

Nature-Based Early Learning and Preschoolers' Receptive and Expressive Vocabulary:
An Exploratory Study

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Abstract

This study examined how nature-based practices affect preschoolers' receptive and expressive vocabulary. The Peabody Picture Vocabulary Test and the Expressive Vocabulary Test were administered to 134 children from 11 preschool classes at the beginning and end of the 2022-2023 preschool year. Results suggest that nature-based practices that are integrated into preschool programs support significant vocabulary growth, but that effectiveness varies by public versus private setting and children's socioeconomic status. This study adds to the literature surrounding effective practices for supporting vocabulary development. It also adds to the growing body of research that incorporates the impact of nature play on children's overall development and school readiness.

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Chapter 1

Introduction

Background

Children can benefit from attending nature-based schools in a variety of ways, including confidence, social skills, motivation and concentration, physical skills, knowledge, and language and communication (O'Brien & Murray, 2007). While parental education level and family socioeconomic status are associated with children's language and cognitive development in the early years, recent research additionally suggests that the early learning environment, quality of staff interactions and conversation support, and teachers' emotional support are also associated with the vocabulary development of young children (Hansen and Broeckhunzen, 2021; Hu et al., 2020). It is also generally acknowledged that early communication and language skills are acquired most easily when learning opportunities are interest-based or have interest-based elements (e.g., Pruden et al, 2006). Yang et al. (2021) suggest that high-quality teacher-child interactions in early learning environments are a key influence on children's early language and cognitive development.

The hypothesis for the study at hand was that nature-based approaches in preschool provide interest-based elements and development-instigating settings that have the potential to strengthen children's vocabulary. It was suspected that nature-based approaches (play-based approaches, experiential learning in an outdoor setting, emergent curriculum, and child-directed philosophy) are conducive to high-quality teacher-child interactions and strengthening children's language development. This study investigated this hypothesis, toward exploring how nature-based approaches in preschool settings might support children's vocabulary development, both within and across socioeconomic strata. The study focused on vocabulary development, as the

preschool years are a critical window for this, and early vocabulary development has a significant influence on children's academic performance over their lifespan. Children's vocabulary skills are often measured in terms of comprehension of words (receptive vocabulary) and production of words (expressive vocabulary), which are associated with word knowledge, knowledge of word order, grammatical rules, conceptual knowledge, and later reading ability (Hadley and Dickinson, 2020). Thus, receptive, and expressive vocabulary were the outcomes studied.

This study was situated in an urban public preschool program in the upper Midwest region of the U.S. This preschool program has efforts underway to become more nature-based, and thus, preschool classes within the overarching program are at varying stages of implementing nature-based practices and settings. Thus, there was the opportunity to study relationships among the nature-ness of a program, socioeconomic status (SES), and vocabulary. The main interest of this study was to explore the potential for nature-based early learning to strengthen vocabulary and ultimately explore if nature-based early learning can reduce existing educational opportunity and achievement gaps between children from different economic backgrounds.

Purpose Statement

The purpose of the study was to investigate the impact of nature-based approaches on preschoolers' receptive and expressive vocabulary. The study was quantitative in nature and seeks to contribute to an understanding of strategies or interventions that strengthen vocabulary development in young children. Considering the relationship between vocabulary development and SES documented in the literature, the potential for nature-based practices in preschool to support vocabulary development for children of lower SES backgrounds was also explored.

Research Questions

Specifically, this study sought to answer the following research questions:

1. Which preschool approaches (nature, blended, or non-nature) support significant receptive and expressive vocabulary growth, when accounting for age and gender?
2. Does the effectiveness of the preschool approach (nature, blended, or non-nature) on receptive and expressive vocabulary growth vary by preschool type (public or private) and/or SES? More specifically, which approaches support significant vocabulary growth in children of lower SES?

Definition of Terms

Nature-based early learning

Nature-based early learning involves multiple aspects of child development, environmental stewardship, and academic achievement (Jordan and Chawla, 2019). Stated simply, it is an educational approach that uses the natural environment as support for learning (Chawla, 2015). Nature-based early learning creates an environment where children between the ages of three to five have extensive outdoor time while developing a connection with the natural world (Larimore, 2021). Nature-based practices follow a curriculum that emerges from children's interests and provides opportunities for learning in, about, and with nature (Warden, 2015).

Receptive vocabulary

Receptive vocabulary is the understanding or comprehension of words spoken or written and is a way to measure how someone can communicate effectively (Yang et al., 2021). For this

study, receptive vocabulary was measured using the Peabody Picture Vocabulary Test Fifth Edition (Dunn, 2019). The Peabody Picture Vocabulary Test is an existing research instrument for use in educational settings with young children (Dunn, 2019).

Expressive vocabulary

Expressive vocabulary is the production of spoken and written words that measure what a person may need, think, or want. (Yang et al., 2021). For this study, expressive vocabulary will be measured using the Expressive Vocabulary Test Third Edition (Williams, 2019). The Expressive Vocabulary Test was an existing research instrument for use in educational settings with young children (Williams, 2019).

Significance

Preschool years are a critical window for language development, and early vocabulary development has a significant influence on the child's academic performance over the life span. Recognizing how vital it is to begin early vocabulary development for young children of low SES can further prevent the vocabulary gap from widening over time (Beck & McKeown, 2007). As nature experiences are a vital part of a child's development (O'Brien & Murray, 2007), it is meaningful to explore how nature-based approaches in preschool settings might support children's vocabulary development, both within and across socioeconomic strata, toward helping move nature-based early learning from pockets of early learning settings into the mainstream provision of early learning and care. This study offers guidance toward encouraging and informing policymaking, teaching practices that reflect the importance of language and vocabulary development for young children, and recognition among practitioners as to the affordances of nature play for supporting children's overall development.

Chapter 2

Review of Literature

Oral Language Development in Early Childhood

Early childhood is a time of rapid brain development that shapes a child's growing capacities for learning. Early brain development is shaped by continuous, bidirectional interactions between human biology in addition to social and educational environments. These interactions are strongly influenced by the quality of the early learning and care environments that families and societies provide. Over time, these environments influence the developmental, educational, biological, and health outcomes that progressively characterize individual lives (Allen & Kelly, 2015).

Language skills progress developmentally over time as children increase their vocabulary, average sentence length, complexity of sentence structure and grammar, and the ability to express new ideas through words (Kipping et al., 2012). Five features of language work independently and also interact during children's progressive language development: phonology (speech sounds of language), semantics (meanings of words), morphology (meaningful parts of words and word tenses), syntax (rules for combining and ordering words into phrases), and pragmatics (use of language in context) (Catts and Kamhi, 1999). The features of phonology, semantics, and morphology are of particular relevance to the development of children's listening and speaking vocabulary and are highly influenced by the interactions and social bonds between adults and children (Allen & Kelly, 2015). During infancy, caregivers' facial and body language as well as words spoken are stimulating and affecting language comprehension. Infants can recognize positive and negative interactions through these spoken words and facial and body language. As babies progress toward toddlerhood, they link objects and their attributes to words.

Young children aged two through age four typically experience dramatic growth in their understanding of the meanings of words, their interrelationships, and grammatical forms (Scarborough, 2001).

Children's language development is part of the ongoing process of making sense of the world around them. Children grow in the knowledge of words and the relationships among words through conversations with others, books and storytelling, and experiences with the everyday world around them. Piaget's (1976) theory of language development suggests that children have a way of thinking that is very different compared to adults. Children's language develops through the processes of assimilation (making a new idea or experience to fit the existing environment or concepts) and accommodation (modifying the usual way of thinking to take on new information) (Beloglovsky & Daly, 2015). Similarly, Karmiloff and Karmiloff-Smith (2001) suggest children build webs among words with related semantics that lead to broader generalizations among classes of similar words. As new words arise, these words are linked to existing webs to further expand the store of words children understand through receptive and expressive language and use in their conversation. Finally, Beck & McKeown (2007) similarly find that children as young as kindergarten and first grade can add sophisticated words to their vocabulary. The earlier that the meanings of words are learned, the more likely they are to be accessed later in life (Beck & McKeown, 2007).

Influences on Oral Language and Vocabulary Development in Early Childhood

There are a lot of research-based strategies for supporting the development of oral language and vocabulary in early childhood. While vocabulary can develop through direct instruction (Coyne, McCoach & Kapp, 2007) and even through picking up words through everyday experiences (Hadley & Dickinson, 2020), one of the strongest evidence-based

strategies for supporting oral language development is interactive storybook reading between children and their caregivers (O'Connor, 2014). These interactions prompt vocabulary development through opportunities for children to hear new words, but also through stimulating conversation outside the immediate context, extending beyond the words being read to book-centered conversations that involve decontextualized language (language removed from the here and now). The quality of adult readers' interactions with children appears to be especially important to children's vocabulary growth, even more so than the frequency of reading, with effects lasting through the end of first grade (Zucker et al., 2013). Another effective strategy that can be used across interactive storybook reading, directed instruction, and informal everyday experiences and interactions is scaffolding. When questions are scaffolded or moved from low-demand questions to high-demand questions; this was found to promote greater gains in learning words (Blewitt et al., 2009).

The quality of the care environment is another influence on oral language development. Research by McCartney (1984) demonstrated the importance of quality verbal interactions with caregivers as a determinant of children's language skills (McCartney, 1984). Hansen and Broekhuizen (2020) also found that a responsive and rich language environment, including extended talk and facilitating conversations, predicted vocabulary growth, similarly confirming the importance of social support for early language development. Vygotsky (1978) recognizes that with the idea of cognitive development and learning, there is an importance of social and cultural interactions involved. (Beloglovsky and Daly, 2015). Children can obtain new information through culture and daily interactions, while also being able to put the new knowledge to use and develop a means to their thinking (Beloglovsky and Daly, 2015). Cummin's (1981) theory of context-embedded language incorporates the student's access to their

visual and oral cues, for a deeper language learning opportunity (i.e. a student looking at pictures of an apple, while the teacher is talking about eating a snack soon, they can ask questions for further understanding of the concept).

