OATS, PEAS, BEANS, AND EARLY LITERACY SKILLS GROW:
A PROGRAM EVALUATION OF EDUCATION THROUGH MUSIC

BY

LAURA D. LEHMAN

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LAURA D. LEHMAN

UNIVERSITY OF CALIFORNIA, SANTA CRUZ, B.A. (2008)

ALFRED UNIVERSITY, M.A. (2011)

ALFRED UNIVERSITY, C.A.S. (2013)

AUTHOR Laura D. Lehman

APPROVED BY Jana Atlas, Ph.D.
Committee Chairperson

Lynn O'Connell, Psy.D.
Committee Member

Andrea Burch, Psy.D.
Committee Member

Hannah Young, Psy.D.
Committee Member

ACCEPTED BY Andrea Burch, Psy.D.
Program Director, School Psychology Doctoral Program

ACCEPTED BY Kevin Curtin, Ph.D.
Chair, Division of Counseling & School Psychology

ACCEPTED BY John D. Cerio, Ph.D.
Dean, School of Graduate and Continuing Studies

ACCEPTED BY W. Richard Stephens, Ph.D.
Provost and Vice President for Academic Affairs

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Dedication

Mom and Dad: Once upon a time a young girl decided she needed to get a doctorate. Though she knew not in what, she dedicated her life to the pursuit, carried forward by her parents' tireless refrains: "Do your best." "We believe in you." No matter how many thousands of miles away her quest took her, she carried those words with her, filled her spirit with them when she felt it weaken, lifted her confidence with them when it began to drag. Wore them with pride and honor as the end of one journey approached and yet another beckoned. You let that young girl dream big, gave her the tools she needed to bring it to life, and supported her every step of the way. Thank you, with all of my heart. Here we are, at last.

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Abstract

The acquisition of literacy skills is a complex and multi-faceted process that begins long before typical school-based literacy instruction. The present study sought to examine and expand research regarding the independent and interactive contributions of neuropsychological development, movement, play, and music on the development of literacy skills. The current study investigated *Education Through Music,* a play-based music-education program that incorporated all of these elements, to determine if their use in an everyday classroom environment impacted literacy-skill development, in particular phonological awareness. Participants included 76 (35 girls, 41 boys) typically-developing, native English-speaking kindergarten students from a school district located in Northern California. Phonological awareness skills were measured at four time periods over the course of a school year using the Phonological Awareness Test 2. Relative to non-music-oriented classroom controls, students participating in Education Through Music classrooms demonstrated significantly higher performance in the areas of segmentation (i.e., using sentences, syllables, and phonemes) as well as rhyming production. Results provide initial support for the use of vocal music in the classroom as it relates to early literacy skill development.

Chapter 1

Introduction

Literacy is inarguably one of the most vital elements for successful navigation of today's society (National Early Literacy Panel, 2008). Attaining literacy is considered so crucial that schools are federally mandated to teach children how to read, and children must in turn demonstrate that they have mastered this ability before they are allowed to graduate (No Child Left Behind Act, 2001). The most efficacious methods for promoting literacy development have been studied extensively (and debated just as contentiously). Based on the results of the National Assessment of Educational Progress' yearly report card, only slightly more than one-third of fourth-grade students reached or exceeded proficiency in reading (National Center for Educational Statistics, 2015). There is room for improvement in reading instruction. Evidence garnered from the fields of neuropsychology, movement, music, and play research can all provide rich insight into this endeavor (Buhs, Welch, Burt, & Knoche, 2011; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; National Institute of Child Health and Human Development, 2000; Pellegrini, 2009; Strait, Slater, O'Connell, & Kraus, 2015; Wolf, 2007; Woods, 2011; Yatvin, 2005). As with all stories, perhaps the best place to begin the journey of reading development is at the beginning, with the brain.

At the foundation of literacy stands neurological development. Specific brain structures and functions must be established before literacy becomes a possibility. There even exist critical periods within the brain's maturation cycle in which language, a critical component of reading, is most easily learned (e.g., the end of which is marked at approximately ten years of age; Arshavsky, 2009). Beyond this period, the task of learning to read becomes exponentially more difficult. In order for the brain to create order, it must receive information from the environment, the prime conduits for which are the senses (Massaro, Rothbaum, & Aly, 2006; Medina, 2010). It is sensory input that fuels the brain development that makes literacy, and indeed, learning in general, possible.

Movement allows independent exploration of the environment (Dodge, Colker, & Heroman, 2002). As movement and exploration increase, so too does the richness of information assimilated by the senses. This information gathering contributes to organization and refinement of neural structures, including those that process language (Bell & Fox, 1997). These experiences likewise enhance performance in motor control areas, which are important in the physical processes of reading and writing (Dodge et al., 2002).

Before children speak the language of words, they speak the language of play. While it may not meet the technical criteria of a *true* language (e.g., English, German, Finnish), it is a prominent form of communication in childhood, and often demonstrates the three basic functions of a language: communication, expression, and reasoning (Kagan & Lowenstein, 2004). The cognitive, physical, verbal, social, and emotional benefits of play have been well documented (e.g., Elkind, 2007; Ginsburg, 2007), as has the transactional relationship between play and brain development, which is due in large part to the multisensory experiences embedded in play (Medina, 2010). Music and songs, often found in play, also show significant contributions to neurological growth (Peretz & Zatorre, 2005) and the development of language and literacy (Salmon, 2010).

Decades of research have shown that literacy development is complex. Indeed, there has been a tremendous proliferation in the study of literacy over the past twenty years (Buhs, Welch, Burt, & Knoche, 2011; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; Woods, 2011; Yatvin, 2005). Old ideas have been discarded, ushered away by the new evidence-based practices supporting such concepts as a specified developmental progression of early literacy skills (National Early Literacy Panel, 2008). It seems interesting, however, that this scholarly pursuit seems to have occurred in isolation from other developmental spheres through which children progress. While movement, play, and music may not, at first glance, *look* like literacy, they are invaluable contributors to its development

Movement

Evolutionarily speaking, movement enabled the survival of our ancestors. Not only did it allow physical escape from long-ago predators, but aerobic exercise also provides additional oxygen to the brain, enhancing problem-solving, and increasing the production and resiliency of neurons (Medina, 2008). Movement, in short, contributes to the development of brains that are well-equipped for survival, adaptation, and growth.

Physical movement is generally divided into two broad areas: gross motor and fine motor. Gross motor movement involves the whole body or large parts of the body (e.g., arms and legs). Fine motor movement involves more refined, smaller muscle coordination, such as grasping a block or coloring with a crayon. The two systems develop in tandem, building off one another, contributing to and reflecting the coordination and communication occurring between the brain and body. As children move within their environments, the brain uses information gathered through the senses as fuel, strengthening and reorganizing its structures, making new connections, enhancing its understanding of the world, and sending continuous messages to keep exploring (Medina, 2010).

Movement is thus a visible indicator of the brain's state of development. Skipping, for example, is a behavioral indicator of neurological organization (Niklasson, Niklasson, & Norlander, 2010). The movement requires timing, coordination, and rhythm, involves both hemispheres of the brain, and denotes efficient neural processing. In essence, skipping is one of the brain's motoric signals that it is ready to move on to higher learning pursuits.

