

LENA Grow's Impact on Children's Kindergarten Readiness

What you'll learn in this paper:

- How kindergarten readiness is a predictor of later academic success and well-being.
- The importance of children's early language environments, specifically those in preschool, and how they relate to school preparedness.
- Quasi-experimental studies from three different school districts that demonstrates the measurable impact LENA Grow has on children's kindergarten readiness, particularly in language and early literacy skills.

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Why is kindergarten readiness important?

Each year in the United States, between three and four million children start kindergarten.¹ For many, it's their first foray into formal education. For others who attended preschool, it's a continuation of their early learning experiences. At the beginning of the school year, kindergarten teachers often note the wide range of abilities with which students enter their classrooms. Some children are already beginning to write short words, while others are just starting to learn the alphabet. Alarming, children who start out below kindergarten level rarely catch up to their peers. One study suggests that nearly three-quarters of those who begin kindergarten in the lowest quintile of reading achievement will still be in the lower quintiles in fifth grade.² Additionally, those who enter kindergarten without foundational social and behavior skills are more likely to repeat a grade or face suspension or expulsion.³

While the COVID-19 pandemic intensified achievement gaps in school readiness,⁴ it didn't necessarily create new challenges — instead, it exacerbated and accelerated existing trends. Beginning even before the pandemic, many young children have been growing up in increasingly constrained social circles.⁵ Smaller family sizes have meant children have fewer opportunities for unstructured play with siblings. More limited interaction with non-parental adults, such as grandparents, has provided children with fewer

nurturing relationships that support early learning and secure attachment. At the same time, children's screen time has increased over the years and remains high,⁶ replacing face-to-face interactions that are critical for cognitive, language, and social development.⁷ And although parents may be spending proportionally more time with their children, they're also reporting higher instances of stress and burnout.⁸ Taken together, these societal shifts will continue to present headwinds for children to succeed in school and beyond.

What does it mean to be kindergarten ready?

Since kindergarten readiness is predictive of later academic success,⁹ it's important to consider what "readiness" means. What skills does a child who is "ready" for kindergarten have? The answer is complicated. There is no universal checklist used to determine whether a child is ready for school. Nonetheless, many experts do agree that school readiness extends beyond just a child's knowledge and abilities. Readiness may also encompass a child's approaches towards learning. Does the child exhibit curiosity and persistence? Being ready for kindergarten includes social skills, too. Does the child share toys when playing with classmates? How do they respond to setbacks? Frameworks for thinking about school readiness often focus on a handful of overarching domains, including a child's physical, social, language, and cognitive development, as well as their approaches to learning.¹⁰

Even with comprehensive frameworks, it's important to recognize readiness as a complex equation.^{11, 12} A child's skills, abilities, and attitudes are only some of the ingredients. In other words, the onus of readiness doesn't rest solely on young children! Schools must also be ready to welcome and support young learners with diverse needs. Families play a huge role in fostering readiness as well. **Readiness may be best thought of as an ecological outcome.** It is not solely a child characteristic but is rather a product of children's cumulative experiences and environments.

How may kindergarten readiness be connected to children's early experiences?

While readiness may be a complex equation, experts agree that the journey toward school preparedness starts years before a child's first day of kindergarten. The earliest years of life are the most critical for development, when the brain is highly flexible and adaptable.¹³ Although smaller than an adult's, a two year old's brain actually has 50% more synapses (the connections between neurons).¹⁴ Through everyday experiences, the developing brain finetunes these



connections, strengthening those that are used and pruning those that are not. This process helps the brain become more efficient. While human brain architecture may seem infinitely complex, our earliest experiences set the stage for future learning and behavior — and by extension, school readiness.

Quantifying the early language environment

A growing body of research has shown that an early and critical factor — the amount of language a young child experiences — may have a profound impact even years later. The idea gained traction in the mid-1990s, when researchers discovered a link between the quantity of words a toddler heard and key developmental outcomes, such as vocabulary growth and IQ.¹⁵

The potential expansion and application of this research inspired Terry and Judi Paul to found LENA (Language ENvironment Analysis). LENA's goal was to develop technology that automatically quantified details of children's naturalistic language environments. How many adult words do children typically hear? How many vocalizations do they themselves make? How many adult-child alternations do they experience?