In addition to quality early learning and care environments, another key factor associated with vocabulary development is children's home environment and demographic background. In a widely publicized study, Hart and Risley (1995) claimed that low SES children hear 30 million fewer words than their middle-class counterparts during the early years of life, or in other words a significant word gap. Sperry et al. (2018), however, suggest that looking at income alone disregards real questions about gaps between different ethnicities that stem from political and power differences between the language dialects that are spoken v. those spoken at school; to highlight a word gap undervalues speech activities in diverse families. Other researchers have emphasized that the research on language gaps in the early years can miss more fundamental takeaways about the deeper racial and economic inequities affecting a child's life living in poverty, referencing a body of research building since the 1960s that shows that a family's socioeconomic status and parental education levels heavily shape children's learning (Coleman et al., 1966; Beck & McKeown, 2007, Lucas, 2016).

Golinkoff et. al (2018), however, suggests that denying the language gap can be harmful to children who already have to cope with the effects of poverty. As language development and literacy skills are intertwined, language development is the basis for reading and school success (Golinkoff et al, 2018). Gaps in children's language abilities in kindergarten account for the majority of the achievement gap between children from families of high and low socioeconomic status (Durham et al., 2007). Golinkoff et al. (2018) suggest that the main takeaway from the word gap study is not about how many words are heard or not heard, but instead that children

need more opportunities to participate in conversations that focus on their interests during everyday interactions with caregivers. This is particularly important, because Golinkoff et al. (2018) argue, that the language addressed to children influences not only their language development, but their social-emotional development and other important developmental skills like acquiring information about the world, self-regulation, and executive function. In a Brazilian study, there was evidence that showed a relationship between SES and the development of language in children and recommended different interventions that should be implemented to reduce differences in development that are produced by social inequality (Santos et al., 2021).

Research by Sylva et al. (2004) highlights the influence of the quality of the home learning environment on children's cognitive and social development, suggesting it is more influential than parental occupation, education, or income. Home environments that included activities such as reading, singing, nursery rhymes, painting and drawing, playing with letters and numbers, visiting the library, and creating regular opportunities for them to play with their friends at home, were all associated with cognitive and social development (Sylva et al., 2004). Researchers have shown that the home learning environment and the language-learning environment at school are more powerful predictors of vocabulary development than children's socioeconomic status (Dickinson, 2011).

Vygotsky's (1978) Sociocultural Learning Theory further underscores the importance of a quality early learning and care environment. Vygotsky (1978) argued that the gap between children's current development and their potential development can be closed through support from a knowledgeable and responsive adult. The presence of and interaction with an adult mentor partially explained developmental differences in young children (Pathan et al., 2018). This is advanced by Krashen's (1982) language acquisition theories and the idea of

comprehensible input or that language is a step higher than the child's current language development ($i+1$). The quality of the interactions between children and staff was particularly important. Children made more progress developmentally when staff showed warmth and were responsive to their individual needs (Sylva, 2004). Teacher language also has been shown to play a pivotal role in supporting learning (Larimore, 2021). Research from Yang et al. (2021) similarly suggests the highly influential nature of high-quality teacher-child interactions in early learning environments on children's early language and cognitive development. Their study found a significant correlation between the quality of teacher-child interactions and the receptive vocabulary development of children between 3 and 6 years of age (Yang et al., 2021).

Justice (2004) defined a language-rich classroom environment as "one in which children are exposed deliberately and recurrently to high-quality verbal input among peers and adults and in which adult-child verbal interactions are characterized by high levels of adult responsiveness" (p.37). Language-rich classroom environments emphasize children's acquisition of language through their interactions with both peers and adults (Justice, 2004). Students' language skills are directly related to their overall success, underscoring the importance of language-rich settings in the classroom (Stehle et al., 2022).

Nature-Based Early Learning and Oral Language Development

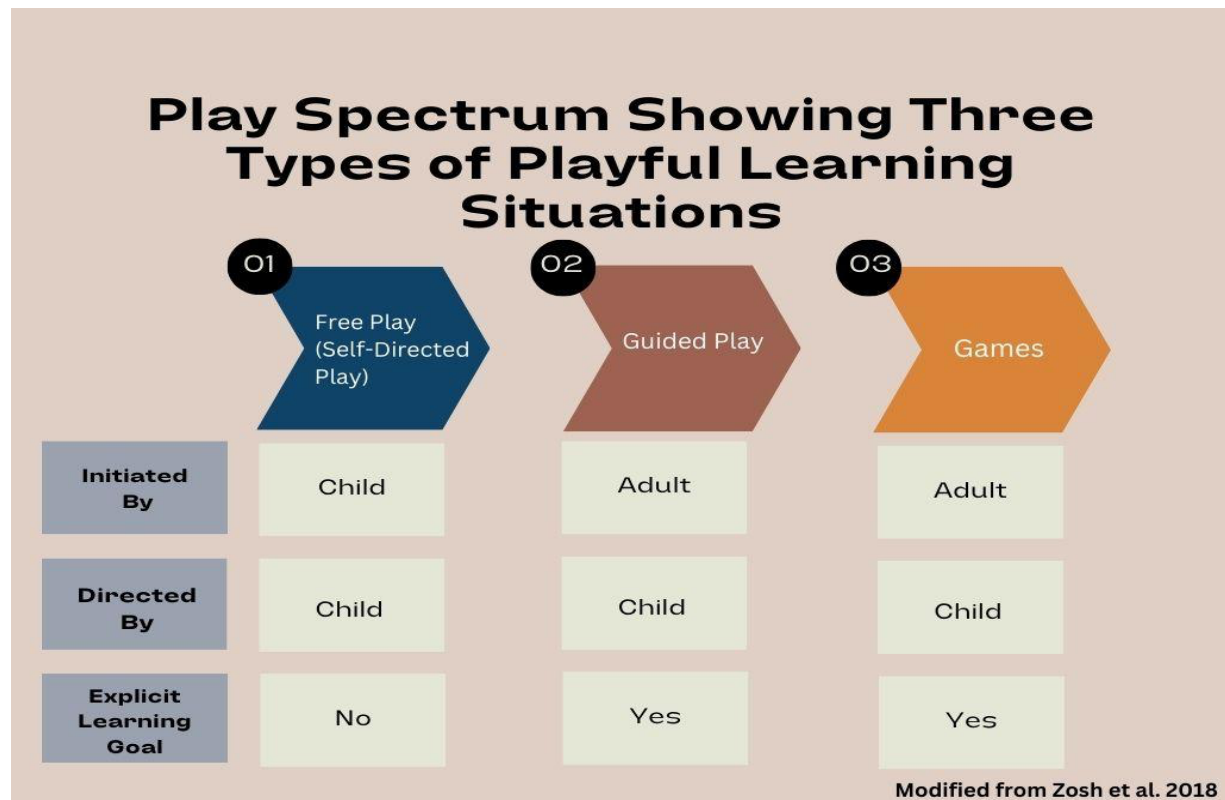
Nature-based early learning has become a popular alternative to the traditional classroom approach to early education. Nature-based early learning is an educational approach that engages children ages 3-5 before starting kindergarten (Jordan & Chawla, 2019). Nature-based early learning occurs with a variety of guidance and structure in urban, suburban, rural, and wilderness settings while encompassing different learning opportunities such as academic achievement and personal development. Beyond benefits to children's health and wellbeing (Bowler et al., 2010),

access to green space is also associated with improved cognitive and social-emotional development of children. McCormick (2017) suggests that experiences in nature promoted attention restoration, memory, competence, supportive social groups, self-discipline, and stress reduction and were even associated with higher standardized test scores.

Findings from Richardson & Murray (2017) suggest that children ages 4-5 had richer speech quality and diversity of vocabulary in a natural environment compared to the indoor and outdoor classrooms that had similar outcomes. When learning is child-led in a natural environment, the quality of utterances is more noticeable compared to indoor and outdoor classrooms where learning is more adult-led (Richardson & Murray, 2017). Outside offers children an opportunity to put their language skills to the test by using and applying words in context (Bilton, 2010). For example, if two children were pretending to play and a child said ‘I want to be a chef’ to their multilingual friend, they could guide them to the mud kitchen to get kitchenware. The friend is not only able to hear the language in a specific context but doesn’t necessarily have to speak to know what is going on in the play scenario with their friend (Bilton, 2010).

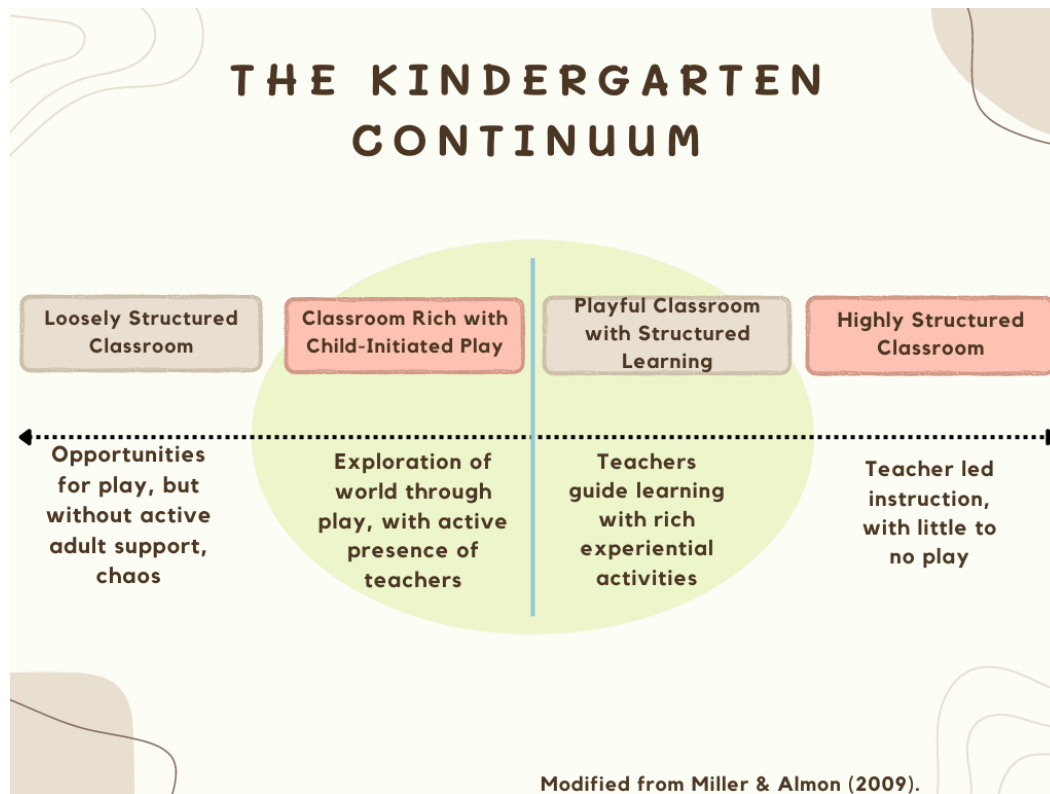
Playful learning is another essential characteristic surrounding nature-based early learning. The idea of playful learning is when a child has the opportunity to have free play (directed by the child) and/or guided play (directed by the teacher through hands-on engagement) (The Power of Playful Learning in the Early Childhood Setting, n.d.). Figure 1 represents a spectrum of play, and the different situations play can be adapted. Thinking about play as a spectrum helps put the idea into perspective and look at it as a lens through which children can flourish, create a sense of agency, and realize that the play itself can look very different depending on its form and scenario (Zosh et al., 2018).