In addition to its evolutionary biological roots, history also records the use of movement's symbolic meaning. Movement likely preceded language itself, acting as a representation of desires, thoughts, emotions, and behavior (Place, 2000). Native Americans have traditionally used movement to visually *tell* legends and histories (Johnston, Hixon, & Anton, 2009), just as dancers have used their bodies to convey thoughts, emotions, and stories for centuries (Goodgame, 2007). Indeed, ballet's script of precise movements and rules of arrangement to convey meaning have even been compared to the vocabulary and syntax that structure verbal languages (Johnston, 2006). Complete languages, such as American Sign Language, exist based solely in hand, arm, and facial movements. Gestures can be found in nearly every culture in the world, representing units of meaning, as well as developmental progress in language acquisition (Goldin-Meadow, 2009; Place, 2000).

Play

From a developmental perspective, play represents one of children's earliest approaches to information processing, environmental exploration, and problem solving, and has been shown to enhance cognitive, physical, social, and emotional functioning (Elkind, 2007; Fischer, 1980; Piaget, 1962, 1969). Piaget (1969) emphasized the interactional nature of child development, explaining that children take in or assimilate new information about the world through their experiences, which in turn affects how the child perceives and behaves. Additional experience provides new knowledge, which modifies and expands previous understanding (i.e., accommodation), altering how the child is able to interact with the world.

Neuropsychologically speaking, play is also an integrative multi-sensory endeavor. All objects have defining characteristics such as texture, color, mass, density, sound, and, regardless of their actual food status, taste. All of these sensory features are processed by specific areas in the brain. These become stronger, and the pathways to and from them become more efficient, as a result of children's play. Through playful exploration, experimentation, and engagement with these different characteristics, the brain becomes more adept at categorizing, storing, and retrieving information. The pathways used to process sensory information have been used with such regularity they have been deemed worth keeping (Medina, 2010). Children must thus receive plentiful input (e.g., sensory-based play experiences) in order to produce output (e.g., behavior, motor movement, language, or literacy). The brain of a being at play experiences longer periods of neurogenesis and synaptogenesis, contributing to its plasticity and capacity for learning (Brown, 2009).

Like movement, as children's play behavior matures, it too develops symbolic meaning (Pellegrini, 1985; Piaget, 1969). Symbolic representation in play evolves from highly concrete, in which one physical object assumes the properties of another, to highly abstract, in which something is created from nothing (Fischer, 1980; Piaget, 1969). Blocks become canoes, carpet the river, and children must concoct a plan for surviving the approaching rapids that exist only within their minds. Such a scenario illustrates meta-play and is an advanced play skill that is highly correlated with reading achievement (Roskos & Christie, 2011). This playful practice in abstraction enhances the transition to the highly symbolic processes of literacy. Written words have no inherent significance. It takes a great deal of imagination and practice to become adept at assigning meaning to what are essentially scribbles on a blank page, and play provides a source of this practice (Pellegrini, 1985; Roskos & Christie, 2011).

While research exploring the connections between play and literacy have appeared in the literature for decades (Elkind, 2007; Pellegrini, 1985, 1998), Roskos and Christie (2011) argue that the majority of this research has been correlational in nature, and that studies employing a more experimental and dynamic skills framework are needed. This framework emphasizes the interactive nature of play skills and cognitive development. Growth in one area contributes to growth in the other and vice versa, indicating that it is important to view skills in the context of environment and experience.

Music

Music is an element of the physical world. Nature is replete with melodies, and a particular symphonic collection of sounds can even form an identifying *soundscape* for a specific context, such as the tinkle of wind chimes from the patio of a grandparent's home (Salmon, 2010). When these soundscapes are heard, the mind creates images of the associated context. Music is thus a gateway to mental imagery, schema, and prior knowledge–factors that are critical in the comprehension of spoken and written language (Carr & Thompson, 1996). In her (2010) classroom study, Salmon found that children were more detailed and enthusiastic in their written and illustrated story retellings when the original story reading was accompanied by an instrumental soundtrack that matched the story's tone.

According to Welch (2005), human infants are born with innate musical ability, resulting in part from sound experiences in the womb. This musical ability can either become enhanced or worsen as a result of environmental musical support, and like other skills, young children's musicality also follows a phase-based developmental progression that begins with melody before language. It is this perception of sound qualities in general that prepares the brain to differentiate sounds in language, a critical skill in early language and literacy development (Aleman, Nieuwenstein, Böcker, & de Haan, 2000; Bolduc, 2009; Peretz & Zatorre, 2005).

Vocal music (i.e., songs) offers an engaging linguistic opportunity. Welch (2005) describes singing as a process that "involves words and music interwoven in a complex cognitive and physical behaviour that has strong cultural associations" (p. 119). Songs, like texts, tell stories. These stories have structure, with a beginning, middle, and end, and follow the rules of language, providing fun and friendly practice with syntax and flow. Children can also be introduced to new vocabulary, rhymes, alliteration, and other components of language and literacy through music (Dodge et al., 2002; Peretz & Zatorre, 2005).

Movement, play, and music interact with one another and neuropsychological development to assist the transition of language, problem-solving, and symbolic representation (i.e., object-referent systems) from the external social realm (i.e., interpsychological) to an internal (i.e., intrapsychological) meta-cognitive process (Vygotsky, 1978). This ability to think about language, to mentally formulate images, and to retrieve cross-indexed information from long-term memory stores to create meaning for things not immediately present in the physical environment, are critical literacy skills.

Literacy

Research about the brain, movement, play, and music illuminates the finding that the foundations for literacy begin to form before children can even speak. Indeed, there is evidence that fetuses become attuned to their mother's voice in the womb (DeCasper & Fifer, 1980; Kolata, 1984), introducing the sounds of language before the face of family. Literacy development has been studied in such depth (Buhs, et al., 2011; Faust & Kandelshine-Waldman, 2011; Lonigan, et al., 2011; Woods, 2011; Yatvin, 2005) that the *Big Five* skill areas of reading are now considered common knowledge (National Early Literacy Panel, 2008). Hierarchical in nature, these key areas begin with the basic skill of phonological awareness and progress to alphabetic principle (i.e., phonics and word study). Exposure and practice enable accuracy and fluency, and when combined with vocabulary development, these skills ultimately provide the foundation for the complex skill of reading comprehension.