The development of LENA's early talk technology has provided researchers with the unprecedented ability to gather information on children's language environments quickly and efficiently. Worn by children in specially designed clothing to optimize audio capture, the LENA device collects data on children's early language environment. Over the course of a typical "LENA Day," the system detects and counts child vocalizations and words from nearby adults. While the technology counts vocal activity, it does not analyze specific words or know what is being said. By the late 2000s, independent researchers had validated LENA technology's accuracy across multiple languages. Rather than relying on time-consuming human transcription, LENA has equipped researchers with hundreds of thousands of hours' worth of language environment data. This has fueled more than 250 scientific publications from around the world that have reported on the use of LENA technology. The insights gleaned from this data continue to shape our understanding of just how important language is in a child's first five years.

The power of conversational turns

One of the most significant discoveries from research using LENA technology has been the unique and predictive power of conversational turns. These back-and-forth exchanges between an adult and a child — LENA's proxy for "serve-and-return" interactions — have been

linked to brain structure¹⁶ and function,¹⁷ early literacy skills,¹⁸ and social development.¹⁹ Conversational turns have also been shown to predict later language outcomes and IQ scores, even beyond the effects of adult word exposure.²⁰ In essence, it's not just about how much adults speak *to* a child, but how much they talk *with* a child. The research is clear: Conversational turns play a crucial role in shaping children's development.

Conversational turns in preschool

Extensive social science research has confirmed that a child's preschool experiences play an important function in school readiness.^{21 22} Both participation in preschool and the quality of the program impact a child's academic and social preparedness.²³ The majority of children under the age of six have all available parents participating in the workforce; this means these adults cannot provide care for the entire week.²⁴ Millions of young children spend a substantial portion of their early years in child care and preschool settings. About half of three- and four-year-olds are enrolled in a formal preschool program,²⁵ where they typically spend an average of 35 to 40 hours per week.²⁶

Given that research has indicated both conversational turns and preschool participation are related to children's development outcomes, what about conversational turns *in* preschool? How might back-and-forth interactions between children and their preschool teachers be related to the child's development? A recent study from Purdue University connected these dots, collecting LENA data on 91 preschoolers.²⁷ After controlling for demographic differences, these researchers found that children who engaged in more conversational turns with their preschool teachers scored significantly higher on vocabulary assessments. This study advances our understanding of how preschool language environments shape a child's ability to succeed later in elementary school.

How does LENA Grow support children's conversational turns in the classroom?

LENA Grow, LENA's professional development program for early educators, is designed to increase the number of interactions between teachers and children in their care. The program follows a five-week cycle of measurement, quantitative feedback, reflective coaching, and practice.

During each "LENA Day," children wear the "talk pedometer" that gathers information on their classroom language environment. This data is automatically processed into easy-to-read feedback reports which highlight children's language experiences at both individual and classroom levels. With these reports,

teachers work alongside coaches to discuss [strategies](#) to increase conversational turns. After coaching sessions, teachers then put these strategies into action. They're able to measure their progress and hone their skills on subsequent "LENA Days."

To date, LENA Grow has been used with tens of thousands of children and educators.²⁸ Across different implementations, the program consistently leads to significant increases in conversational turns. The most substantial gains have been observed among children who initially had fewer interactions than their peers.²⁹

On average, these children experience a +40% increase in turns over the course of the program.

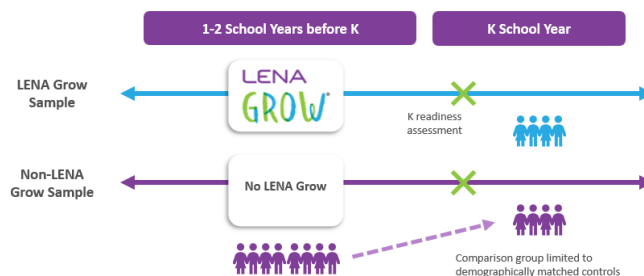
Moreover, children who began the program below the typical level for center-based care (15 turns per hour) also experienced a sizeable boost of +60%.