Figure 1. *Spectrum of Playful Learning Situations*



Another example that offers different perspectives of play would be the Kindergarten Continuum (Miller & Almon, 2009). There's a balance of teacher and child learning activities, a time reserved in the schedule for uninterrupted play and opportunities in the daily routine that focus on self-regulation, literacy and mathematics, and problem solving. Figure 2 shows these different play elements in the classroom where best practices find a spot somewhere in the middle (Miller & Almon, 2009).

Figure 2. *Kindergarten Continuum*



The importance of the quality-of-care environment on children’s oral language development is also highlighted by a recent study on the effects of a statewide pre-kindergarten program on children (Durkin et al., 2022). The Durkin et al (2022) study included 2,990 low-income children in Tennessee who applied to a free, public prekindergarten program; those who attended had lower achievement levels than their peers later on in middle school. In a 2022 NPR interview, Dale Farran, an early childhood education suggests that for three- and four-year-olds, a rigorous school is not the solution, play-based approaches may be more effective than academic programs (Kamenetz, 2022 NPR). The biggest lesson Farran concluded from her research is that we’ve simply asked too much of pre-K:

“Whoever thought that you could provide a 4-year-old from an impoverished family with 5 1/2 hours a day, nine months a year of preschool, and close the achievement gap, and send them to college at a higher rate?” she asks. “I mean, why? Why do we put so much pressure on our pre-K programs? We might actually get better results, from simply letting little children play” (Kamenetz, 2022 NPR).

Schools have to recognize that access to play is not equitable for all children and research from Souto-Manning (2017) discusses this topic in more detail, “Although play has traditionally been positioned as a privilege, it must be (re)positioned as a right, as outlined by the United Nations Convention on the Rights of the Child, Article 31” (785). Offering a variety of options to lower-income families could potentially be a lean in the right direction. For example, Head Start programs that offer voluntary prekindergarten and school readiness plus, use play-based learning and program planning that centers on the family to meet the needs of every child (Voluntary Prekindergarten and School Readiness Plus, n.d.).

Many research studies support how children’s language skills improve with an introduction of play; there is evidence that play can promote language development (Sawyer & DeZutter, 2007), support pre-reading skills (Bergen & Mauer, 2000), and instill forms of intermediate language (Johnson et al., 2004). There is a high emphasis on supporting preschoolers’ vocabulary development and literature that expands on vocabulary interventions for children (McLeod et al., 2017). Guidance and research are fairly limited on what is available as far as play-based interventions go within the preschool classroom and the main options right now are adding different play components to create richer instruction for reading books in the classroom as a source of vocabulary development (McLeod et al., 2017). Nature-based learning is more than play-based but still follows a curriculum from children’s interests and provides opportunities for learning in, about, and with nature (Warden, 2015). Prins et al. (2023) conducted a study with children ages 4-7 at three different Dutch schools, findings indicated that complex language was used more often while playing in the nature-based playground. The

results of this study revealed that conversations tended to be more abundant at the nature-based playgrounds versus the non-nature-based playgrounds, with an opportunity for richer language development and scaffolding (Prins et al., 2023).

Theoretical Grounding for Nature-Based Early Learning's Impact on Oral Language and Vocabulary Development

In addition to reviewing studies that suggest a link between nature-based early learning and oral language development, it is useful to consider theoretical explanations for this link. One possible explanation is research suggesting children engage in more explorative play and creative activities when in natural spaces (O'Brien & Murray, 2007), which in turn may foster language development and social interaction skills (Moore & Wong, 1997). Another possible explanation relates to the affordance theory, that suggests that children's perception of the environment can affect what actions are taken (Waller et al., 2017). Heft (1988) suggests that children may perceive an environment differently that is more meaningful to them. An adult might enter an area and note what is there, a tree or a mud puddle, while a child may enter an area and note what might be done, climbing the tree or an area to splash. Heft (1988) describes affordances as the "functionally significant properties considered in relation to an individual" (p. 29). There are multiple ways that the learner can receive different experiences from the learning environment that then allows language to evolve (Nguyen, 2022).

According to the Social Constructivist theory (Sivan, 1986), learning is an active process involving interactions with one's environment and with others. Nature-based learning settings seem abundant with opportunities for children to make meaning from their direct experiences through interactions with others. Sivan (1986) indicated that learning involves sensory input to construct meaning and learners need to engage in the world, so they are actively involved in their learning and development. Access to nature fosters social interactions and supports the

development of social relationships (Ernst, Juckett, & Sobel, 2021). Multiple studies suggest that green spaces can draw people together in ways that lead to social interactions, friendships, and social ties (e.g., Kuo et al., 1988; Coley et al., 1997; Fabor Taylor et al., 1998; Sullivan et al., 2004). Studies have investigated the relationship between nature and play, looking at whether it improves children's social interactions by developing language, communication abilities, and positive relationships (Pyle, 2002).

Neuroscience and what is known about the learning that happens through play also offer insight into the possible link between early learning in nature and oral language development. Liu et al. (2017) suggest positive caregiver-child interactions help build the neural foundations for developing healthy social-emotional regulation. Social interaction activates brain networks related to recognizing the mental states of others, which can be critical for teaching and learning overall. Liu et al. (2017) further indicate that when children interact with peers, important developmental skills form such as language acquisition, cooperation, and social learning. As expressed, children who engage in more explorative play and creative activities when in natural spaces (O'Brien & Murray, 2007), may develop richer language and higher social skills with their peers (Moore & Wong, 1997).

Overall, preschool years are integral to language development. Early vocabulary development has a significant influence on the child's academic performance over the life span. As nature experiences are a vital part of a child's development (O'Brien & Murray, 2007), it is meaningful to explore how nature-based approaches in preschool settings might support children's vocabulary development, both within and across socioeconomic strata, toward helping move nature-based early learning from pockets of early learning settings into the mainstream provision of early learning and care.

Chapter 3

Methodology

Introduction

The purpose of the study was to investigate the impact of nature-based approaches on preschoolers' receptive and expressive vocabulary. To contribute to an understanding of strategies or interventions that strengthen vocabulary development in young children, the study sought to answer the following research questions:

1. Which preschool approaches (nature, blended, or non-nature) support significant receptive and expressive vocabulary growth, when accounting for age and gender?)
2. Does the effectiveness of the preschool approach (nature, blended, or non-nature) on receptive and expressive vocabulary growth vary by preschool type (public or private) and/or SES, and more specifically, which approaches support significant vocabulary growth in children of lower SES?

Participants

There were a total of 134 children, ages 3- 5 years old, across the 11 preschool sites who had parental/guardian consent to participate in the study (see Table 1). These preschool programs were located in the upper Midwest region of the U.S. and the study participants attended the preschool in all-day, five-day/week classes. Members of this metropolitan area community are 89% White, with the remaining percentages relatively evenly distributed across Black, Hispanic or Latinx, Asian, and American Indian or Alaskan Native. Fifty-four percent of participants were female, and the average age was 53 months.

Seven classes (across six school locations) in an urban public preschool program, two private nature preschools, and two private non-nature preschools participated in the study. (see

Table 1). Of the 11 participating classes, four classes were private preschools, and seven were public preschool classes from the same school district. The district's public preschool integrates federal Head Start programming with state-level school readiness, voluntary prekindergarten, and special education programming. Thus, within these seven public preschool classes, some children attend at no cost to families through state or federal funding, and others attend through income-based tuition. Fifty-eight percent of the 134 participants from across the 11 classes were of lower SES using federal/state early learning eligibility guidelines for free or reduced tuition as a proxy indicator of SES (see Berzofsky et al., 2014, regarding the use of income as a single proxy indicator of SES). While there was some within-classroom SES variation, much of the SES variation was across-classroom variation. See Table 1 for a summary of programs and participants, including the number of participants and participant demographics.

Study participation occurred over the 2022-2023 preschool year. Permission for preschool site-level participation was granted by the school district's early childhood program director for the seven public preschool sites and by the lead teacher/director for the other four privately operated sites. Potential participants were recruited through an invitation letter/consent form that was provided to parents and/or guardians through the typical communication channels for each of the participating preschool sites (see Appendix A).