Phonological awareness comprises such tasks as identifying individual sounds in a word as well as blending those sounds together to make smooth words. This construct includes phonemic awareness, or knowledge of the sounds of language (e.g., knowing the word bath has the sounds /b/ /a/ /th/). Phonemic awareness is related to decoding, spelling, and reading comprehension, and is one of the best predictors of later reading achievement (National Early Literacy Panel, 2008). *Alphabetic principle* (i.e., phonics and word study) reflects the relationship between oral language sounds and written symbols (i.e., letters). It is not only the basic letter-sound correspondence used in basic decoding (e.g., knowing the sounds that the letters *p* and *o* make individually and blending them together to read the word *pop* in a story about balloons and trees), but also includes more advanced strategies such as roots, prefixes, and associated word meanings. It is also a crucial component of translating written text into oral language and thus reading comprehension (National Reading Panel, 2000). *Fluency* is a measure of a student's accuracy, speed, and intonation while reading. A good reader will be able to recognize many words automatically, decode (i.e., sound-out or translate the written symbol of the word to its constituent sounds) unfamiliar words quickly, and read with inflection and good pace. Fluency is a necessary component for reading comprehension. When students must spend a great deal of time decoding words, little mental energy remains for actually understanding what they have read (National Reading Panel, 2000). *Vocabulary* refers to the collection of words and their meanings stored in a student's mental lexicon. It is learned through students' interactions with other individuals, as well as written stories and other texts. Students accumulate both an oral vocabulary (i.e., the words they speak and understand) and well as a reading vocabulary (i.e., the words they recognize in print). Vocabulary interacts positively with fluency and comprehension, as students are more likely to quickly recognize and understand familiar words (National Reading Panel, 2000). *Reading comprehension* measures how well a student understands what he or she has read. Reading comprehension occurs along a continuum ranging from literal understanding to making hypotheses about the text content and author intention, to making connections between texts and contexts. Strategies for comprehension can be directly taught. Reading comprehension can be referred to as the ultimate goal of reading–reading to learn (National Reading Panel, 2000).

Education Through Music

Music programs have recently been shown as promising contributors to the development of skills necessary for reading development (Corrigall & Trainor, 2011; Gromko, 2005; Moritz et al., 2013; Overy, 2003). *Education Through Music* (ETM) is a form of music education for children, starting in infancy. ETM is designed for use in all classroom types, including general subject and music-specific classrooms. Its curriculum incorporates findings from music, play, education, developmental, and neurological research. The program utilizes folk songs combined with song-experience games, and techniques such as secret songs, mapping, and hand-signs (described in greater detail in the following chapter).

Current Study

While movement, play, and music and have each been found to contribute to neurological and literacy growth, no study has researched these elements collectively to determine if playful, purposeful, multisensory experiences contribute uniquely to the development of literacy in children. The present study evaluated the effects of a program, *Education Through Music*, which incorporates each of these themes into its basic methodology, on the development of literacy. The investigation sought to address the question of whether there are differences in early literacy development rates between Education Through Music (ETM) and non-music-oriented classrooms.

> It was the hypothesis of this study that kindergarten students who participated in an Education Through Music classroom would demonstrate significantly better phonological awareness skills than kindergarten students in a non-music-oriented classroom, over the course of a school year.

Chapter 2

Literature Review

Children must first be participants in the world before they can communicate about their experience in the world. They must, in turn, be experienced oral communicators before they are able to convey and comprehend written communication (i.e., reading and writing). Brain development is synchronized with this process, occurring in a bottom to top, sensory to abstraction, basic reaction to complex thought order of development (Healy, 2004b). Reading is one of the most abstract, complex challenges required of the brain in modern times (Wolf, 2007). At some point in the reading process, nearly every specialized function of the brain is recruited, calling upon visual perception, auditory processing, the emotional system input of motivation and attention (de Diego-Balaguer, Martinez-Alvarez, & Pons, 2016; Rose & Dalton, 2009), as well as the motor and executive contributions of planning, sequencing, and organizing (Rose & Dalton, 2009). Research has long sought the holy grail that can transform all students into readers. The answer is that, at least for now, there is no answer. No single activity turns on the reading switch. A reading brain is a well-connected brain and a well-connected brain is only formed through a lifetime of experience, beginning even before birth (Healy, 2004b; Medina, 2010). Over the course of this decades-spanning topic of inquiry, it has been demonstrated that many of the activities to which children are naturally drawn, namely movement, play, and music, are quite neurologically enriching, creating fertile ground for reading to develop (Brown, 2009; Kraus & Slater, 2015; Overy, 2000; Roskos & Christie, 2011; Tierney & Kraus, 2013). While strategies may differ, educating children, creating readers and lifelong learners, requires both an understanding of how the brain develops as children mature as well as a plan for developing an environment that honors and nurtures the process.

Education and Curriculum: Models and Influences

As an alternative to traditional schooling in the United States, there exist models of education in which the pendulum has remained relatively stable, their philosophies grounded in research-supported theories of child development and learning. These alternative education models share a common philosophical belief that children are innately motivated to learn and that traditional schooling methods are not equipped to either enhance or maintain self-directed learning (Burnett, 2007; Schwartz, 2008). In addition, they contend that traditional schooling has a rigid, clinical adherence to conventional academics (e.g., didactic teacher-led instruction, independent seat-work) and neglects important areas of development (Schwartz, 2008). Both the Montessori and Waldorf methods emphasize individually-based and paced education. Classrooms are multi-age (spanning three years in Montessori classrooms) and children are allowed to work on a task until it has been mastered. In effect, it is the students who are self-teachers, while the adult *teacher* adopts a role more akin to *guide*, structuring the environment in such a way that encourages exploration, experimentation, and discovery (Burnett, 2007). Art (e.g., music, drawing, woodwork) is a critical component of curriculum. It is seen as a learning element in its own right, rather than a reward, supplemental exercise, or frivolous use of time as it may be perceived in other settings.

There is limited empirical data related to student outcomes in these programs; however, what is available indicates that student academic achievement matches that of students in a more traditional school setting (Mallett, 2015), and in some instances, may actually exceed (McDurham, 2012). These education models offer compelling avenues for supporting the development of the reading brain and it seems feasible to incorporate key features of these nontraditional methodologies within typical public school classrooms. The question then arises of what this might look like and whether or not it would be as effective or even more effective than traditional education techniques. As can be seen in the studies described below, many researchers have examined just such an endeavor, and in fact have found numerous positive results.

To Play or Not to Play: A Politically (Not Developmentally) Charged Debate

For as long as there has been a system of schooling, there has existed tremendous debate concerning how the system should function. Every decade or two, the educational pendulum shifts from one side to the other, granting each side temporary victory, disguising the fact that no true resolution has been created. An examination of educational policy in the last six decades and the historical events with which its changes coincide illuminates the interplay between education, play, and politics. The relationship between play and education is at times highly divisive, with some advocating that play is a critical element in the learning experience (e.g., Thompson, 2004; Walsh, Sproule, McGuinness, & Trew, 2011; Zigler & Bishop-Josef, 2004), while other, mainly political opinions, would seem to argue that there are clear boundaries between what is play and what is academic (No Child Left Behind Act, 2001, [NCLB]).

One of the earliest separations of school and play in the United States can be traced to the 1957 launching of the Soviet Union Satellite, Sputnik. Zigler and Bishop-Josef (2004) interpret the resulting replacement of play with mathematics and science-centric curriculum as a threat response by the American government for having been *beaten* in the space race. They note that the most vocal opponents of play in school were from the American military, and not from the fields of child development or educational research.