Does LENA Grow have an impact on children's school readiness?

LENA Grow has been shown to increase the number of conversational turns children experience in preschool classrooms, but does it also improve their school readiness? Recent quasi-experimental evaluations from three different LENA partners across the country—[Henderson County Schools](#) in Kentucky, [Cherokee County School District](#) in South Carolina, and [Porter-Leath](#) in Tennessee — have shed light on this very question. Even across three different kindergarten readiness assessments, the studies found that LENA Grow had a measurable impact on children's school readiness.

The evaluations for each implementation site followed a similar analytical process:

- 1. Identify LENA Grow Participants:** The group of children who participated in LENA Grow during their preschool years (one to two years before starting kindergarten) was identified.
- 2. Create a Matched Comparison Group:** Each school district also provided data on non-LENA Grow students. From this pool of non-LENA Grow children, a demographically matched subsample was randomly selected. This matching process balanced participants on gender, race/ethnicity, and socioeconomic status. Additionally, Cherokee County and Henderson County also matched participants based on their pre-K experience.
- 3. Analyze Kindergarten Readiness Outcomes:** The match groups were then compared on their kindergarten readiness assessment scores.



Using demographically matched samples is an important step in educational research because it reduces potential bias. The process ensures that observed differences in school readiness are due to LENA Grow participation rather than random demographic factors. While taking such steps is not as powerful as conducting a randomized controlled trial, a rigorous matching process can provide strong evidence of a causal relationship between LENA Grow participation and improved kindergarten readiness.

Did LENA Grow participants in Henderson County, Ky., enter kindergarten more prepared?

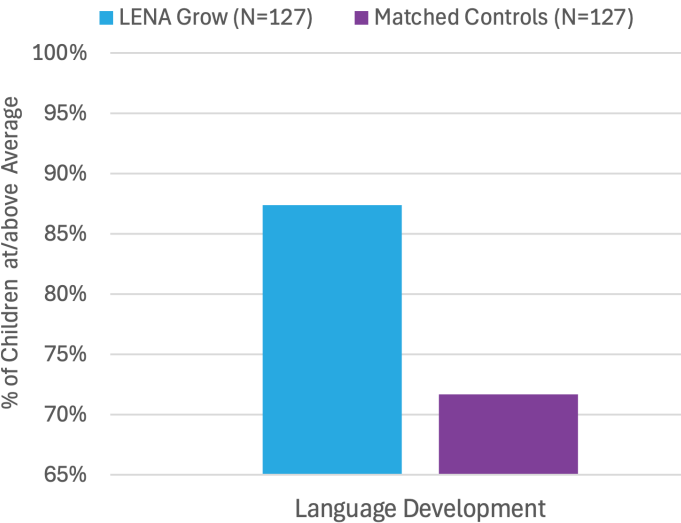
In Kentucky, Henderson County Schools first brought LENA Grow to their community in 2019. Since then, they've been implementing the program at their early learning center with three- and four-year-olds.

For their kindergarten readiness screener, Kentucky uses the BRIGANCE®.³⁰ Administered at the start of the kindergarten year, the BRIGANCE® measures children's readiness in five developmental domains. Cognitive, physical, and language development are assessed by children's kindergarten teachers through a series of structured tasks. Self-help and social-emotional development are assessed via parent or primary caregiver completed questionnaires. For each developmental domain, a child's resulting score categorizes them as below average, average, or above average. A child's performance in the cognitive, physical, and language domains is combined into a readiness composite score. This composite score categorizes kindergarteners as *ready with intervention*, *ready with enrichments*, or *ready without intervention or enrichments*.

