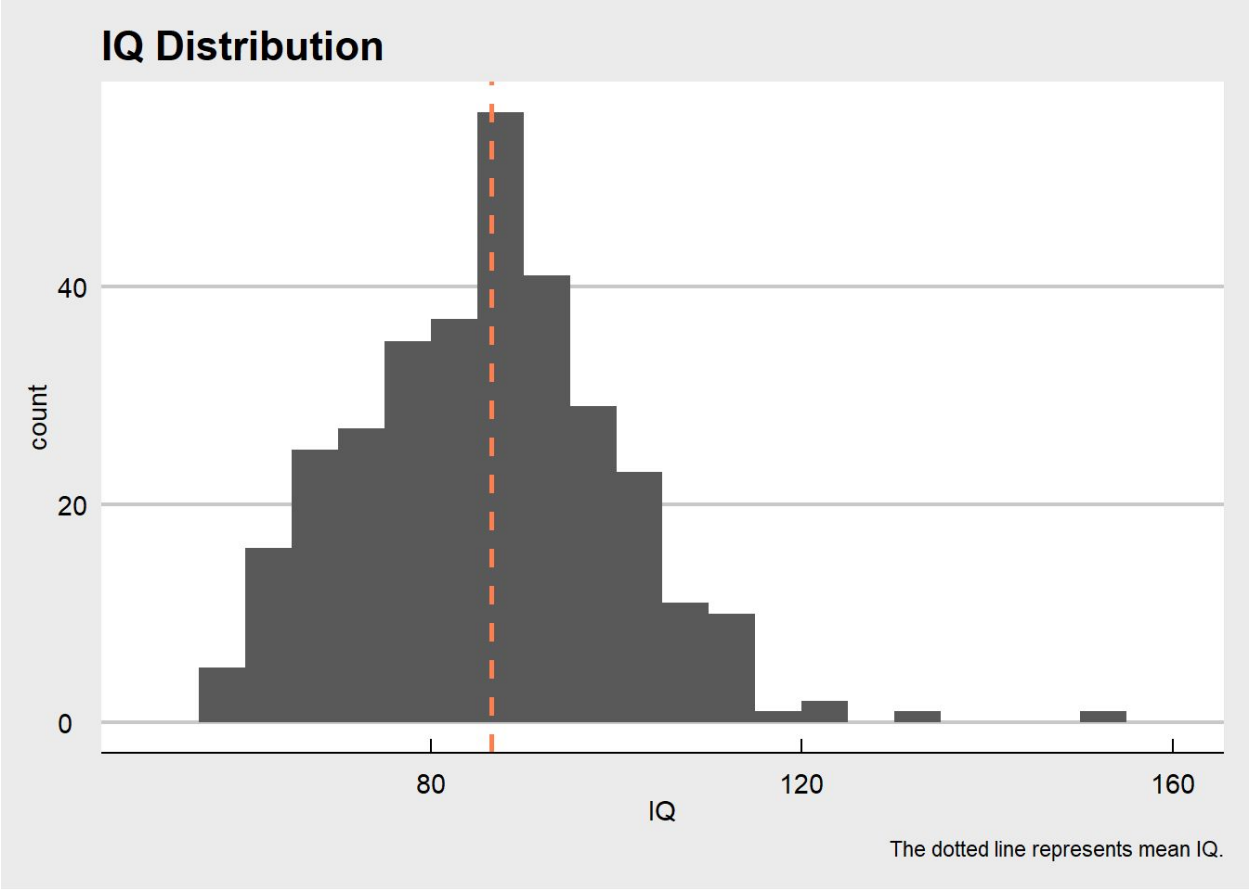


Figure 1. Stanford-Binet IQ test - Pattern Analysis subtest score distribution.

Figure 1 showed an approximately normal distribution of the Pattern Analysis subtest of the Stanford-Binet IQ test among the sampled children. The average score was 86.5. Since the scores were standardized, the population distribution should be fixed at a mean of 100 and a standard deviation of 16 (Thorndike, Hagen, & Sattler, 1986). Therefore, the cognitive abilities of children participated in this project on average were almost one standard deviation behind that of a typical child.