Positivity towards play re-emerged in part from the research and writings from developmental psychologists such as Piaget (1952, 1969) and Vygotsky (1978), who examined the developmental progression of play throughout childhood. The hypotheses they made about play and its connections to the process of learning, as well as its contributions to the mental, physical, social, and emotional growth of the child, inspired decades of research. During the relative calm and prosper of the late 1970s-1980s, play was even purposefully and thoughtfully included in the classroom (Wolfgang & Sanders, 1982).

Empirically speaking, play-focused research has continued to grow and is fairly prominent in the literature base, crossing disciplines such as medicine (Ginsburg, 2007; Thompson, 2004), child development (Pellegrini, 2009), and education (Walsh, Sproule, McGuinness, & Trew, 2011), often with positive findings. True to history's pattern, however, there is a disconnect between what is reported in the research and what is implemented in the classroom. As recent focus in education has shifted to proficient performance on high stakes tests (NCLB, 2001), it appears to have been directed away, at least in part, from allowing children to explore their natural interest-based pursuits. Teachers are required to devote a district-specified number of instructional minutes each day to the subjects of reading/language arts, mathematics, science, social studies, and potentially one-on-one instruction for students designated as *English Learners*. In many instances, the resulting curriculum is primarily teacher-directed, significantly limiting children's opportunity for self-directed learning, and in some classrooms essentially eliminates play, even among lower grade levels (Segal, 2004). Despite the beneficial, and indeed significant contributions of play to development, Jarrett et al. (1998) note increasing concern over the rapid decline in the amount of time that children spend engaged in imaginative, unstructured play and musical activities. Rising in tandem with the emphasis on test scores brought about by NCLB is a surging belief that the most efficient way to improve learning is to increase the amount of time children spend in the classroom completing traditional academic tasks, in consequence decreasing outdoor, play-based, and musical activities such as recess and music (Pellegrini & Bjorklund, 1997). While research does indeed show a connection between time allocated for play in school and desired behaviors such as academic achievement and prosocial behaviors, the relationship is actually contradictory to the logic just described. For example, as time allotted for recess diminishes in the effort to increase student performance, the opposite outcomes result. One study found that behavioral problems increased and academic achievement declined (Jarrett et al., 1998). Another study demonstrated that children's attention for classroom tasks actually increases following play-based activities such as recess (Pellegrini, Huberty, & Jones, 1995). Not only do students display fewer internalizing problems, such as anxiety and depression, and externalizing problems such as hyperactivity (Holmes, Pellegrini, & Schmidt, 2006; Jarrett et al., 1998) and aggression (Kuo & Sullivan, 2001) when they are given adequate time for outdoor recess, they also perform better on standardized tests and curriculum-based measures of achievement (Pellegrini & Bjorklund, 1997). Research has shown recess to be such an important part of the school day that it is endorsed by the National Association for Sport and Physical Education, the National Association of Elementary School Principals, the National Association for the Education of Young Children, and the American Association for the Child's Right to Play (Ginsburg, 2007; National Association for Sport and Physical Education, 2001). When viewed collectively, these studies indicate that when play is purposefully included in educational planning it has the potential to significantly contribute to academic, physical, social, and emotional growth, which are all components of school readiness in general and language development in particular. These are also the foundational skills of reading, and are necessary before more formalized and targeted instruction can successfully occur.

Modern Reading Instruction and Intervention

Current reading instruction and intervention typically focuses on the Big Five skill areas identified by the National Early Literacy Panel (2008), which include phonological awareness, alphabetic principle, fluency, vocabulary, and comprehension. Curriculum and assessment are designed to ensure that students acquire these skills with the assumption that they will lead to fluent reading with comprehension. It may be the case, however, that students enter school without the prerequisite background experience and skills necessary to begin instruction at this level and that classrooms may need to focus first on skills that precede even the Big Five (Joseph, 2015; Kraus & Slater, 2015; Tierney & Kraus, 2013).

General education. Direct instruction of phoneme to letter mapping and manipulation is one of the most widely used and accepted teaching strategies for reading instruction in the early grades. This is not to say that it is the only strategy utilized, merely that it is the one which has received the greatest attention in both general education and intervention research (Joseph, 2015). Many school districts adopt published reading series as the primary component of reading instruction in general education classrooms. Reading series are typically segmented into units of instruction and include pacing guides to indicate how quickly the lessons should progress (Pearson, 2013). Some reading series are also scripted, indicating that the teacher is expected to conduct the lesson by following the prompts within the manual. Routman (2003) indicated that there are benefits and deficits to this approach. Scripted and paced programs aim to ensure consistency in implementation from one classroom to the next and may also provide a degree of support for inexperienced teachers. What is often absent from these programs, however, is the kind of natural dialogue (e.g., free-flowing language in a meaningful context) between student and teacher that is often more beneficial than a pre-recorded answer that may or may not be sensitive/responsive enough to a given situation (Routman, 2003; Zigler & Bishop-Joseph, 2006). Regardless of specific content or format (e.g., organization of lessons, scripted or unscripted teacher prompts), most reading programs currently in production highlight their alignment with the Big Five, in part to demonstrate the research and/or evidence base for the program.

Reading assessment and intervention. Many assessment tools in the school setting are also aligned with the Big Five categories. Aimsweb, for example, is a frequently used and National Center on Intervention recognized, curriculum-based assessment tool providing resources to assess and monitor children's progress toward reading goals (in addition to spelling, writing, and mathematics). In its *Test of Early Literacy*, designed for kindergarten and first grade, it uses multiple probes (i.e., short tests) to assess aspects of children's phonological awareness (i.e., ability to segment phonemes) and alphabetic principle (i.e., letter naming and letter to sound mapping) skills. Reading fluency (grades K-8) and reading comprehension probes (grades 1-8) are also available. In some school districts, these assessments are given tri-annually to the entire student population as a reading-health *check-up*, and as a tool for determining which students are in need of reading intervention, as determined by national benchmark goals and norms provided by the publishers. Likewise, students who are determined to be in need of intervention are assessed more frequently throughout the year using these measures (also known as progress monitoring) to determine response to intervention.

Reading interventions themselves are also primarily focused on the Big Five, with the guiding principle that the skill areas develop semi-hierarchically, and that foundational areas (beginning with phonemic awareness) must be mastered before the next reading skill can develop (e.g., alphabetic principle). Reading interventions are typically matched to the area of deficit noted by assessment (e.g., segmenting/blending phonemes, oral reading fluency). Joseph's (2015) primer for reading assessment and intervention, for example, is considered a *go-to* reference book and is published by the National Association of School Psychologists, indicating its likeliness to be utilized in the schools.