This Henderson County kindergarten readiness evaluation zeroed in on children who participated in LENA Grow during the 2022-23 school year and who then began kindergarten during the 2023-24 school year. Ultimately, BRIGANCE® scores from 127 LENA Grow participants and 127 demographically matched non-LENA Grow controls were analyzed. In addition to gender, race/ethnicity, special education status, and free lunch

status, the matching process also considered children’s pre-kindergarten experiences — i.e., whether or not they participated in a child care program. Including this variable helps further reduce potential bias by ensuring that differences in outcomes are more likely attributable to LENA Grow participation rather than variations in child care enrollment. Full details on the LENA Grow sample’s demographic characteristics and matching process may be found in the appendix.

Based on their BRIGANCE® scores, 72% of children who did not participate in LENA Grow were at or above average with respect to their language skills, compared to 87% of LENA Grow participants. This 15-percentage point difference was statistically significant, demonstrating that LENA Grow participation had a measurable and positive impact on children’s school readiness. Further statistical analysis using binary logistic regression indicated that **children who participated in LENA Grow were 2.7 times more likely to score at or above average in language skills compared to their non-LENA peers.**



In terms of overall composite scores, the difference between LENA Grow children and control participants was less stark; 54% of controls were considered ready without any enrichments or interventions compared to 57% of LENA Grow participants. Still, the substantial and statistically significant results for the language domain speak to how a focus on conversational turns in preschool may yield improvements in school readiness even a year later.

Did LENA Grow participants in Cherokee County, S.C., enter kindergarten more prepared?

Like Henderson, Cherokee County School District in South Carolina implemented LENA Grow in its preschool classrooms to enhance teacher-child interactions. One



of the initial motivations to bring LENA programs to the county was to boost school readiness outcomes, as the school district tended to lag behind statewide averages.³¹ While LENA Grow classrooms at Cherokee County consistently demonstrated increases in conversational turns, the question remained: Would children who participated in the program enter kindergarten better prepared than their peers?

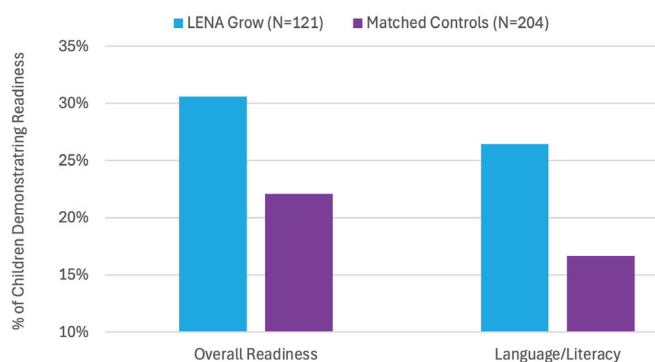
To assess school readiness, South Carolina uses the aptly named Kindergarten Readiness Assessment (KRA).³² Through a series of observations and direct tasks, kindergarten teachers assess children in their classrooms in four developmental domains — social foundations, language and literacy, mathematics, and physical well-being. Each domain is scored on a scale from 202 (low) to 298 (high). Scores from these four domains are used to calculate an overall average as well. In addition to numeric scores, children are categorized as “emerging readiness,” “approaching readiness,” or “demonstrating readiness” based on their performance.

For this evaluation, LENA Grow participants again were compared to a demographically matched control group of non-participants. A total of 121 LENA Grow participants were matched with 204 non-LENA children based on key demographic characteristics. See the appendix for a full list

of matching variables and frequency tables. Importantly, both groups attended pre-K programs at the district's elementary schools. Thus, children from both groups had similar early learning experiences — except that for LENA Grow participants teachers engaged in the program's structured coaching and feedback cycles designed to boost conversational turns. This similarity presents an ideal research scenario to isolate the impact of LENA Grow on school readiness outcomes.

The analysis indicated that children who participated in LENA Grow performed better on the KRA than control children. On average, in the language and literacy domain, LENA Grow participants scored 264.5 compared to 259.9 for controls — this difference of +4.6 points was statistically significant. Similarly, LENA Grow participants outperformed control children in overall readiness by +3.8 points, on average.