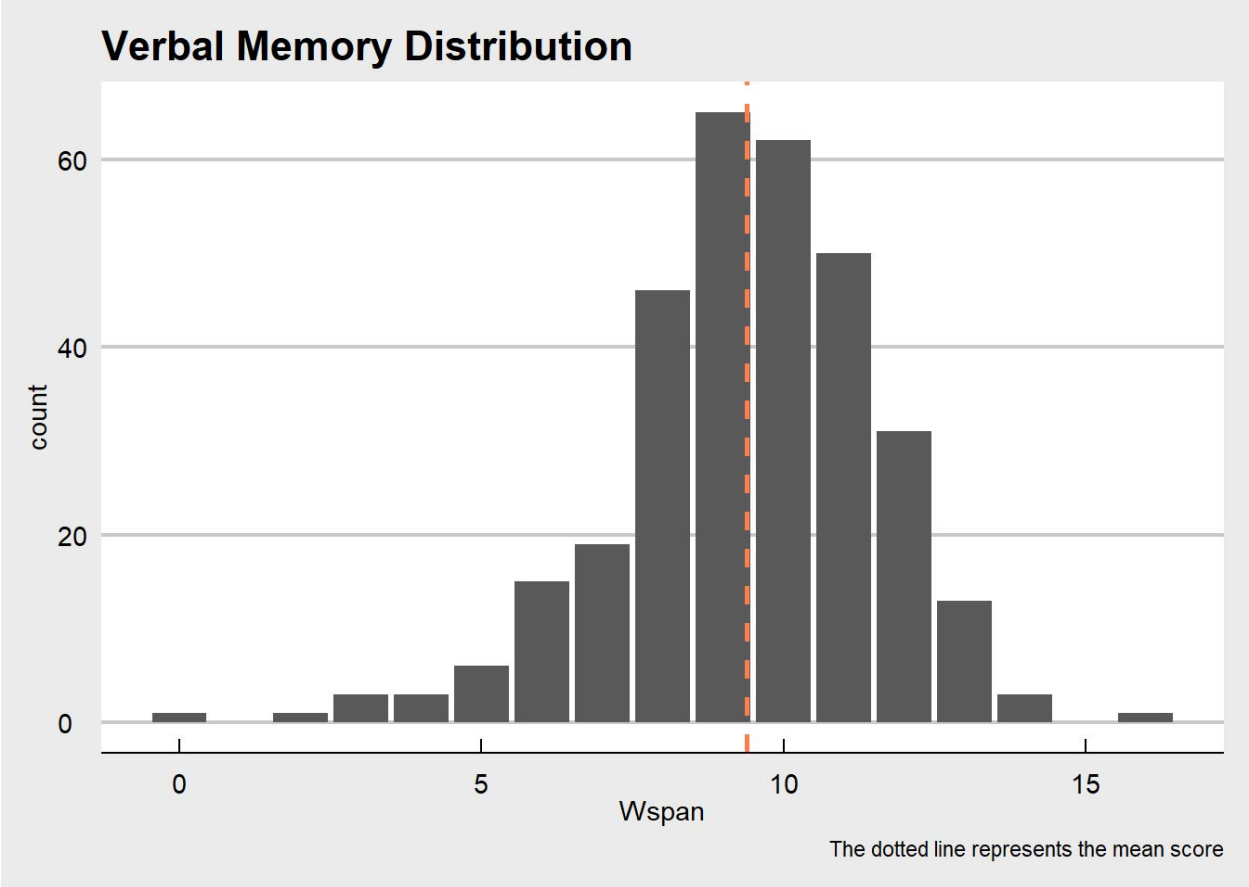


Figure 2. Pre-CTOPP - verbal rote memory subtest score distribution.

The distribution of the verbal rote memory test was slightly left-skewed, with an average score of 9.40 (see Figure 2). Since the norm of the test was not clear, no conclusion of their performance compared to peers can be made from the graph.