Beyond the Big Five. While the value of the traditional Big Five areas of reading development still remains strong, research indicates that they are neither the only skills important to consider in reading acquisition, nor do they operate in isolation. Joseph (2015) lists that, in addition to the Big Five, oral language, broader phonological awareness, and rapid automatic naming skills are also critical to reading development. The inclusion of these skills is somewhat novel in that they typically develop in early childhood, before the introduction of formal reading instruction. Culminating brain research is also beginning to suggest that, in addition to phonological awareness, auditory sensitivity in general (i.e., how the brain processes all sounds) and multisensory integration, which develop from experience in the physical world and are related to the creation of meaning and mental representations, are quite possibly the penultimate precursors to reading development (Kraus & Slater, 2015). In this regard, they may be considered the *bedrock* to the foundational Big Five. Even more important is the fact that many students still demonstrate weakness in these areas, even as they are being expected to learn and become proficient in the traditional areas of reading. As such, these areas are often not considered when assessing reading development, resulting in an incomplete picture and leading to instruction that may not be effective. Fortuitously, brain research also indicates that these skills can continue to be developed even through adulthood, and that movement, play, and music may be uniquely suited for the endeavor (Moritz, Yampolsky, Papadelis, Thomson, & Wolf, 2013).

Neuropsychology: How the Brain Learns

Humans are hardwired for learning. Only a few weeks into gestation, the primitive fetal brain produces 1.5 billion neurons each day, and continues this rate of growth for an entire year after birth (Medina, 2010). Such is the plethora of dendritic connections at birth that infants enter the world with the neurological capacity to learn nearly anything. This process of learning occurs through the construction of new mental pathways (i.e., synaptic connections) or new connections among mental pathways, allowing for shared information among and between different specialized areas in the brain (e.g., vision, hearing, motor movement). The formation of these mental pathways and connections creates relatively permanent acquisition or reorganization of knowledge that brings about new comprehension about the world (Bruning, Schraw, Norby, & Ronning, 2004). Pathways, or specific patterns of neuronal activation, are formed and maintained through repeated use.

The brain uses electrical signals to pass messages down neuronal pathways to get information from the environment and tell the body how to react. Each time a message pattern *fires* in the brain, support cells called myelin coat neurons in a sheath resembling and functioning as insulation (Breedlove, Watson, & Rosenzweig, 2010). Repeated *firing* of these pathways strengthens their myelination, resulting in rapid communication along webs of chained neurons, enabling the brain to readily access, store, and recombine information in long-term memory, and carry it forth to working memory. Infrequently used connections are pruned to save space and energy for more common endeavors (Medina, 2010). Essentially, the brain employs a *use it or lose it* philosophy. It grows and becomes more efficient through practice (i.e., interaction with the environment), while excising its superfluous components. Despite their incredible neural potential at birth, infants enter the world as *works-in-progress*. Experiences in their new air-based environment are necessary to further development and to actualize abilities for which the extensive synaptic growth of gestation laid the foundation.

Thompson (2004) describes two types of brain development related to experience and the formation of neural pathways: *experience expectant* development and *experience dependent* development. Experience expectant refers to brain development in which specific experience or stimulation is both expected and required, such as sensory perception (e.g., hearing, vision), language, and motor coordination–systems that are nearly universal in the human species. The brain is hardwired to attain and use these systems, and yet still requires input from and interaction with the environment in order to sustain the neural connections that are present at birth. Experience dependent brain growth is far more individual and occurs throughout the lifespan. Each human collection of experiences is unique, as is the resulting brain organization that contributes to the different skills and abilities (i.e., pattern of strengths and weaknesses) observed from person-to-person.

Interestingly, literacy straddles the realms of experience expectant and experience dependent brain development. While the process of literacy requires the contribution of universal neural components (e.g., language, vision, motor coordination), it also demands that these areas be used and communicate with one another in novel, unnatural ways that can only occur through rich, purposeful interactions with the environment (i.e., experience). Such tremendous functional differences exist in a brain that has acquired literacy versus a brain that has not, that many involved in its research refer to it as a different type of brain altogether: *the reading brain* (Rose & Dalton, 2009; Wolf, 2007).

The Reading Brain

Contrary to what its prevalence in educational curriculum and standards across the globe might suggest, reading was never an intentional feature of the brain (Wolf, 2007). There exists no reading lobe. Present instead are areas designed for language, vision, motor movement, hearing, planning, coordination, among many others. Each of these areas, individually and combined, contribute to the process of reading, but must be *hijacked*, per say, in order to manipulate and reorganize their functioning in such a way as to result in a *reading brain*. This process is time-consuming and extremely effortful.

Essential components of the reading brain. Imaging studies (e.g., fMRI, PET) indicate that the functional neural architecture of the brain is changed significantly as a result of literacy acquisition (Petersson, Reis, & Ingvar, 2001). The brain structures appropriated by the reading brain can be considered in three general cortical regions: the posterior cortex, the anterior cortex, and the limbic system (Rose & Dalton, 2009). The posterior cortex is responsible for recognizing patterns, including sensory information such as vision, hearing, and smell. In the reading brain, this region applies its pattern recognition function to the rules of written and spoken language (e.g., orthography, phonology, syntax). The anterior cortex contains the brain's strategic networks and is responsible for planning, organizing, and coordinating an action. The reading brain uses this region as a kind of metacognitive tool for planning reading strategies, such as looking for familiar words, re-reading, knowing how to look for different perspectives, and self-monitoring comprehension. The limbic system houses the networks for emotion and affect, and impacts what we value and which environmental patterns we are motivated to attend to in a given situation. In the reading brain, the limbic system guides the general approach to reading, determining if the text is worth the effort or if other demands take precedence.

Although there are specialized cortical regions, there often exist multiple locations in the brain that work in tandem to process a given task, such as letter or word recognition. According to Rose and Dalton (2009), this distributed network of activity not only contributes to the acquisition of literacy, but also changes based on the individual reader and text variables (e.g., reader experience and background knowledge, text difficulty).

Rose and Dalton (2009) describe reading as a pattern-based system. The reading brain must recognize patterns, plan strategies, and feel. Reading requires the visual identification of letters and words, as well as an understanding of the rules of a written language (e.g., orthography, grammar, syntax) and the rules for the sounds of a language (i.e., phonology). In addition, a variety of strategies are useful when encountering unfamiliar words (e.g., sounding out each letter, recognizing word chunks, root words, prefixes, suffixes). With experience, the availability of these strategies of approach is enhanced, as is the ability of the reader to self-monitor the application of a given strategy. At play with both of these processes is motivation. The reader must decide if it is worth the time and effort to even attempt puzzling out the written patterns. When these processes work efficiently and in tandem, the reader is able to derive meaning from a text, rather than simply decoding its words.

Each system contributes uniquely to the process of reading; a weakness in one area could cause a disruption in the system resulting in difficulty, delay, or disability in its acquisition (Rose & Dalton, 2009; Wolf, 2007). Conversely, environments richly supportive of these areas could potentially lessen or prevent these reading problems from occurring.

The reading brain's relevance in education. Understanding how the brain develops normal processes, as well as the abnormal process of reading, highlights two important outcomes that are critical to education. Not only do the events in the child's learning environment contribute to the tenet of *use it or lose it*, but also to the reading brain's notion of *use it AND reuse it*. To borrow from a current catchphrase, the entire process of reading can be thought of as *up cycling* – creating a magnificent new system by assembling existing components in a novel fashion. If reading is expected in the schools, it should then follow that classroom design incorporate what is known about the demands of the reading brain's growth and development. A supportive reading brain environment would include numerous and varied opportunities to practice language, to engage the senses, to experience different forms of movement, and to do so with ample interaction with others.