Table 1. Summary of Preschool and Study Participant Data

Approach ^a	Program	Program's Degree of "Nature-ness" ^b	Type	# of Study Participants	Study Participants' Average Age (mos.) ^c	% of Study Participants Female	% of Study Participants' Lower SES ^d
Less Nature	a	18	Public	12	53	75	100
	b	23	Public	14	54	50	100
	c	24	Public	11	56	63	100
	d	25	Private	13	54	76	0
	Subtotal	-	-	50	54	66	100
Blended	e	30	Public	16	54	44	56
	f	32	Public	14	52	50	100
	g	33	Public	6	52	83	67
	h	33	Private	13	49	46	0
	i	33	Private	11	51	37	9
	Subtotal	-	-	60	52	47	47
Nature	j	35	Public	12	54	25	100
	k	37	Private	12	51	58	0
	Subtotal	-	-	24	53	42	50
Total				134	53	54	58

^aLess nature category of preschools indicates less integration of nature-based approaches and lower "nature-ness" scores relative to the other programs; Blended indicates more integration of nature-based approaches and middle-level scores relative to the other programs; Nature indicates the most integration of nature-based approaches and higher scores relative to the other programs.

^bScore on Nature-ness Rubric, ranging from 13 to 39, with higher scores indicating higher levels/more nature-based settings, practices, etc.

^cAge in months at time of the pretest.

^dLower SES are participants who are income-eligible for free or reduced preschool tuition based on state and federal guidelines that are dependent on household size and income and based on U.S. poverty guidelines.

Design

To investigate the influence of nature-based practices on children's receptive and expressive vocabulary, a quasi-experimental design (pretest-posttest nonequivalent comparison group) was used for this study (Creswell and Creswell, 2018). This design was necessitated as the groups are intact, with parents choosing the preschool site for their children; thus, the treatment and comparison groups couldn't be randomly assigned. This quasi-experimental design was appropriate for the exploratory nature of the proposed research and is commonly used in

educational settings where the researcher cannot influence the assignment of participants to treatment and comparison groups (Creswell and Creswell, 2018). The dependent variables were receptive and expressive vocabulary, as measured by the Peabody Picture Vocabulary Test, Fifth Edition (Dunn, 2019) and the Expressive Vocabulary Test, Third Edition (Williams, 2019), with two observations (one at the beginning of the preschool year, and one at the end of the preschool year). The independent variables were preschool approach (less nature, blended, or nature), preschool type (public or private), and SES.

Regarding the independent variable preschool type, the 11 participating preschool classes varied in terms of their degree of nature-ness (use of nature-based practices and settings). For the study at hand, programs were assigned to one of three groups (Less Nature, Blended, and Nature) differing by their incorporation of nature-based practices used relative to each other. Assignment of programs to these three groups was accomplished by asking teachers to complete the Preschool “Nature-ness” Categorization Rubric (see Table 2; based on Ernst et al., 2021 and Ernst et al., 2022).

The rubric has 13 items covering curriculum/instructional practices, nature-related curriculum instruction practices, teacher roles, and indoor/outdoor environments. For each item, teachers select which of the three responses (cells in the row) best describes their class/instruction. The responses for each item are scored on a three-point scale. Responses in the column on the right were scored one point and reflected less incorporation of nature-based practices. Responses in the middle column were scored two points, and responses in the left column were scored three points, reflecting higher/greater incorporation of nature-based practices. The responses across the 13 items are scored and totaled. Higher total points indicate greater incorporation of nature-based practices, with the highest score on this rubric being 39 and the lowest being 13.

This rubric can be used to describe how these three groups (Nature, Blended, and Less Nature) differed, with the cells in the column on the right characterizing programs that have less incorporation of nature-based practices, the middle column generally descriptive of Blended programs, and the column on the left characteristic of Nature programs). Programs categorized as Nature have a focus on both environmental outcomes (such as respect for nature) and Kindergarten preparation that emphasizes areas such as developing curiosity, love of learning, problem-solving, and independence, as well as other social-emotional outcomes. The programs categorized as Blended tend to be more focused on kindergarten readiness and early academics than Nature programs yet have more incorporation of unstructured nature play than Less Nature programs. Programs categorized as Less Nature tend to be heavily focused on early academics and Kindergarten readiness. Also, more of the day tends to be teacher-directed rather than child-directed.

Table 2. Preschool “Nature-ness” Categorization Rubric

Adapted from Ernst et al., 2021 and Ernst et al., 2022. Rubric in Ernst et al. (2021) builds upon the work of Bailie (2016) and Larimore et al. (2019).

Teacher Name or Code: _____

For each row, please circle one cell that best describes what the students in <i>your</i> preschool classroom/section experienced this year (your classroom/approaches over this school year, even if it is different from another classroom section in your program).			
1. Instructional Focus	Both environmental outcomes (nature connection, respect for nature) and Kindergarten preparation (developing curiosity, love of learning, problem-solving, independence, as well as other social-emotional outcomes)	Both environmental outcomes (nature connection, respect for nature) and Kindergarten preparation (early literacy and math, positive behaviors, and other social-emotional outcomes)	Kindergarten preparation, including developing early literacy and math skills and fostering positive in-classroom behaviors, as well as other social-emotional outcomes
2. Social and Emotional Learning Outcomes	Accomplished primarily through nature play and/or playful, guided outdoor learning, as well as teacher-guided negotiations.	Accomplished through a combination of developmentally appropriate direct instruction, curriculum materials, indoor play, outdoor play, and outdoor play in nature	Accomplished through developmentally appropriate direct instruction and curriculum materials, as well as through play (primarily indoors)
3. Proportion of day child v. teacher directed	More of the day is child-directed than teacher-directed	Relatively equal use of teacher-directed activities and child-directed activity	More of the day is teacher-directed than child-directed
4. Classroom management approach	Emphasizes developing empathy and community	Involves a combination of classroom expectations, classroom rules, and developing empathy and community	Oriented toward behavioral expectations and classroom rules
5. Use of nature play	Substantial focus on child-directed nature play	Some child-directed nature play encouraged	A small amount of child-directed nature play encouraged
6. Use of outdoor learning	Some teacher-guided nature learning outdoors (with a greater emphasis on child-directed playful learning when outdoors)	Some teacher-guided learning outdoors	Small amount of teacher-guided learning outdoors
7. Impromptu nature learning	Frequently, based on what’s found outdoors/in nature (including weather-related)	Some, based on what’s found outdoors/in nature (including weather-related)	Infrequent impromptu nature learning
8. Role of teacher during outdoor playtime	Primarily observes play toward understanding children’s interests and interactions, using this information to guide and enrich future outdoor learning and play.	A range of things, from actively guiding play or joining into play, to providing ideas for play, to observing children play toward maintaining safety and appropriate child behavior and interactions	Primarily observes and/or actively guides play, toward maintaining safety and appropriate child behavior and interactions
9. Indoor time	Time in the indoor classroom is primarily child-driven. The teacher sets up the indoor classroom with open-ended activities for children to choose from	Inside, teachers lead small and/or large group activities along with providing time for child-directed play	Inside, teachers structure, organize, and often lead activities for children. There is an emphasis on teacher-designed activities for children.
10. Respect	Emphasis on respect for nature and others (equal emphasis)	Emphasis on respect for nature and others, with slightly more emphasis on respect for others	Emphasis on respect for others (and a respect for nature as secondary or not emphasized)
11. Conflict resolution	Teachers allow children to work out conflicts on their own as much as possible.	Teachers balance child and teacher negotiation strategies to resolve conflicts.	Teachers provide guided negotiation when conflicts arise.
12. Indoor classroom	Includes substantial nature content in wall displays, classroom materials, etc. Classrooms softly lit; muted colors	Some nature content; Classrooms brightly lit; combination of colors (muted and bright)	Emphasizes things other than nature that are relevant and of interest to preschoolers; Classrooms brightly lit, bright colors
13. Outdoor environment	Outdoor environment used is primarily an unmaintained, natural setting(s); a maintained natural playspace is also available	Variety of outdoor environments used, including unmaintained natural area, maintained naturalized outdoor play space, and outdoor playground	Outdoor playground is primarily used when outdoors, with a naturalized outdoor play space and/or a natural environment also available

Constructs and Measures

The two instruments used in this study were the Peabody Picture Vocabulary Test Fifth Edition (Dunn, 2019) and the Expressive Vocabulary Test Third Edition (Williams, 2019). Both involve pictures and prompts, where children are asked to either point to the picture that shows the word (prompt) or are shown a picture and asked to say the word that describes the picture. These instruments are valid for children ages 2 ½ and older, and thus appropriate for our proposed study population. Each instrument took 10-20 minutes to complete, depending on the child; the instruments were administered individually to each participating child as a pretest at the beginning of the year and again at the end of the year for a post-test. The evidence of the validity of both was gathered through expert review, analysis of individuals' response processes during pilot testing, and score comparison with the Clinical Evaluation of Language Fundamentals-Preschool and the Kaufman Test of Educational Achievement.

The PPVT-5 is a measure of receptive vocabulary. Each item consists of a stimulus word and four pictures, one of which depicts the stimulus word and three that are appealing distractors. Each set of four pictures is balanced for color, size, and orientation. Stimulus words are nouns, verbs, and attributes reflecting vocabulary that is acquired early in a child's life (such as basic shapes, body parts, and household items), as well as vocabulary that correlates with academic success (in subject areas of math, science, geography, history, and the arts). The examinee (child) provides a nonverbal response to each stimulus word spoken by the examiner. For example, the examiner says, point to the vine, and then the child responds by pointing to one of the pictures. There are 240 items ordered by increasing difficulty with recommended age-based start points. The reliability of the PPVT-5 for preschool-aged children is .98 (Dunn, 2019).

The EVT-3 is a measure of expressive vocabulary that uses two item types: labeling and synonyms. There are 190 items arranged in order of increasing difficulty, and like the PPVT-5,

there are age-based starting points. For each item, the examiner presents the picture of the item at hand and reads the corresponding stimulus question. The child examinee provides a one-word acceptable response that, based on the stimulus question, either provides the label for the picture, answers a specific question about the picture, or provides a synonym for the word that fits the picture, thereby allowing for an assessment of vocabulary knowledge and word retrieval. For example, if there's a picture of a dog the examiner says, what is this, and then the child responds with a guess of what the picture is. The reliability of the EVT-3 for preschool-aged children is .96 to .98 (Williams, 2019).