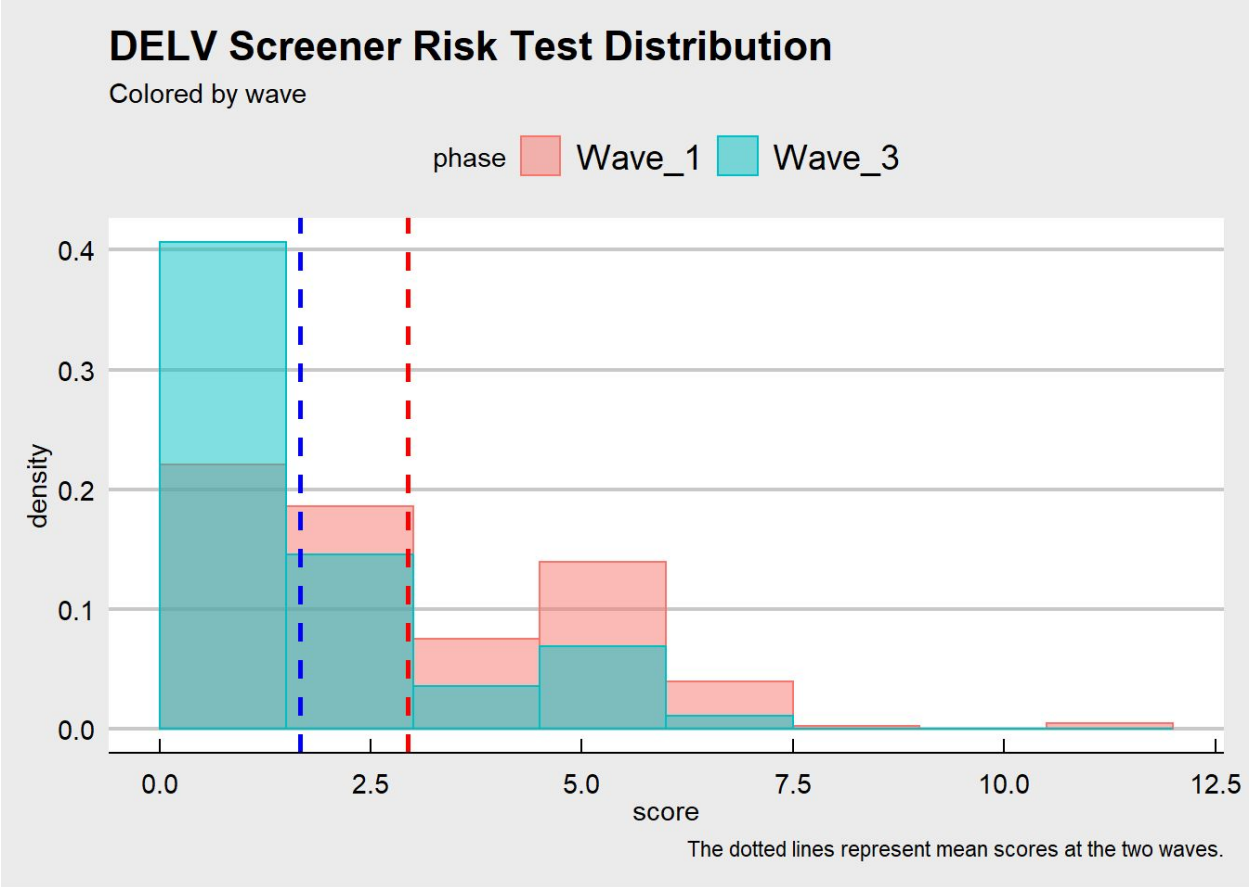


Figure 3. DELV Screener Risk score distribution by wave.

Figure 3 demonstrated children's performance at Wave 1 and Wave 3 in DELV Screener Risk test. Since a higher score represents more errors in this assessment, a lower average score at Wave 3 indicated the improvement in their language skills over time. Moreover, over 40% of the children received a score close to or equal to 0 at Wave 3, resulting in a possible floor effect. DELV would have a low discrimination ability on children in Wave 3.