Beyond average scores, the percentage of children categorized as “demonstrating readiness” was also greater for LENA Grow participants. In the language and literacy domain, 26% of LENA Grow participants met this benchmark, compared to 17% of controls. For overall readiness, 31% of LENA Grow participants were considered ready for kindergarten, compared to 22% for their non-LENA peers. These differences were further validated through binary logistic regression analyses, which found that **LENA Grow participants were 1.8 times more likely to demonstrate readiness in language and literacy, and 1.6 times more likely to demonstrate readiness overall.**



Combined with the results from Henderson County, these findings add to an expanding body of evidence that LENA Grow's focus on increasing conversational turns in preschool classrooms can translate into measurable outcomes in school readiness. This data suggests that when children experience rich language environments in their preschool classrooms, they enter kindergarten with strong foundational language skills, putting them on the path to future academic success.

Did LENA Grow participants from Porter-Leath enter kindergarten more prepared?

Porter-Leath, a nonprofit Head Start grantee based in Memphis, Tenn., focuses on the building blocks of healthy child development by providing early childhood education programs, family support services, and other essential resources. Since 2019, the organization has implemented LENA Grow in early childhood classrooms across its network. Previous evaluations have shown that children in Porter-Leath's LENA Grow classrooms experienced accelerated language development and social skills over the course of a preschool year.³³ A separate analysis found that teachers who participated in LENA Grow were more likely to remain in their roles than early educators who did not go through the program.³⁴ While these two datapoints highlight meaningful child development and teacher retention outcomes, the question about LENA Grow's longitudinal impact remained. Does participation in Porter-Leath's LENA Grow program better prepare children for kindergarten?

To address this question, LENA's research team collaborated with Memphis-Shelby County Schools (MSCS), where the majority of Porter-Leath children begin their K-12 journeys. To align with the evaluations conducted in Henderson and Cherokee counties — where children participated in LENA Grow one to two years before kindergarten — this analysis zeroes in on Porter-Leath children who participated in the program at three years old or older.

MSCS assesses children's kindergarten readiness using the i-Ready® assessment. Typically, children take this adaptive assessment on tablets or computers with teacher support. i-Ready® evaluates children in two primary domains — English Language Arts (ELA) and Mathematics. Given the documented link between conversational turns and early reading development, this study concentrates on children's ELA performance. Based on their scores, i-Ready® classifies students as below grade level (i.e., emerging kindergarten) or as at/above grade level (i.e., early, mid, late kindergarten).

A total of 33 former Porter-Leath children who participated in LENA Grow within the one to two years before kindergarten were identified and successfully linked to MSCS i-Ready® scores. A demographically similar sample of 99 non-LENA Grow children were randomly selected as comparisons. See the appendix for demographic matching variables and resulting frequency tables.

Results revealed that a statistically significantly greater proportion of LENA Grow children were at kindergarten level or higher compared to their demographically matched peers — 33% vs. 17%. Binary logistic regression further reinforced this finding, showing that **LENA Grow participants were 2.4 times more likely than controls to demonstrate kindergarten readiness in ELA.** While it's a smaller sample than those of the other two school districts, the results in Memphis echo the same findings.

What can these results tell us about LENA Grow's impact on children's school readiness? What questions remain?

Child care programs across the country have embraced LENA Grow as a professional development tool to enhance conversational turns between early educators and children in their care. While most participating classrooms see an increase in conversational turns, evaluations spanning three districts across Kentucky, South Carolina, and Tennessee speak to how LENA Grow can also have measurable impacts on children's school readiness.

The evidence from these evaluations paints a compelling picture of LENA Grow's positive effect on student outcomes. Across the variety of measurement tools each district employed, children who participated in LENA Grow were statistically significantly more prepared than their demographically matched peers. Elevations were most often observed in domains related to language and early literacy skills — critical predictors of long-term academic success.