Data Collection Procedures

Prior to data collection, permission was sought from the Institutional Review Board for the Social and Behavioral Sciences at the University of Minnesota to carry out the study at hand. They approved the research protocol, including the data collection procedures, as well as the recruitment, invitation, and consent procedures that were described prior. Teachers were asked to complete a summary sheet regarding the demographic information for each child for whom parental consent had been granted. The following demographic data were collected: children's age in months, gender, and SES (eligibility for free or reduced tuition). Children's race and ethnicity were not collected due to the lack of variation and to avoid being able to identify specific participants. Pretesting began in September 2022, and post-testing occurred in April and May 2023. Researchers administered the PPVT-5 and EVT-3 to each participating child following the administration instructions provided by the testing manuals. For both assessments, the basal level is achieved when the child responds correctly to the first three consecutive items from the age-based starting point. Once the basal is achieved, testing continues until the individual responds incorrectly to six consecutive items.

Raw scores were calculated by subtracting the number of errors from the ceiling item. Raw scores were then converted to standard scores by using the age-based standard score table in the testing manuals. Standard scores were used, per guidance by Sullivan et al. (2014), to control for skill level and change in skill level as a result of age, per Baker (2020). As Ingvalson et al. (2023) explains, the standard scores are meant to be sensitive to age-typical growth, and thus a significant change across testing sessions is not reflective of maturation or development, nor would a significant change be expected in the absence of a treatment effect.

General Analytic Strategy

General linear modeling (mixed model ANCOVA) was conducted to evaluate the effects of preschool approach, preschool type, and SES on growth in preschoolers' receptive and expressive vocabulary. In the model, the between-subjects independent variables were preschool approach (nature v. blended v. less nature), preschool type (private v. public), and SES (higher v. lower); the within-subjects independent variable was time (beginning and end of school year), and age in months and gender were covariates. Two general linear modeling analyses were conducted, one for each of the two dependent variables, which were receptive vocabulary, as measured by the PPVT-5, and expressive vocabulary, as measured by the EVT-3. Following the testing of main and interaction effects, simple main effects analyses were conducted to test for significant vocabulary growth at each level of the independent variable preschool approach. Additional planned simple main effects analyses were conducted to explore the results of the significance testing of the interaction effect among time, preschool type, and SES, at each level of the independent variable preschool approach. In these analyses of simple main effects, Holm's sequential Bonferroni approach was used to control for the familywise error rate.

Chapter 4

Results

Receptive Vocabulary Results

The main effects of preschool approach and preschool type on preschoolers' receptive vocabulary were significant, $F(2, 110) = 7.44, p < .001, \eta^2 = .12$ and $F(1, 110) = 6.72, p = .01, \eta^2 = .06$ respectively. When controlling for age and gender, and averaging across preschool type, SES, and time, the preschoolers in programs using a blended approach had a mean receptive vocabulary level of 102.49 (SE = 3.20); preschoolers in programs using a nature approach had a mean of 99.21 (SE = 2.44), and preschoolers in programs using a non-nature approach had a mean of 91.42 (SE = 1.88). Preschoolers in private programs had a mean receptive vocabulary level of 107.19 (SE = 3.23) compared to preschoolers in public programs ($M = 90.61, SE = 1.56$), when controlling for age and gender, and averaging across preschool approach, SES, and time. The main effects of SES and of time were nonsignificant, $F(1, 110) = .43, p = .51, \eta^2 < .01$ and $F(1, 110) < .01, p = .94, \eta^2 < .01$, respectively. While these significant and non-significant main effects are presented by convention, they have little practical interpretation or use, given this study's focus and research questions.

When controlling for age and gender, the two-way interaction between preschool approach and time was not significant, $F(2, 110) = .80, p = .45, \eta^2 = .01$. However, the observed power of this interaction term was low (.18, computed using $\alpha = .05$) and likely insufficient for detecting potential significance. Since the plots of the estimated marginal means visually suggested the potential presence of an interaction, follow-up analyses were conducted to explore the simple main effect of time at each of the three levels of program approach. This allowed for determining which of the three preschool approaches supported significant growth in children's

receptive vocabulary, when averaging together private and public preschool programs, as well as lower and higher SES, and controlling for age and gender.

Results suggest a significant simple main effect of time (significant growth) for preschoolers in programs using a nature approach, $F(1, 110) = 5.20$, $p = .02$, partial $\eta^2 = .05$. The mean difference from pre- to post-PPVT levels for preschoolers in programs using a nature approach was 5.64 (SE = 2.39). There also was a significant simple main effect of time (significant growth) for preschoolers in programs using a non-nature approach, $F(1, 110) = 4.63$, $p = .03$, partial $\eta^2 = .04$. The mean difference from pre- to post-PPVT levels for preschoolers in the non-nature programs was 3.98 (SE = 1.85). There was no significant growth for preschoolers in programs using blended approaches, $F(1, 110) = .22$, $p = .64$, partial $\eta^2 < .01$, with a mean difference of 1.45 (SE = 3.13) between pre- and post-levels. These results suggest significant receptive vocabulary growth for children in programs using the nature and non-nature approaches, when controlling for age and gender and averaging the effects of preschool type (public v. private) and SES. Programs using nature and non-nature approaches appear to be effective in helping improve receptive vocabulary, with preschoolers in these programs acquiring vocabulary more quickly than other individuals of the same age.

Additional planned follow-up analyses of simple main effects were conducted per the research question regarding if the effectiveness of preschool approach (nature, blended, or non-nature) on receptive vocabulary growth varied by preschool type (public or private) and SES, and more specifically which approaches supported significant receptive vocabulary growth in lower SES children. These follow-up analyses were also important considering the significant main effect of preschool type (public v. private), as well as low observed power ($< .01$) for the three- and four-way interaction terms. Table 2 presents the adjusted means and standard errors

for pretest and posttest levels of receptive vocabulary as a function of preschool approach, preschool type, and SES.

Results suggest significant simple main effects of time (significant growth), corresponding to a medium effect size, for higher SES children in private nature and non-nature programs, $F(1,110) = 4.94, p = .03, \eta^2 = .04$ and $F(1,110) = 8.11, p < .01, \eta^2 = .07$, respectively, as well as for lower SES children in public blended programs, $F(1,110) = 4.14, p = .04, \eta^2 = .04$. There were nonsignificant simple main effects of time for higher SES children in public and private blended programs, $F(1,110) = 1.44, p = .23, \eta^2 = .01$ and $F(1,110) = .28, p = .60, \eta^2 < .001$, respectively. There also were nonsignificant simple main effects of time for lower SES children in public nature and non-nature programs, $F(1,110) = .99, p = .32, \eta^2 < .01$ and $F(1,110) = .21, p = .65, \eta^2 < .01$, respectively, and in private blended programs, $F(1,110) = .06, p = .80, \eta^2 < .01$. These results suggest the effectiveness of program approach further varies by preschool type (public v. private) and SES, with programs using nature approaches and programs using non-nature approaches supporting significant receptive vocabulary growth beyond expected developmental gains for higher SES children in private settings; blended programs significantly supported receptive vocabulary growth for lower SES children in public settings. (Note Table 3, as some of the combinations of variables did not have participants.)

Table 3. *Adjusted Means and Standard Errors for Receptive Vocabulary (PPVT-5) Pre- and Post-test Levels by Preschool Approach, Preschool Type, and SES*

Preschool Approach	Preschool Type	SES	Adj. Pretest Mean (SD) ^a	Adj. Posttest Mean (SE) ^a	n
Less Nature	Public	Lower	89.93 (2.08)	89.04 (2.37)	37
		Higher	--	--	-
		Subtotal for Public (SES Combined)	89.93 (2.08)	89.04 (2.37)	37
	Private	Lower	--	--	-
		Higher	88.92 (3.28)	97.76 (3.75)	13
		Subtotal for Private (SES Combined)	88.92 (3.28)	97.76 (3.75)	13
	Total Less Nature (Type and SES Combined)		89.49 (1.95)	93.40 (2.23)	50
Blended	Public	Lower	88.09 (2.57)	93.21 (2.94)	37
		Higher	95.08 (4.20)	99.85 (4.80)	9
		Subtotal for Public (SES Combined)	91.58 (2.46)	96.52 (2.81)	36
	Private	Lower	111.53 (12.02)	108.75 (13.75)	1
		Higher	112.34 (2.58)	111.04 (2.96)	23
		Subtotal for Private (SES Combined)	111.94 (6.20)	109.88 (7.10)	24
	Total Blended (Type and SES Combined)		101.76 (1.95)	103.21 (3.78)	60
Nature	Public	Lower	83.16 (3.58)	86.53 (4.10)	12
		Higher	--	--	-
		Subtotal for Public (SES Combined)	83.16 (3.58)	86.53 (4.10)	12
	Private	Lower	--	--	-
		Higher	109.79 (3.58)	117.34 (4.10)	12
		Subtotal for Private (SES Combined)	109.79 (3.58)	117.34 (4.10)	12
	Total Nature (Type and SES Combined)		96.47 (2.53)	101.94 (2.80)	

^aAdjusted for age in months and gender.

Note: Holm's sequential Bonferroni approach applied to control for familywise error rate.

Note: Bold indicates statistically significant growth.

Expressive Vocabulary

The main effects of preschool approach and SES on preschoolers' expressive vocabulary were significant, $F(2, 108) = 5.52$, $p < .01$, $\eta^2 = .09$ and $F(1, 108) = 9.27$, $p < .01$, $\eta^2 = .08$

respectively. When controlling for age and gender, and averaging across preschool type, SES, and time, the preschoolers in programs using a nature approach had a mean expressive vocabulary level of 99.86 (SE = 2.00); preschoolers in programs using a blended approach had a mean of 99.68 (SE = 2.68), and preschoolers in programs using a non-nature approach had a mean of 96.46 (SE = 2.00). Lower SES preschoolers had a mean expressive vocabulary level of 92.74 (SE 2.59), and higher SES preschoolers had a mean of 105.10 (SE = 1.56), when controlling for age and gender, and averaging across preschool approach, preschool type, and time. The main effect of preschool type (public v. private) was nonsignificant, $F(1,108) = .78$, $p = .38$, $\eta^2 < .01$. The main effect of time was also nonsignificant, $F(1,108) = 2.41$, $p = .12$, $\eta^2 = .02$. As noted prior, these main effects are presented by convention, but have little practical interpretation.