The Reading Brain: Relations to Movement, Play, and Music

It is worth noting that play and music are highly child-motivating, low-cost, platforms in which these elements of a supportive reading brain environment occur naturally and repeatedly. The interactive nature of brain development and environmental influence allows, if not insists, the investigation of literacy acquisition take a multidimensional path. Movement, play, and music, influential in both neurological development and literacy acquisition, are three such dimensions.

Detecting patterns and making predictions: Language and sound. Language is perhaps the earliest pattern with which infants become accustomed. Orienting to speech sounds even in utero, the earliest auditory pathways become entrained to attend to the speech sounds infants hear on a regular basis. This early entrainment prepares the brain for expertise in its native language, while also decreasing sensitivity to foreign language sounds not experienced on a regular basis (Kuhl, 2004). Language lies at the heart of reading, as the written word is essentially oral language captured in print. As such, language research is becoming increasingly more prominent in the study of reading (e.g., Forgeard, Schlaug, Norton, Rosam, & Iyengar, 2008; Kraus & Slater, 2015; Overy, 2000; Tierney & Kraus, 2013; Zhang & McBride-Chang, 2010). Long considered to be a contributing factor in overall development and academic achievement, language is now viewed as a critical component in the development of reading skills (Joseph, 2015). Exposure to spoken language contributes to a child's internalization of how sounds work or function within a given language. This includes vocabulary (i.e., the meaning of words or groups of sounds), semantics (i.e., meaning of words in a particular sentence or phrase), and syntax (i.e., the structure of language, how words are arranged), and contributes to decoding and comprehension. These elements assist in both decoding and comprehending written text. Language, movement, play, and music are related in a number of different ways.

Movement is considered to be a precursor to formal language (e.g., infant gesture), a tool for emphasizing important aspects of language (e.g., hand motions while speaking), as well as a well-developed language in itself (e.g., American Sign Language). Motion itself may even convey meaning. For example, in signed languages, motion is used to express the direction of transfer (e.g., either towards or away from the signer) of both concrete objects and abstract concepts, such as receiving good news (Brown, Martinez, & Parsons, 2006). Likewise, the similarities between language and music are abundant. Language and music are both hierarchical systems, in which smaller elemental units (e.g., language phonemes, musical notes) are combined to form a larger whole that takes on greater meaning than the mere sum of the individual components (e.g., sentence, musical phrase or composition). Rather than a haphazard collection and assembly, there are also rules governing the arrangement and manipulation of both linguistic and musical sound (Anvari, Trainor, Woodside, & Levy, 2002). Just as musical meaning can be defined by elements such as rhythm patterns, pitch, and melody, so too can meanings in language be conveyed through rhythm patterns, pitch, and stress relationships. See Appendix A for a more detailed comparison. The commonalities between music, language, and the development of literacy extend beyond these observable surface qualities to the cognitive domain.

Neurological foundations for language and reading. Debate exists in the research literature regarding the neurological processes most important in language learning and reading development. One of the richest avenues for researching how successful reading occurs in the brain is by comparison with brains that demonstrate difficulty in acquiring reading (e.g., in dyslexia). The purpose of this research is threefold: prevention, intervention, and high quality learning environments. Learning what is necessary for successful reading development and where the process can go awry can inform the creation of interventions for children with reading disabilities, as well as school and home environments that can help prevent reading disorders in children who may be at risk. Two areas of research include speech-sensitivity and general auditory sensitivity.

Some argue that speech-sensitivity is the best indicator of language and reading development, as written text symbolizes spoken language. They highlight this specialized level of sound processing as key, as not all children who demonstrate reading difficulty also demonstrate impaired general auditory functioning (Mody, Studdert-Kennedy, & Brady, 1997). Others argue that speech-sensitivity may be too limited and that more general auditory sensitivity is the critical factor, as many individuals with reading difficulties demonstrated impairments in both speech and non-speech processing (Kraus & Slater, 2015). Disagreement in the research has occurred primarily because a mixture of results has indicated that either one or the other or both has been found to be a significant predictor of reading ability, or conversely, disability, depending on how the study was designed and who participated.

Rather than an either/or approach to these hypotheses regarding language and reading development, Zhang and McBride-Chang (2010) proposed an integrated model of these neurological pathways. The researchers suggest that *both* auditory sensitivity and speech-sensitivity are unique and complementary contributors to language and reading development. The authors stated that auditory sensitivity, reflecting how different aspects of non-speech-specific sound are processed, can be divided into two categories, rhythmic and temporal. The rhythmic aspect of auditory sensitivity relates to the stress or strength and weakness of sounds and contributes to the perception of word boundaries. Temporal processing of sound indicates the discrete time space that sounds occupy in addition to how rapidly they occur in sequence (e.g., stop consonants occur more rapidly in time than vowel sounds, although this applies to non-speech sounds as well), which contributes to phonemic awareness. Speech perception is likewise divided into two primary categories – suprasegmental and segmental. Suprasegmental speech perception is the first to develop and includes broader awareness of speech elements (e.g., speech prosody, including stress, lexical tone, and intonation) and larger portion segmentation (e.g., onset-rime, syllable segmentation). Segmental speech perception develops later and is specific to the individual phoneme level.

Zhang and McBride-Chang's (2010) model posits that rhythmic auditory sensitivity is most related to suprasegmental speech-perception, which in turn contributes to segmental speech perception, verbal short-term memory, phonological awareness, rapid automatized naming, and morphological awareness, leading finally to reading. Similarly, temporal auditory sensitivity is linked to segmental speech-sensitivity, which contributes to verbal short-term memory, phonological awareness, and rapid automatized naming. These, in turn, contribute to reading ability. Overarching each of these interconnected pathways is the premise that sensitivity to sound, whether speech-specific or more general, is integral in the process of learning to read. Intriguingly, although not specifically included in the Zhang and McBride-Chang (2010) model, movement, play, and music are all integrally connected with the processes in the model, strengthening neural networks that contribute to language and ultimately reading.

Auditory Sensitivity and Speech Sensitivity: Contributions of Movement and Music. Making sense of the sounds that occur in the environment is an incredibly complex process, acutely so for speech sounds, that requires a precisely-tuned auditory processing system (de Diego-Balaguer et al., 2016; Strait, Kraus, Parbery-Clark, & Ashley, 2010). There are, in fact, so many sounds occurring at once that if the brain attended to them all, it would quickly become overwhelmed, as can happen in the case of those with sensory disorders and sensitivities, such as Autism Spectrum Disorder (Visser et al., 2013). The brain must decide which sounds are most essential in a given moment and which sounds can effectively be ignored. This decision is made by a number of interactional neural processes, including those responsible for attentional and perceptual abilities (e.g., the auditory cortex, sensorimotor cortex, and the frontal lobes) (Strait et al., 2010; Strait, Slater, O'Connell, & Kraus, 2015). The effectiveness of the decision-making network is enhanced by experience, particularly with speech and music sounds.