While the findings presented here are indeed promising, future research with access to additional datapoints could deepen our understanding of LENA Grow's effects. For example, these evaluations focus on children who experienced LENA Grow during preschool and pre-K. But what would the impact be for children exposed to the program even earlier, in their infant and toddler classrooms? Moreover, further investigation could reveal whether LENA Grow has differential impacts for particular demographic groups. For instance, could the program be especially beneficial for dual language learners, who are at an increased risk of entering kindergarten less prepared.^{35 36} If so, could LENA Grow be used as a tool to reduce or eliminate that risk? Finally, larger-scale analyses could further clarify the quantitative relationship between preschool conversational turns and school readiness outcomes. Do children who experience more conversational turns than their classmates start kindergarten more prepared? Is there a particular threshold of conversational turns students should experience to increase their likelihood of reaching readiness benchmarks?



Conclusions

The field of early childhood education is still expanding its understanding of how early talk environments — especially those in child care settings — shape school readiness. As noted, even defining “readiness” is not always straightforward. However, what is clear is the need to support and strengthen it, especially considering a recent uptick in delays. A solid foundation in kindergarten sets children up for continued learning. Disparities that exist early on may be more difficult to bridge later.

These three quasi-experimental evaluations provide strong evidence that LENA Grow, with its focus on boosting interactive talk between preschool teachers and their children, meaningfully improves school readiness, as measured by standardized assessments. **In all three studies, LENA Grow participants were statistically significantly more likely to demonstrate readiness than their non-LENA peers.**

The responsibility for school readiness should not rest solely on the shoulders of young children. Instead, it should be a shared effort — schools, communities, child care networks, and families must work together to set our youngest learners on the path towards success. Early educators should have access to tools and professional development programs that allow them to foster school readiness. LENA Grow is one such tool, as it continues to show promise in preparing children for later academic success.

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Appendices

Henderson 1. LENA Grow Participant Age during Pre-K LENA Sequence

Note: Child age presented in months and is based on the date of their first LENA Day

N	Mean	SD	Min	Max
127	58.0	4.2	51.2	66.4

Henderson 2. Analysis Sample Demographic Characteristics

		Control (N=127)		LENA Grow (N=127)	
		N	%	N	%
Gender	Male	64	50%	63	50%
	Female	63	50%	64	50%
Race/Eth	Unknown	0	0%	0	0%
	African American	12	9%	12	9%
	American Indian	1	1%	0	0%
	Asian	0	0%	0	0%
	Hispanic	7	6%	8	6%
	Multiracial	17	13%	18	14%
	White	90	71%	89	70%
IEP	No IEP	105	83%	105	83%
	Yes IEP	22	17%	22	17%
LEP	No Limited English Proficiency	123	97%	124	98%
	Yes Limited English Proficiency	4	3%	3	2%
Lunch Status	Paid Lunch	56	44%	38	30%
	Free/Reduced Lunch	71	56%	89	70%
Pre-K Setting	Pre-K Child Care Setting (state-funded program, Head Start, child-care program)	127	100%	127	100%
Elementary	A. B. Chandler	12	9%	12	9%
	Bend Gate	17	13%	17	13%
	Cairo	10	8%	10	8%
	East Heights	20	16%	19	15%
	Jefferson	18	14%	17	13%
	Niagara	14	11%	14	11%
	South Heights	12	9%	18	14%
	Spottsville	24	19%	20	16%

Henderson 3. Binary Logistic Regression Output, Predicting Language Development Readiness on LENA Grow Participation

Outcome: 0 = below average on language development; 1 = at or above average on language development

Variables	B	SE	Wald	df	Sig.	Odds Ratio
LENA Grow (0 = No, 1 = Yes)	1.01	0.332	9.243	1	0.002	2.745
Constant	0.927	0.197	22.183	1	0.000	2.528

Summary	Value	Sig
Model χ^2	9.878	0.002
Cox R2	0.038	
N	254	

Cherokee 1. LENA Grow Participant Age during Pre-K LENA Sequence

Note: Child age presented in months and is based on the date of their first LENA Day