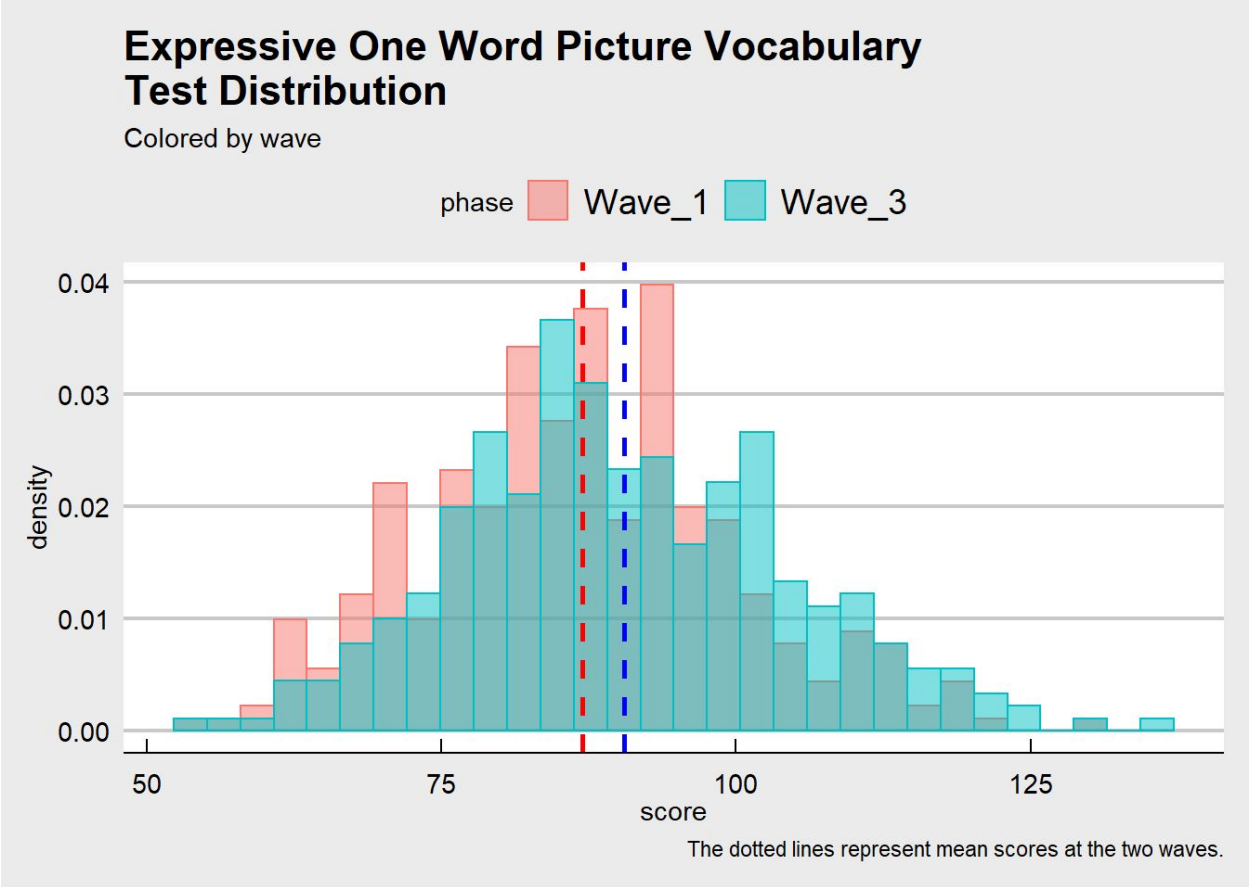


Figure 4. Expressive One Word Picture Vocabulary Test score by wave.

Figure 4 showed the distribution of scores in Expressive One Word Picture Vocabulary Test. Children did slightly better at Wave 3 than at Wave 1, as can be seen from the higher mean score at Wave 3.