De Diego-Balaguer et al. (2016) describe attention as a causal factor in the process of learning in general. They point to temporal attention, the ability to track auditory information in time, as a specific factor in language development, particularly as many characteristics of speech are time-related. Attention and cognition are interactive, as attention serves as a kind of mediator in what and how something is processed. Joint attention, or shared simultaneous focus on an object or activity, often occurs both in everyday interactions and in play situations. For example, as a parent follows the gaze and chubby-handed reach of an infant, retrieves a beloved toy hippopotamus, and admires the crinkly noise its sparkly tutu makes as the child rubs the fabric, parent and child are jointly attending to the same object. When coupled with descriptive dialogue, these shared experiences can also create a link between words and objects or actions. The authors distinguish between exogenous, or bottom-up attention, and endogenous, or top-down attention. Exogenous attention occurs early in development and is influenced by environmental stimuli, such as speech features, including prosody, pitch, rhythm, etc. Endogenous attention, by contrast, is primarily learned through experience, selecting and disregarding information for processing, based on perceived relevance and established relationships, and is useful in learning more complex language rules. The authors view attention as developing over time in conjunction with the development of language skills. In essence, attention likely develops at the speed necessary for language acquisition, with attention focused first to the basic form and then to the rules.

Temporal processing and attention has been the focus of numerous studies examining musical training, as described previously. These studies have found that both exogenous and endogenous temporal attention resources benefit from musical training, and that important aspects of language and reading development benefit as well (Kraus & Slater, 2015). Pantev et al.'s (2003) study demonstrated the developmental progression of auditory attention using magnetoencephalography (MEG) to monitor neural activity. Non musicians were able to perceive the overall contour (melody) of the musical stimulus, while musicians perceived not only the contour of the sound, but also the individual components and were better able to predict what should come next in a sequence based on internalized representations of the sound pattern (i.e., demonstrated greater neural activity when the tone deviated expectations). This contrast mirrors attention development in that those most-novice in musical experience could perceive the form, while those most practiced in musical experience had internalized the rules.

In the literature, language processing is typically described as primarily left-hemisphere dominant (particularly for rule-based aspects such as syntax), while music processing is typically described as primarily right-hemisphere dominant, in homologous areas of the brain (Bever & Chiarello, 1974; Brown, Martinez, & Parsons, 2006). It has been demonstrated, however, that as experience/training in either language or music-based activities increases, brain activation actually becomes more bilateral, even resulting in activation of areas presumed to be domain specific, either for music or for language. This suggests a number of things. Above all, this change indicates that the brain is actually quite plastic (Pantev et al., 2003; Strait & Kraus, 2014). Even after the spectacular neurogenesis and periods of heavy pruning that occur in early childhood, the brain is still capable of making new connections (i.e., learning) and significant growth through adulthood, given the necessary experience. It also indicates increased efficiency in neural communication.

Of particular importance to the acquisition of language and reading are specific functions of the auditory system, including auditory working memory, speech-in-noise perception, speech segmentation, and rhythm detection.

- Auditory working memory refers to the ability to mentally hold and manipulate sounds, and is necessary for processing speech, decoding, and comprehension (Kraus, Strait, & Parbery-Clark, 2012).
- Speech-in-noise perception (i.e., auditory figure-grounding) taps the ability to isolate a specific sound among background or competing sounds. Phonologically, it contributes to the ability to rhyme (i.e., separating the onset of the word from the rime) and to segment sound, both at the word and phoneme level (Kraus, Strait, & Parbery-Clark, 2012; Richards, 1980; Tierney & Kraus, 2013).
- Speech segmentation refers to the ability to process sounds in the speech stream, identify boundaries between phrases, words, and phonemes, and is believed to be related to the ability to segment music into notes and phrases (Anvari, Trainor, Woodside, & Levy, 2002).
- Rhythm detection describes the ability to perceive the flow of sound, its beat, or stress-unstress relationship, occurring in both music and language (Overy & Turner, 2009; Richards, 1978; Tierney & Kraus, 2013).

In addition to its relationship with auditory development and early literacy skills, music training has also been demonstrated to contribute to reading comprehension. Corrigall and Trainor (2011) found that length of music training for 6-to-9-year-old children was a significant predictor of reading comprehension, even after controlling for age, socioeconomic status, and full-scale IQ. Studies examining the contributions of movement and play have found similar results.

Feeling: Language and reading comprehension. Reading comprehension is generally considered to be the oasis at the end of the sometimes harrowing stretch of desert that is the process of learning to read. It is the moment when written words are composed not only of sounds, but of scents, textures, tastes, sights, and emotions as well. It is a moment of meaning. Given the intricacies of all the steps that must come before, reading seems nothing short of a miracle. Novelists themselves are even known to ponder the complexities of the reading process. In Jasper Fforde's imaginative series of novels in which the main character, Thursday Next, is able to, quite literally, enter a text and engage with its characters for the purpose of policing integrity to plotline among other things, reading is described as "…an infinitely complex imaginotransference technology that translates odd, inky squiggles into pictures inside your head" (Fforde, 2003, p.48). While that precise technology may not yet be in use today, a neurological correlate has been discovered that is, in reality, not so far off.

Sensorimotor experience has a great deal to do with the mental representations that are available for the comprehension of events that occur in the physical world as well as on the written page (Glenberg et al., 2008; Lahav et al., 2007; Molnar Szakacs, 2005; Molnar-Szakacs & Overy, 2006). One potential avenue for this process is the Mirror Neuron System

(MNS). The *mirror* component of the MNS is highlighted in the finding that certain regions within the brain are active both when a motor action is performed by an individual and when it is observed. The same pattern of activation has also been demonstrated when an action is simply heard (Lahav et al., 2007). The system's active recruitment and integration of all available sensory data is evident in Ricciardi et al.'s (2009) study examining the MNS in individuals with congenital blindness. Despite the total absence of visual experience, blind individuals nevertheless showed brain activation within MNS regions when asked to identify a variety of sounds. The greatest activation was found for familiar sounds (i.e., sounds with which the participants had the greatest experience). The same patterns of activation were found in the vision-typical control group. The authors concluded that the MNS utilizes a variety of sensory information in its mental representations, and that experience strengthens the neural circuitry involved in the process.

Research has shown that movement-specialized areas of the brain are also recruited in the process of understanding language. Glenberg et al. (2008) found that processing and comprehending both concrete and abstract language activates motor and premotor areas, as well as brain regions typically utilized for perception, action, and emotion. The researchers hypothesized that as an individual interacts with the physical world, their motor experiences create mental *action schemas* which provide a framework for organizing and understanding future experience. These action schemas include such components as who, what, where, and how. For example, experience with the concrete action sequence *get a cookie* helps to establish the framework of giver, receiver, object, and mode of transfer. This schema may then be utilized to understand an abstract concept, such as, *get an idea*. Behavioral and neurophysiological data from the study supported modulation of the motor system in comprehending abstract and concrete language, supporting the presence of action schema in the motor cortex. More broadly speaking, the researchers concluded that motor experiences assist in the comprehension of language involving transfer, both of concrete objects and abstract concepts, both in spoken and written language. Likewise, Zarr, Ferguson, and Glenberg (2013) also found MNS involvement in language comprehension.