When controlling for age and gender, the two-way interaction between preschool approach and time was not significant for expressive vocabulary, $F(2, 110) = .80$, $p = .45$, $\eta^2 = .01$. However, like the receptive vocabulary data, the observed power of this interaction term was low (.18), and plots of the estimated marginal means visually suggested the potential presence of an interaction (that growth in expressive vocabulary varied by preschool approach). Consequently, follow-up analyses were conducted to explore the simple main effect of time at each of the three levels of preschool approach and determine which of the approaches supported significant growth in children's expressive vocabulary, when averaging together private and preschool programs, as well as lower and higher SES, and controlling for age and gender.

Results suggest a significant simple main effect of time (significant growth) for preschoolers in programs using a nature approach, $F(1, 108) = 4.45$, $p = .04$, partial $\eta^2 = .04$. The mean difference from pre- to post-EVT levels for preschoolers in the nature programs was 4.17

(SE = 1.98). There also was a significant simple main effect of time (significant growth) for preschoolers in programs using a non-nature approach, $F(1, 108) = 7061$, $p < .01$, partial $\eta^2 < .01$, with a mean difference of 4.29 (SE = 1.55) in pre- to post-EVT levels. There was not significant growth for preschoolers in programs using blended approaches, $F(1,108) = 1.20$, $p = .28$, partial $\eta^2 < .01$, with a mean difference of 2.91 (SE = 2.65) between pre- and post-levels. These results suggest significant expressive vocabulary growth, beyond what would developmentally be expected, for children in the programs using nature and non-nature approaches, when controlling for age and gender and averaging the effects of preschool type (public v. private) and SES.

Additional planned follow-up analyses of simple main effects were conducted per the research question regarding if the effectiveness of the preschool approach on expressive vocabulary growth further varied by preschool type (public or private) and SES, and more specifically which approach was most effective for supporting expressive vocabulary growth in lower SES children. These follow-up analyses were also important considering the significant main effect of SES, as well as low observed power for the three- and four-way interaction terms ($< .01$). Table 3 presents the adjusted means and standard errors for pretest and posttest levels of expressive vocabulary as a function of preschool approach, preschool type, and SES. Results suggest significant simple main effects of time (significant growth) for higher SES children in private non-nature programs, $F(1,108) = 10.65$, $p < .01$, $\eta^2 = .09$, corresponding to a large effect size, as well as for the single lower SES child in a private blended program, $F(1,108) = 4.22$, $p = .04$, $\eta^2 = .04$, corresponding to a medium effect size.

Additionally, there was a significant simple main effect of time for higher SES children in the private programs using the blended approach, $F(1, 108) = 10.80$, $p < .01$, $\eta^2 = .09$; this

effect though was of significant decrease, not growth. There were nonsignificant simple main effects of time for lower SES preschools in public non-nature programs, $F(1,108) = .01$, $p = .98$, $\eta^2 < .01$, and for lower and higher SES children in public blended programs, $F(1,108) = .18$, $p = .67$, $\eta^2 < .01$ and $F(1,108) = .38$, $p = .54$, $\eta^2 < .01$, respectively. There also were nonsignificant simple main effects of time for lower and higher SES children in public and private nature programs, $F(1,108) = 1.42$, $p = .23$, $\eta^2 < .01$ and $F(1,108) = 3.13$, $p = .08$, $\eta^2 = .03$, respectively. These results suggest the effectiveness of the preschool approach in supporting significant expressive vocabulary growth varies by preschool type and SES, with programs using a non-nature approach supporting significant expressive vocabulary growth for higher SES children in private settings and potentially blended programs supporting significant growth for lower SES children in private settings. (See Table 4, as some of the combinations of variables did not have participants, and the category of lower SES in private blended programs had a cell size of one participant.)

Table 4. *Adjusted Means and Standard Errors for Expressive Vocabulary (EVT-3) Pre- and Post-test Levels by Preschool Approach, Preschool Type, and SES*

Preschool Approach	Preschool Type	SES	Adj. Pretest Mean (SD) ^a	Adj. Posttest Mean (SE) ^a	n
Less Nature	Public	Lower	94.59 (1.94)	94.63 (1.79)	37
		Higher	--	--	-
		Subtotal for Public (SES Combined)	94.59 (1.94)	94.63 (1.79)	37
	Private	Lower	--	--	-
		Higher	94.02 (3.07)	102.57 (2.83)	13
		Subtotal for Private (SES Combined)	94.02 (3.07)	102.57 (2.83)	13
	Total Less Nature (Type and SES Combined)		94.34 (1.82)	98.60 (1.68)	50
Blended	Public	Lower	92.76 (2.53)	93.67 (2.37)	37
		Higher	102.32 (3.93)	100.2 (3.62)	9
		Subtotal for Public (SES Combined)	97.54 (2.34)	96.96 (2.16)	36
	Private	Lower	80.01 (11.27)	99.73 (10.39)	1
		Higher	116.82 (3.48)	110.87 (2.28)	23
		Subtotal for Private (SES Combined)	98.91 (5.83)	105.30 (5.37)	24
	Total Blended (Type and SES Combined)		98.23 (3.11)	101.13 (2.86)	60
Nature	Public	Lower	91.63 (3.22)	94.89 (2.96)	12
		Higher	--	--	-
		Subtotal for Public (SES Combined)	91.63 (3.22)	94.89 (2.96)	12
	Private	Lower	--	--	-
		Higher	103.92 (3.36)	108.99 (3.10)	12
		Subtotal for Private (SES Combined)	103.92 (3.36)	108.99 (3.10)	12
	Total Nature (Type and SES Combined)		97.77 (2.32)	101.94 (2.13)	24

^aAdjusted for age in months and gender.

Note: Holm's sequential Bonferroni approach applied to control for familywise error rate.

Note: Bold indicates statistically significant growth.

Chapter 5

Discussion

Limitations

A quasi-experimental design was used for this study since it wasn't possible to control enrollment processes and randomly assign children to different preschool approaches, which would be necessary for an experimental design. This quasi-experimental design is appropriate for the exploratory nature of this research and is commonly used in educational settings where the researcher cannot influence the assignment of participants to treatment and comparison groups (Creswell and Creswell, 2018). A main limitation of the quasi-experimental design is you cannot rule out pre-existing factors that occur in or outside of school, which may influence the growth of vocabulary development.

The preschool programs not only differed in their levels of nature-ness but differed in other ways. These between and within groups differences could have influenced vocabulary development. These differences in preschool programs make it difficult to associate vocabulary outcomes with just one factor. Additionally, the teachers' instructional styles and the quality of teacher-child interactions may have influenced the study results. The public preschool programs participating in the study made their data from the CLASS (Classroom Assessment Scoring System) assessment available (Measuring Quality: Teacher-Child Interactions, 2021; Pianta et al., 2008). Initially, the research plan was to use this CLASS data to control for variations in teachers' instructional styles.

However, there was little variation in the data from the CLASS assessment. There was little variation in data across the participating teachers, with high performance for emotional support and classroom organization and upper middle to high performance in instructional

support. When the CLASS data was used in the analysis, it was not a significant factor in the model, nor was there a significant zero-order correlation with the posttest values on the dependent variables. This seems to suggest that the varying effectiveness of the approaches was not due, or at least not solely, to differences in style of teacher interaction, although there are likely other ways in which teachers and classrooms differ beyond what is captured through CLASS. Also, with prior studies suggesting mixed evidence regarding the relationship between the CLASS assessment and language gain, lack of measurement correspondence (measuring teacher-child interactions and vocabulary at different levels of specificity) may present further difficulty in determining if or to what degree even small differences in teacher-child interaction style influence effectiveness of approaches studied.

Within the aspects of teacher-child interactions, some of the teachers for the public preschool programs changed between pre-and post-tests, meaning the class got a new teacher during the middle of the school year, which is another limitation that could potentially affect vocabulary outcomes for those specific students. A related limitation stems from this study's 'nested' data, where participants were within classes within preschool types. Because the groups were fixed rather than random, due to insufficient sample size at the program level (Huta, 2014), multilevel modeling was not used, which introduces the possibility of inaccurate statistical estimates.

Discussion of Findings

This study sought to assess the effect of nature-based practices on preschoolers' receptive and expressive vocabulary to contribute knowledge regarding effective practices for supporting vocabulary development and adding to the growing body of research surrounding the impact of nature play on child development and school readiness. Considering the relationship between

vocabulary development and SES documented in the literature, the potential for nature-based practices in preschool to support vocabulary development for children of lower SES backgrounds was also explored. The following discussion focuses mostly on receptive vocabulary growth, as nature-based practices did not appear to support significant expressive vocabulary growth. In terms of receptive vocabulary growth, the results suggest incorporating nature-based practices into preschool was effective, but that effectiveness varied by preschool type (public v. private) and SES. Preschool programs that use a blended approach significantly supported receptive vocabulary growth beyond expected developmental gains for lower SES children in public settings; they were acquiring receptive vocabulary more quickly than individuals of the same age. This finding is consistent with recent findings in studies focused on resilience (Ernst et al., 2021) and executive function, where blended preschool programs were significantly more effective than non-nature programs. Additionally blended preschool programs were particularly effective for lower SES children (Ernst et al. 2022). However, unlike those studies, the study at hand suggests non-nature preschool was also effective, but only for higher SES children in the private preschool setting. Similarly, the nature approach was effective for the higher SES children in the private preschool setting but did not appear to support significant growth for lower SES children in public settings. These children were coming into the program with high levels of receptive vocabulary, with significant growth across the preschool year that was not only influenced by unstructured play in natural environments but quite likely by interactions with peers with advanced vocabulary and high-level speech by teachers in response to preschoolers with a collective high vocabulary.