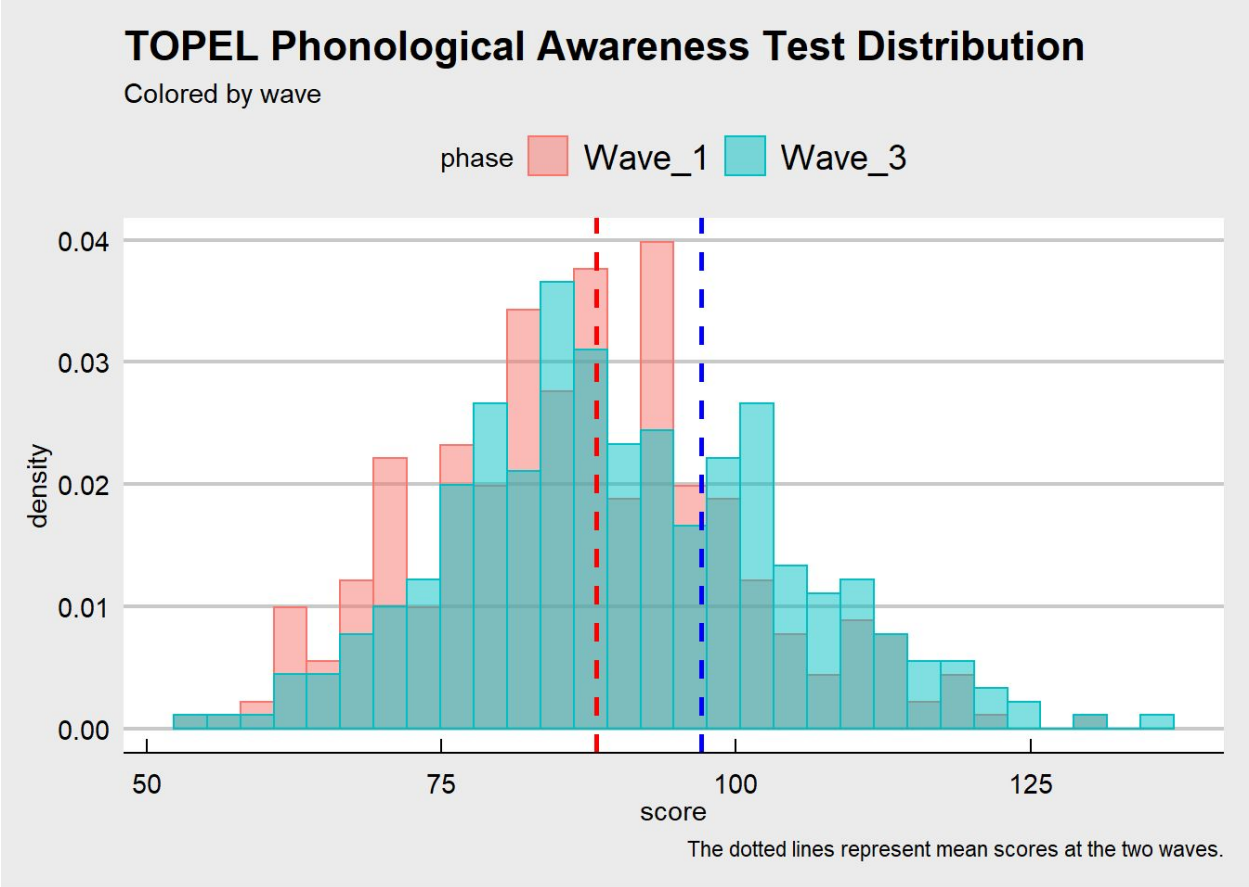


Figure 5. TOPEL Phonological Awareness Test score by wave.

Figure 5 displayed the score distributions of the TOPEL Phonological Awareness Test by wave. Similar to previous results, children improved over time and did better at Wave 3.