N	Mean	SD	Min	Max
121	51.5	7.7	37.2	64.9

Cherokee 2. LENA Grow Analysis Sample Demographic Characteristics

		Control (N=204)		LENA Grow (N=121)	
		N	%	N	%
Gender	Female	101	50%	59	49%
	Male	103	50%	62	51%
Race/Eth	American Indian	0	0%	1	1%
	Asian	1	0%	1	1%
	Black	88	43%	53	44%
	Pacific Islander	0	0%	0	0%
	White	109	53%	62	51%
	Multiracial	6	3%	4	3%
Spec Ed	No Special Education	169	83%	104	86%
	Special Education	35	17%	17	14%
SES	Paid Lunch	45	22%	35	29%
	Free/Reduced Lunch	159	78%	86	71%
Pre-K Exp	Participation in CCSD Pre-K program	204	100%	121	100%
Age at time of KRA	<64 Months	65	32%	40	33%
	64-67 Months	73	36%	44	36%
	68+ Months	66	32%	37	31%

Cherokee 3. Independent Samples T-Test, Comparing Mean KRA Scaled Scores

	Control			LENA Grow			Comparison					
	N	Mean	SD	N	Mean	SD	Diff	Coh. d	t	df	Sig.	
Overall	204	261.2	12.8	121	265.0	11.5	3.8	0.31	2.663	323	0.008	**
Lang/Lit	204	259.9	12.9	121	264.5	12.1	4.7	0.37	3.214	323	0.001	**

Cherokee 4. Binary Logistic Regression Output Predicting Language-Literacy Readiness on LENA Grow Participation

Outcome: 0 = Not demonstrating readiness in language/literacy; 1 = demonstrating readiness in language/literacy

Variables	B	SE	Wald	df	Sig.	Odds Ratio
LENA Grow (0 = No, 1 = Yes)	0.587	0.279	4.423	1	0.035	1.798
Constant	-1.609	0.188	73.392	1	0.000	0.200

Summary	Value	Sig
Model χ^2	4.389	0.034
Cox R2	0.013	
N	325	

Cherokee 5. Binary Logistic Regression Output, Predicting Overall Readiness on LENA Grow Participation

Outcome: 0 = Not demonstrating overall readiness; 1 = demonstrating overall readiness

Variables	B	SE	Wald	df	Sig.	Odds Ratio
LENA Grow (0 = No, 1 = Yes)	0.442	0.26	2.901	1	0.089	1.556
Constant	-1.262	0.169	55.881	1	0.000	0.283

Summary	Value	Sig
Model χ^2	2.879	0.09
Cox R2	0.009	
N	325	

Porter-Leath 1. Analysis Sample Demographic Characteristics

		Control (N=99)		LENA Grow (N=33)	
		N	%	N	%
Gender	Female	63	64%	21	64%
	Male	36	36%	12	36%
Race	American Indian or Alaskan Native	0	0%	0	0%
	Asian	0	0%	0	0%
	Black or African American	99	100%	33	100%
	Native Hawaiian or Pacific Islander	0	0%	0	0%
	White	0	0%	0	0%
	Unknown	0	0%	0	0%
Ethnicity	Hispanic	0	0%	0	0%
	Non-Hispanic	99	100%	33	100%
ELL Status	English Language Learner	0	0%	0	0%
	Non-English Language Learner	99	100%	33	100%
SES	Economically Disadvantage Indicator	39	39%	13	39%
	No Economically Disadvantaged Indicator	60	61%	20	61%

Porter-Leath 2. Binary Logistic Regression Output, Predicting ELA Readiness on LENA Grow Participation

Outcome: 0 = below kindergarten level (i.e., emerging kindergarten) in ELA; 1 = at or above kindergarten level (i.e., early, mid, late kindergarten) in ELA

Variables	B	SE	Wald	df	Sig.	Odds Ratio
LENA Grow (0 = No, 1 = Yes)	0.88	0.455	3.737	1	0.053	2.412
Constant	-1.574	0.266	34.863	1	0.000	0.207

Summary	Value	Sig
Model χ^2	3.61	0.057
Cox R2	0.027	
N	132	

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- Memphis-area collaborators: Urban Child Institute, Seeding Success, Porter-Leath, and Memphis Shelby County Schools

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