The positive influence of nature-based practices on preschoolers' receptive vocabulary in this study is potentially explained by the importance of children's physical environment and how

it affects their development (Kounin & Sherman, 1979). Gibson's affordance theory (1979) suggests that aspects of the natural environment may be impacting the quality of play and also vocabulary development. The variety of affordances in the nature-based play areas can develop and scaffold more complex language and vocabulary use (Prins et al., 2023). Dickinson and Moreton (1991) echo this finding with a study on three-year-olds, during pretend play the children were talking more frequently, and the results were associated with the improvement of their vocabulary size once they started kindergarten. More advanced language capabilities often emerge in play and reveal an opportunity for children's overall growth in development specifically linked to their literacy (Dickinson and Moreton, 1991). Neuman and Roskos (1992) informs that the acquisition of literacy skills is supported through playful learning with adults (i.e. guided play), the literacy that is included in playful scenarios is learned more often and at a faster pace.

As for the blended approach, the program showed promising results with support for receptive vocabulary growth for lower SES children in public settings. Receptive vocabulary develops very quickly in early childhood and can support the foundation for learning language and reading (Taylor et al., 2013). Foorman et al. (2016) recommends for children to develop a deep understanding of words, they need to hear and use new words, listen to how words are read in books, ask and answer questions with new words, and connect new and old words while relating them to their own experiences. This reflects how the blended approach is particularly effective, with different aspects of teaching that include a balanced level of teacher-led and child-led learning. The child-led nature play offers peer conversation and quality play, while the teacher-led activities provide exposure to new vocabulary words and extra support to reinforce learning that then enhances nature play as a whole. Researchers have looked at the overall

influence of teacher-child interactions on the development of children's vocabulary using Pinata and colleagues' (2008) Classroom Assessment Scoring System (CLASS). Instructional support is of particular interest, with evidence of a strong, positive relationship with children's receptive vocabulary development (Hu et al., 2017; Paulick, 2019; Yang et al., 2021). Teacher-child interactions can create an ongoing change that facilitates developmentally appropriate instruction (IMNRC, 2015). Emergent curriculum, which is usually associated with nature-based early learning, aligns well with children's involvement within the language and learning environment.

Another relevant research implication that is from Karanth et al. (2017) looks at specific research-based interventions that promote receptive and expressive language development among toddlers and early adolescents. The focus of most of the lessons is to promote language expression through expressive language skills, although lesson plans for understanding language or receptive language skills are included as well (Karanth et al., 2017). Some of the interventions focus on play to induce different kinds of language/vocabulary skills using various items such as communication boards, for example retelling stories through pictures or puppets, answering "guess who" questions through gestures or pictures, and even following simple directions (Karanth et al., 2017). Comparing these interventions with the blended preschool approach and Head Start programs reveals a lot of overlap. The Head Start programs use a lot of communication boards and other picture items to guide children in understanding through role play and scaffolding. For example, if it was time to clean up and a child wasn't done playing, the teacher would show the child pictures of the schedule for the day and explain to the child through the pictures that after clean-up time, it is time for a snack and then outside play. Another example includes the idea of roleplay, which is more associated with Vygotsky's (1978) concept

of the zone of proximal development (ZPD), referring to what a learner can do without help versus what they can achieve with encouragement and support from a knowledgeable adult.

In addition to exploring the effect of nature-based practices on receptive vocabulary, this study also looked at the effects on expressive vocabulary. Results from this study suggest significant expressive vocabulary growth, beyond what would developmentally be expected, for children in the programs using nature and non-nature approaches, when preschool type (private versus public) and SES were not incorporated into the analysis. However, when preschool type and SES were incorporated into the analysis, only the non-nature approach, when implemented in a private preschool setting with children of higher SES, seemed to support significant expressive vocabulary growth beyond what would be developmentally expected. These findings also suggest that for programs using a nature approach, children didn't fall behind in terms of vocabulary development, in spite of the majority of their preschool time spent in nature play.

The literature provides some insight into why the results differed from receptive to expressive vocabulary. Generally, receptive language skills are usually much more advanced than expressive language skills in normally developing children (Fenson et al., 1994). When learning language, most of the time receptive development (understanding language) comes before expressive vocabulary (speaking/utterances), very similar to multilingual students (Fenson et al., 1994). Receptive vocabulary size continues to exceed expressive vocabulary size, not only in childhood but also in adulthood. First graders, for instance, exhibit receptive vocabularies of 8,000–14,000 words and expressive vocabularies of approximately 2,600 words (Anglin, Miller, & Wakefield, 1993). Expressive vocabulary is usually harder to boost compared to receptive vocabulary. Children demonstrate comprehension of spoken words before using them and build receptive vocabularies faster than expressive vocabularies (Benedict, 1979; Fenson et al., 1994).

A cross-sectional study in Bogota suggests that there is a socioeconomic gradient in child development for children ages 6-42 months, using the Bayley-III test (Rubio-Codina et al., 2015). The results show an age-increasing SES gap for receptive and expressive language earlier on in age and outcomes in receptive language vary more consistently with age than the expressive language (Rubio-Codina et al., 2015). This pattern may be related to how receptive skills develop before expressive language skills. Rubio-Codina et al. (2015) found that the gap increases considerably for children ages 31-42 months. These findings can help with decision-making and the implementation of interventions for early childhood, specifically cognitive and language skills, where the deficits are greatest.

Gómez et al. (2019) suggest that a peer's vocabulary diversity has a positive impact on a child's vocabulary diversity overall and peers' syntactic complexity has a positive relationship with children's syntactic complexity and receptive vocabulary. These findings suggest that peers' language use may influence dual-language learners and English-only learners' language development overall. Another relevant concept is peer-to-peer interactions and the positive influence they have on children's vocabulary, particularly in the context of preschool where children spend a significant amount of time interacting with each other (Gómez et al., 2019). Kartushina et al. (2022) conducted a cross-sectional study during the COVID-19 pandemic that looked at the vocabularies of almost 2,000 children between 8-36 months across 13 countries and 12 languages. Children who had less passive screen exposure and whose caregivers read more to them showed larger gains in vocabulary development during lockdown, after controlling for SES and other caregiver-child activities. Children also gained more words than expected (based on normative data) during lockdown; either caregivers were more aware of their child's development, or vocabulary development benefited from caregiver-child interactions during

lockdown, or both (Kartushina et al., 2022). These findings and studies shed light on the results of this study, but also reveal the complexity of influences on and patterns of vocabulary development and consequently the need for further research.

Program Implications and Recommendations

The results of this study have implications for both practice and research regarding incorporating nature-based practices and the impact on children's vocabulary. Children in private preschool settings arrive with high vocabulary skills and/or grow in their vocabulary skills throughout the year, seemingly independent of the use of nature or non-nature-based approaches. Thus, vocabulary support may need to be focused more on the public-school setting, where approach and SES seems more influential on vocabulary development. Additionally, another important implication from this study is that it is "Okay" to play. Children who spent a majority of their preschool day in nature play were still developing receptive vocabulary at a rate similar to their peers. This suggests that unstructured nature play in the context of a child-led, emergent curriculum doesn't reduce school readiness and offers opportunities for many different developmental benefits.

Potentially, these findings could also instill new practices that nature-based programs could fold into their approach that would close a vocabulary performance gap, amongst different groups of socioeconomic status. An example could include students with varying levels of SES and vocabulary levels interacting and playing with each other. Peer-to-peer interactions and the positive influence they have on children's vocabulary, particularly in the context of preschool where children spend a significant amount of time interacting with each other is a relevant concept to consider. In consideration for public early learning programs, receptive vocabulary growth in Lower SES children may be best supported through some incorporation of nature-

based practices (a blended approach). The blended approach offers an opportunity for not only enhanced vocabulary growth but other important overall development opportunities (physical, social-emotion, cognitive benefits).

Recommendations for Future Research

In terms of research implications, future studies that explore the capacity of nature-based practices in early environments should be aware of the importance of looking at multiple variables such as preschool setting (public v. private) and SES. Overlooking these variables and just focusing on which program approach (nature, non-nature, and blended) works best could either denounce the effectiveness of the programs with some nature practices or overgeneralize programs that are fully nature-based. Future research might investigate why expressive vocabulary growth seems to be impacted differently by nature-based practices, as in this study, incorporating nature-based practices impacted receptive vocabulary but not expressive vocabulary. Further research might discover more implications that can help support the goals of nature-based practices while instilling developmental benefits for all children, no matter which program they are enrolled in. In alignment with receptive and expressive vocabulary development, another future research idea could focus more on multilingual students for a follow-up study. Specifically looking at the differences between receptive and expressive vocabulary growth as well as SES and school type for the participants. Also, further research would be helpful considering how school readiness is interpreted in the scope of early learning and looking at aspects that regard unstructured nature play potentially detracting from children's readiness for school (Sobel, 2022).

In this study, spoken language wasn't one of the variables that was looked at but comparing multilingual students to students who only speak one language (i.e. English) could

assist in answering the question of what strategies support receptive versus expressive vocabulary and how the strategies differ in practice and scope; or potentially a longitudinal study that looks at the students' vocabulary development from preschool and beyond into elementary school. Similar to a study conducted by Moreton (1991) which looked at how often children spoke during pretend play and how it was related to their vocabulary development once they started kindergarten.

Despite study limitations, the findings are promising, as they add to the literature on the positive impacts developmentally that can be instilled through nature-based practices. This is very significant, since navigating nature-based practices within programs is not always accessible or desired, specifically in public preschool settings. Additionally, it is encouraging to have benefits occur among participants of lower SES in publicly funded preschool programs situated in urban settings. The blended approach that includes nature-based practices is not only effective, but also more equitable, as a wider range of children can experience the benefits of nature-based practices.

Conclusion

Preschools provide a rich language learning environment for children and are one of the many contexts where young children learn language (Hoff, 2006). Vocabulary is central to oral language development and critical to early literacy achievement, with cumulative and cascading effects on reading comprehension, domain-specific knowledge, and school success. This study examined the effect of nature-based practices on the vocabulary development of preschoolers. Findings suggest benefits of nature-based practices can extend beyond private nature preschools and occur within a publicly funded school district and in urban settings. Public programs that had some incorporation of nature-based practices (blended programs) were particularly effective in

supporting receptive vocabulary growth in children from lower socioeconomic backgrounds.