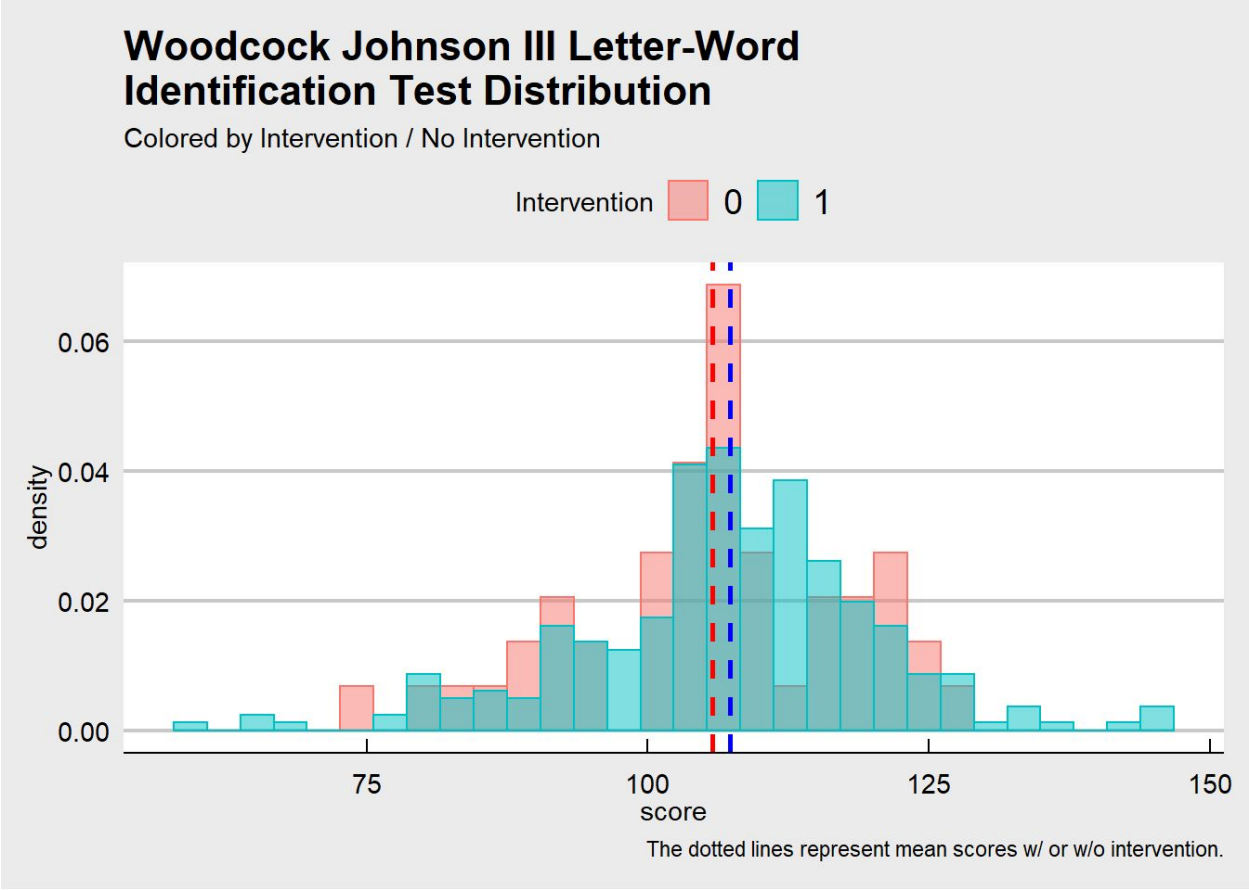


Figure 6. Woodcock Johnson III Letter-Word Identification Test score distribution by intervention.

Children were given the Woodcock Johnson III Letter-Word Identification Test at Wave 5 (see Figure 6). Bins in red illustrated the score distribution of children without intervention, and bins in blue showed those under intervention. Children with intervention did slightly better than those without intervention, and the difference was insignificant in a two-way ANOVA that take ethnicity and intervention as factors (see Table 5), $F(1, 317) = 0.57$, $p = .451$.

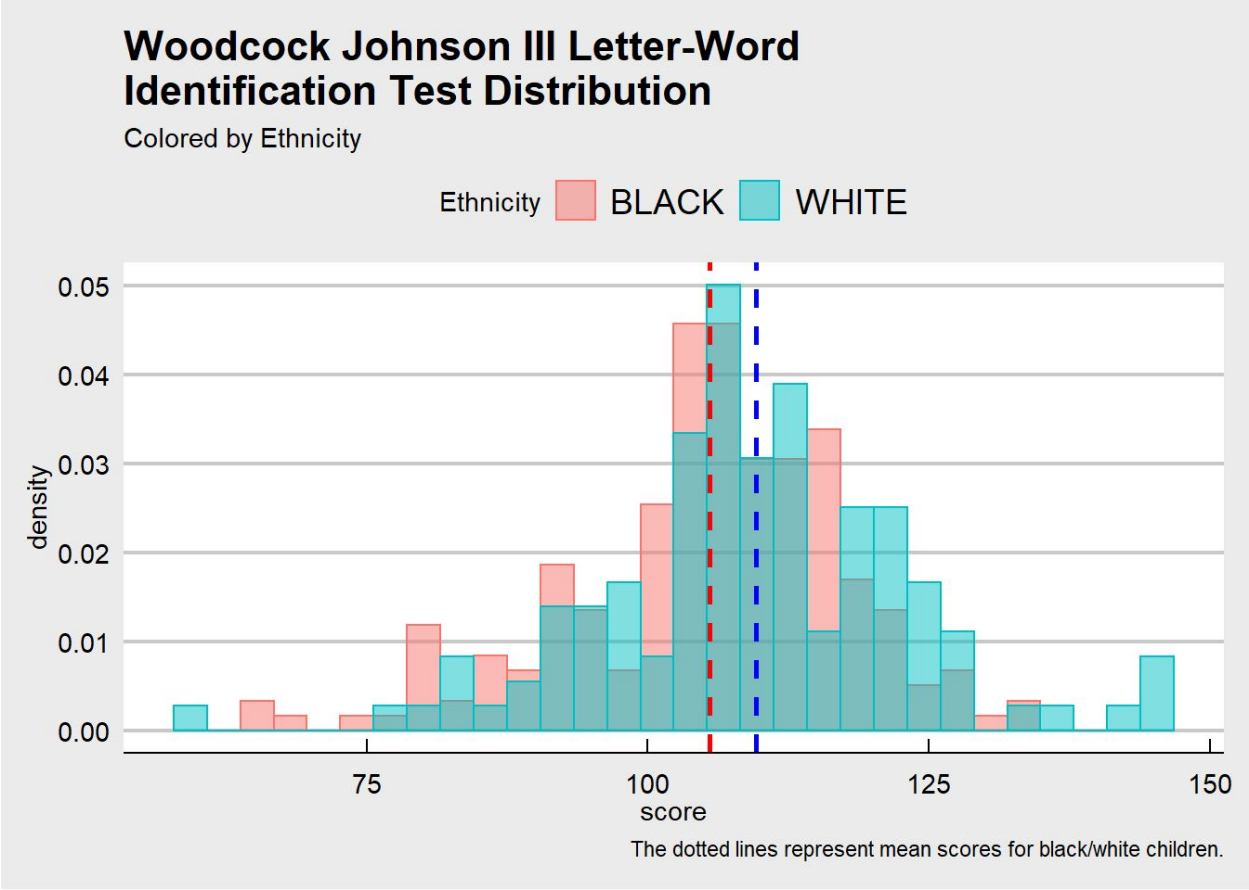


Figure 7. Woodcock Johnson III Letter-Word Identification Test score distribution by ethnicity.

Figure 7 was plotted to examine the performance of white vs. black children in Woodcock Johnson III Letter-Word Identification Test. On average, white children scored higher than black children, and such difference was significant in a two-way ANOVA with factors of ethnicity and intervention (see Table 5), $F(1, 317) = 7.14$, $p = .008$.

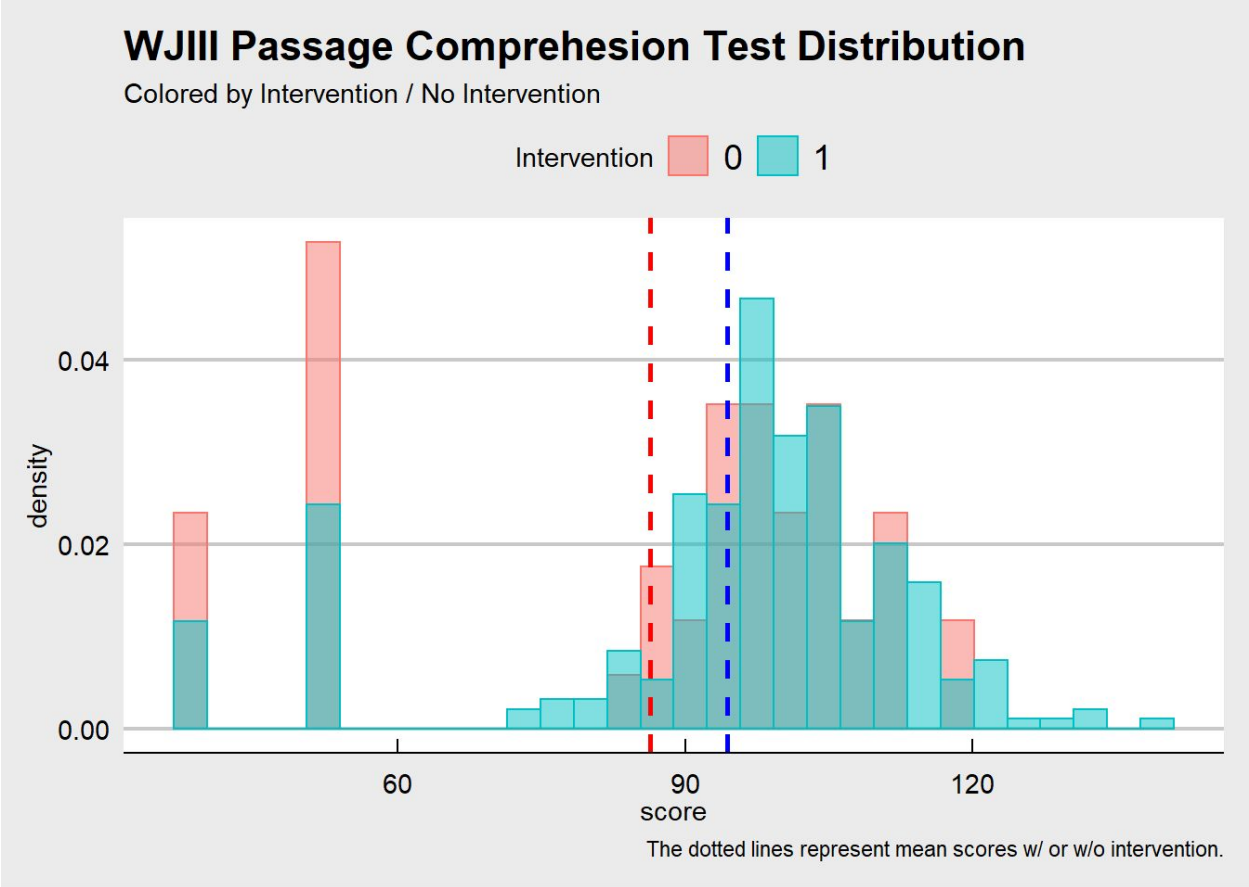


Figure 8. Woodcock Johnson III Passage Comprehension score distribution by intervention.