While more research is needed, findings are encouraging amidst policy and practice efforts to support strong language skills as a foundation for learning for all children and among concerns regarding nature play's potential to prepare children for school.

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Appendix

Appendix A-Consent Form

PARENT/CHILD INVITATION AND CONSENT FORM FOR RESEARCH PARTICIPATION

Dear Preschool Parents and Guardians,

Your preschool-aged child is invited to be in a research study exploring the influence of preschool on young children's vocabulary development. This study builds on prior research with your child's preschool. Please read this information and ask any questions you may have before agreeing to allow your child to participate. This form can be returned to your child's teacher at your earliest convenience. Thank you sincerely for your time and consideration!

Title of Research Study: Nature-Based Early Learning and Preschoolers' Receptive and Expressive Vocabulary: An Exploratory Research Study

Investigator Team Contact Information:

For questions about research appointments, the research study, research results, or other concerns, call the study team at:

Investigator Name: Dr. Julie Ernst Investigator Departmental Affiliation: Applied Human Sciences, UMD Phone Number: 218-726-8241 Email Address: jernst@d.umn.edu	Student Investigators: Erika Doetskott, doetk004@d.umn.edu and Hannah Stelley, stell174@d.umn.edu
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Supported By: This research is supported by the George B. Storer Foundation.

Key Information about This Research Study

The following is information to help you decide whether or not to be a part of this research study.

What is research?

The goal of research is to learn new things in order to help people in the future. Investigators learn things by following the same plan with a number of participants, so they do not usually make changes to the plan for individual research participants. You, as an individual, may or may not be helped by volunteering for a research study.

Why am I being invited to take part in this research study?

We are inviting your child to take part in this research study because your child attends preschool at one of the sites participating in this research study.

What should I know about a research study?

- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide.

Why is this research being done?

The purpose of this study is to explore the role of preschool in the development of children's expressive and receptive vocabulary. There is a need to understand and develop strategies that further young children's vocabulary, given the critical developmental period of early childhood.

How long will the research last?

This study will take place this upcoming preschool year.

How many people are expected to be in the study?

We expect about 150-200 preschoolers will participate.

What will I need to do to participate? What happens if I say "yes" to allow my child to participate?

If you want your child to participate in this research, you will need to sign and return this consent form. Then your child will then be invited to participate by the researcher on the day she visits your child's classroom. During your child's interview time with the researcher, your child will be invited to listen to a word spoken by the researcher and then select one of four pictures that best describes the word's meaning. Then your child will listen to another word and again be invited to point to that word from another set of four pictures; this will continue for about five minutes. Then the interview will switch slightly, to where your child is shown a picture, and then the researcher will ask them if they know the word for what is depicted in the photo. Your child will be invited to continue doing this for about five minutes (the total time for each depends on how quickly they move through the photos and at what point they reach their "ceiling level" based on their age and the number of correct/incorrect responses in a row). If your child loses interest, the interview can be ended early. This will take place during normal preschool hours, in an area of the classroom that is out of the way of other activities, yet still in the view of the teacher. This interview will take place at the beginning of the school year, and then your child will be invited to participate in the same interview at the end of the school year. In addition, teachers will provide the researcher with information on participating children's age, gender, whether or not they participated in preschool the previous

year. This information will be coded, as will the interview data, so that it is not identifiable (your child's name will not be associated with their demographic information nor their interview responses).

Is there any way that being in this study could be bad for me? What are the risks?

There is potentially a risk of your child tiring from participation or getting bored during the interview. Children who are hesitant around unfamiliar adults may be less comfortable in participating. The teacher and researcher will both be watching for children who are hesitant or do not want to participate, as well as for children who lose interest in participating during the interview. While these risks are possible, they are not severe, and efforts will be made to minimize the possibility of these risks occurring.

Will being in this study help me in any way?

There are no benefits to you from your taking part in this research. However, possible benefits to others include helping educators learn more about how to support vocabulary development in young children.

Will it cost me anything to participate in this research study?

There will be no cost to you for any of the research activities.

Will I be compensated for my participation?

You will not be compensated for allowing your child to participate. However, your child's preschool teacher will receive \$200 in appreciation for allowing this research to be conducted with their preschool children. Your child's teacher will be using this money to purchase education materials/classroom supplies for her program and students. While we hope you consider participating, this funding is not dependent on your participation and your child's participation.

What happens if I do not want to be in this research?

You do not have to allow your child to participate. It will not be held against you or your child in any way. If you do not want your child to participate, then he/she would participate in the regularly scheduled preschool activities during the time the researcher is visiting your child's classroom.

What happens if I say "Yes" but I change my mind later?

Your child can leave the research study at any time, and no one will be upset with you or your child. You can let your child's teacher know that you would like to remove your child from the study, or you can contact the researcher directly. Your child also can participate in a portion of the interview and is absolutely free to stop participating in the interview at any

point. The researcher will be watching for cues as to if the child is losing interest or wanting to be finished and will periodically ask if they want to continue or to be finished.

What happens to the information collected for the research?

If you allow your child to participate, he/she will be assigned a code, and your child's interview responses and demographic information will be labeled through that code, rather than your child's name. Research records will be stored securely, and efforts will be made to limit access to the data other than the researcher and potentially the research review board at the University of MN, in the event they would need to inspect the study. The stored data will not contain identifying information, and the data will be stored according to current University policy for protection of confidentiality. In any sort of journal article stemming from this research that we might publish, we will not include any information that will make it possible to identify a participant, and we will not indicate the name of the specific teachers. In addition, the results will be presented at an aggregate level (not at an individual level). We will be sharing the aggregate results with the participating classrooms, if they express interest in knowing the results, but we will not be disseminating these results out to individual parents. The data from this study will not be used for any future research after this study is complete.

Whom do I contact if I have questions, concerns, or feedback about my experience?

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

Will I have a chance to provide feedback after the study is over?

The HRPP may ask you to complete a survey that asks about your experience as a research participant. You do not have to complete the survey if you do not want to. If you do choose to complete the survey, your responses will be anonymous. If you are not asked to complete a survey, but you would like to share feedback, please contact the study team or the HRPP. See the "Investigator Contact Information" of this form for study team contact information and "Whom do I contact if I have questions, concerns or feedback about my experience?" of this form for HRPP contact information.

Statement of Consent:

I have read the above information. I have asked questions if I have them and have received answers. **I consent for my child** to participate in the study. (Your signature documents your permission for the named child to take part in this research.)

Printed name of child participant:

Printed name of parent or guardian:

Signature of parent or guardian: _____ Date: _____

Appendix B-Letter to Teachers

Greetings Preschool Teachers,

Thank you so much for your cooperation with this study! If you have any questions or concerns, please let me know (jernst@d.umn.edu). I sincerely appreciate your time and effort.

1. **Code Sheets:** Please fill out both code sheets. This allows us to keep the data “deidentified” and to link pretest scores, posttest scores, and demographic data. Note there are two versions:
 - *Version you KEEP for the duration of this school year*, so that you know which student goes with which code (this one has student names with codes)
 - *Version that goes back to me*: this one has codes and demographic data. Becky may be able to assist with completing the demographic information if needed.
2. **Consent Forms:** The attached consent forms can be distributed to parents/guardians on your home visits or during the first week of school. Please ask for them to be returned to you as soon as possible (within the week if possible). Parents/guardians should return to you the entire form, not just the last page, as the university requires, we retain the entire form with the original signature. If parents request a copy, feel free to provide that, or let me know and I can arrange for a copy to be provided. The consent forms are labeled with student codes. Please make sure you are giving the consent form to the parent/child based on the coding sheet, and as consent forms are returned to you, please indicate if consent was or was not granted on both coding sheets.
3. **Return** to me when I visit for the pretesting (or whomever is pretesting at your site, which may be me or one of the two student research assistants, Erika or Hannah).
 - a. Code sheet (return just the one without names of children that has the demographic data; you keep the one with the names on it to use in the spring)
 - b. Consent forms (with the post-it note codes left on them)

Note: If parents ask about the study or want you to explain it, you might indicate we are studying how preschool supports the development of children’s vocabulary. The way we measure it is through a short game-like activity, where children will be shown a set of pictures and asked to point to the picture that represents the word being spoken to them. The other activity that will be used is children will be shown pictures and asked to say the word that describes the picture at hand. When the researcher visits, she will be in the eyesight of the teacher, but in an out of the way location to not disrupt other classroom activities. The researcher leading the project is a parent and has been at UMD for almost 20 years. The two students helping on this project both have a lot of experience with young children, and both are kind and friendly. If a child appears to not want to play the activity, that will be fine, and they can return to the other classroom activities. This is voluntary, and parents don’t have to allow their child to participate. (If you would like, it may be helpful for you to skim the consent form, so you know what parents are reading/being invited to do.) Thank you again! Julie Ernst, UMD Professor

Appendix C-Coding Sheets

Sample School (S) – All Day 5 Day

(RETAINED by Teacher) PLEASE SAVE ALL YEAR

Child's Name (fill in)	Participant Code	Has permission to participate (place checkmark if consent form returned and parent/guardian granted consent)
	S1	
	S2	
	S3	
	S4	
	S5	
	S6	
	S7	
	S8	
	S9	
	S10	
	S11	
	S12	
	S13	
	S14	
	S15	
	S16	
	S17	
	S18	

Sample School (S) – All Day 5 Day Code Sheet **(RETURNED to Becky or Julie or Hannah)**

*(*Only complete for children with parent consent to participate; Becky can assist if you do not know some of this information)*

Participant Code	Consent to Participate?	Gender	Age in Months as of Sept. 2022	Did the child attend preschool last year?	Is the child income-eligible for free or reduced early learning participation (<i>using the state/federal threshold of family income equal to or less than 185 percent of the federal poverty level in the current calendar year</i>)
S1					
S2					
S3					
S4					
S5					
S6					
S7					
S8					
S9					
S10					
S11					
S12					
S13					
S14					
S15					
S16					
S17					
S18					