Children also took the Woodcock Johnson III Passage Comprehension Test at Wave 5 (see Figure 8). Children with intervention on average scored higher than those without intervention, and the difference was significant in a two-way ANOVA with factors of ethnicity and intervention (see Table 5), $F(1, 317) = 6.04$, $p = .015$. A noticeable feature of this distribution was that a high density of children scored below 60 regardless of whether they had received intervention. It was possible that there were some mistakes in the execution of the intervention or the administration/ scoring of the test.

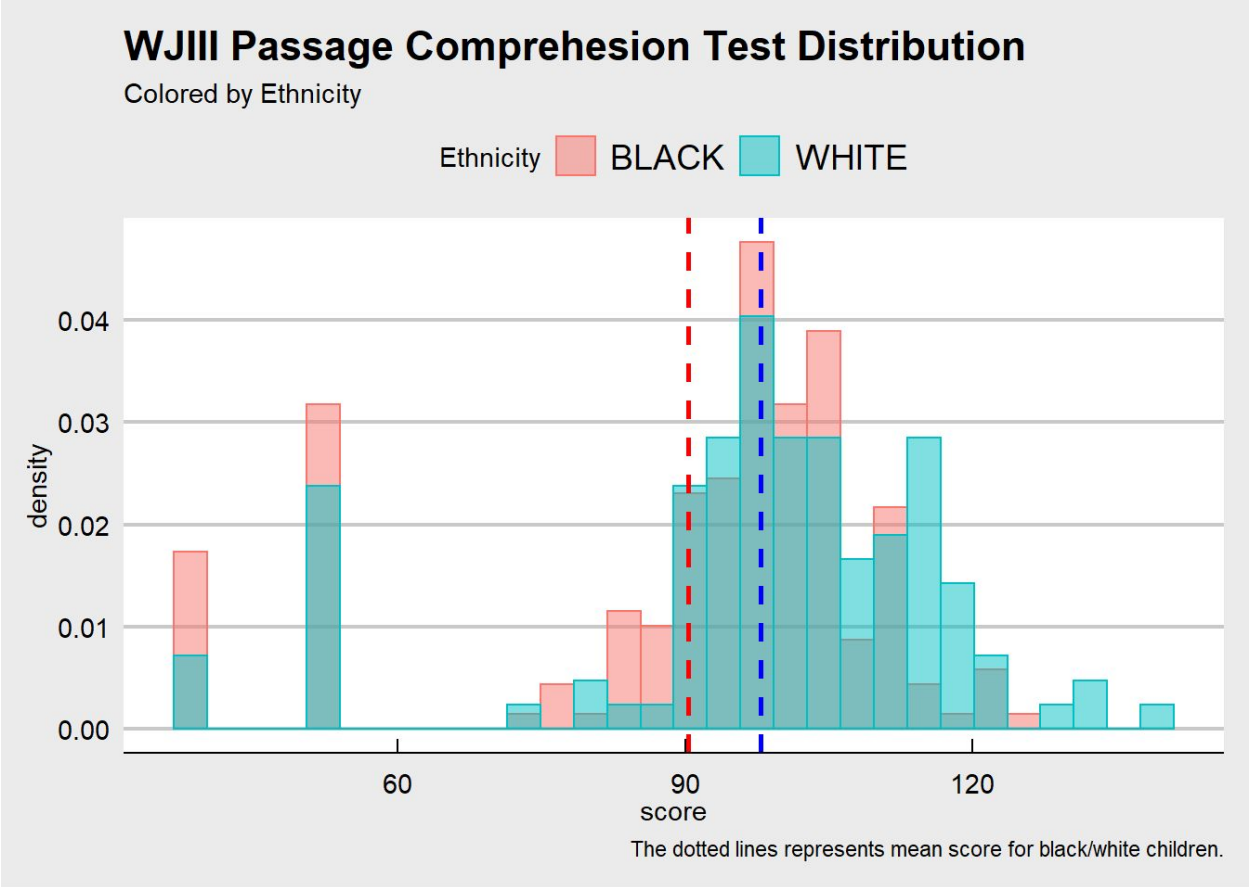


Figure 9. Woodcock Johnson III Passage Comprehension score distribution by ethnicity.

Figure 9 demonstrated the scores of Woodcock Johnson III Passage Comprehension Test of white and black children. Similar to the Letter-Word Identification Subtest, white children received a significantly higher score than black children, as evidenced from the two-way ANOVA result (see Table 5), $F(1, 317) = 9.56$, $p = .002$. As discussed above, a portion of children obtained a score lower than 60, regardless of ethnicity.

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