Play in Language and Reading Comprehension

Play, like children, evolves over the course of development. Piaget (1962) described children's play as both an indicator of, as well as a means for, developing intelligence. According to Piaget, play moves along a continuum from concrete to abstract, indicating that it is, at least in part, through concrete play that children develop the capacity for abstract thought.

Sensorimotor play as a platform for language. Piaget (1962) asserted that play begins in the sensorimotor realm. *Sensorimotor play* occurs at the intersection of movement and play, where both movement and play are prominent and significant contributors to the process/action. It is, after all, possible to move physically within an environment and gather information about it without acting playfully (e.g., moving a box carefully to check for spiders before lifting it fully). It is also possible to play with minimal movement (e.g., sing an imaginary friend a lullaby while lying in bed). Through interactions with the self and surroundings, infants gradually learn to see themselves as separate from the environment. This otherness inspires an innate fascination with everything in reach, making every object something to be explored. Through every sensory system available to the child, sight, smell, taste, sound, and touch, the child develops an ever-expanding, integrating, and self-modifying knowledge base, which then becomes available to them as a mental representation. Mental representations are the fuel for symbolic play and pave the way towards abstract thought.

Symbolic play as a platform for language. Play may provide the ideal platform for natural language use and manipulation in childhood. Its most obvious connections can be observed through symbolic play. *Symbolic play* is characterized by its use of transformations (Piaget; 1962; Vygotsky, 1978). The identities of objects are fluid and can morph at the child's will, in a seemingly endless series of transformations. Double stitching on a pants-seam can become a train track, a grape the train ascending the mountain, its progress impeded by the monster at the summit, hungry for a tasty, steamy treat. These metamorphoses are made possible by the mental representations available to the child as a result of sensorimotor experiences. They are able to call to mind at will the characteristics of an object not currently present and apply them to one that is, linking mentally the way it should look, sound, smell, feel, and perhaps, in the case of the drooling monster, taste.

More sophisticated symbolic play incorporates its representative features into increasingly complex play scenarios, and is also referred to as *sociodramatic play* or thematic-fantasy play. This type of play typically involves at least two children and often appears as small vignettes, scenarios, or story reenactments, with or without physical props, and are typically longer in duration involving sustained attention (Roskos & Christie, 2006, 2011). Smilansky (cited in Singer & Lythcott, 2004) found that children engaged in sociodramatic play situations use a rich variety of language. In this type of play, for example, words were used to change personal identity, change the nature of objects, substitute spoken words for action, and to describe situations. Language used during play (e.g., type, quantity, and variety) is also positively correlated with current and future performance on language tasks (Roskos & Christie, 2011).

In a study researching the connections between thematic-fantasy play and reading comprehension, a group of children in kindergarten through second-grade heard an adult read a story and were subsequently tested on reading comprehension and story recall (Singer & Lythcott, 2004). Immediately following the reading of the story, the children either acted out the story they had just heard (i.e., thematic-fantasy condition), verbally discussed the story in a group, or drew pictures of the story. The children in the thematic-fantasy condition performed significantly better on both measures, particularly those with the most active roles. To determine if there was a specific component of thematic-fantasy play that most contributed to reading comprehension, Marbach and Yawkey (as cited in Singer & Lythcott, 2004) designed a similar study using five-year-old children. All three experimental conditions utilized reenactment of the story, either with the children's own bodies, with puppets, or with art supplies. Story recall was tested through story playback in which the tenth word was omitted and the children were asked to supply it. The children using their own bodies during the reenactment performed significantly better than the children in the other conditions. These studies indicate that physical movement through sociodramatic play may be beneficial to both children's ability to recall a story, as well as their story comprehension.

Flow/inner motivation: Balancing challenge and skills. Play researchers concede that play is a challenging concept to define (Lillard et al., 2013; Pellegrini, 2009). The observable qualities of play are not as obvious as it may at first seem. Often associated with giggles and squeals, play may just as easily be silent or have the look of deep concentration. A common element in many definitions of play include some aspect of the activity's apparent purposelessness (Brown, 2009; Piaget, 1962). While somewhat inelegant, it is meant to illustrate a defining characteristic of play that is otherwise difficult to observe – an activity that a child performs simply for the pleasure performing it brings. In other words, an action that reflects self or inner motivation.

Csikszentmihalyi (1990) included inner motivation as a central facet of his concept of *flow*. His research stemmed from an investigation of the factors that led to an *optimal experience* in any given endeavor. While flow research originated with adults, Csikszentmihalyi observed that it was regularly observable in children and often while they were at play. According to Csikszentmihalyi, “During the first few years of life every child is a little ‘learning machine’ trying out new movements, new words daily. The rapt concentration on the child’s face as she learns each new skill is a good indication of what enjoyment is about” (p. 47). Flow is most likely to occur when an individual’s skills match the perceived challenges of an activity/event. As one progressively acquires more skills, the challenge must also increase, resulting in ever more growth coupled with ever more challenge. The same relationship can be seen in the skills children demonstrate and the challenges they set up for themselves in play scenarios. The commonalities between flow and play are so great that Brown (2009) refers to it as *play state*.

Similar themes are also found in Vygotsky’s (1978) *Zone of Proximal Development*. In educational settings, this term is often used to describe the relationship between the teacher and student in a learning scenario. The teacher’s role is to provide activities and measured assistance which allows the student to perform one step beyond his/her current abilities. With additional practice, support is gradually removed and the student is able to perform the task on their own. The same process is repeated as learning challenges increase and change, supporting the child's personal growth. Vygotsky also emphasized the role of the Zone of Proximal Development in children's play, stating that play "…creates a zone of proximal development of the child. In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself. As in the focus of a magnifying glass, play contains all developmental tendencies in a condensed form and is itself a major source of development."(Vygotsky, 1978, p.102)

St. John (2004) examined the role of flow, musical play, and education with a group of four and five-year-old children participating in a Kindermusik classroom program. The program curriculum contained singing (e.g., singing games, chants, singing melodic skill games, singing with movement, singing with instruments, and singing a cappella), focused listening (e.g., musical sounds as well as environmental), rhythm activities (e.g., physical experience and notation), instrument playing, movement activities (e.g., moving to recorded music with and without manipulatives, and movement to story-telling), and writing (e.g., activity pages such as tracing rhythms and rests). Over a period of fifteen weeks, eight 75-minute weekly sessions were videotaped and later coded for variables related to flow experience. Behavioral and affective indicators measured included such variables as challenge, perceived skill, and awareness of adults and peers. Results indicated that the flow paradigm of high skill and high challenge was consistently observed during the Kindermusik sessions. Movement activities (i.e., to music and story-telling, with and without manipulatives) were found to be one of the highest flow-generating activities. The children who moved to sound were consistently involved, alert, successful, and actively predicted what came next in the music material, adapting their own behavior to increase the level of personal challenge.

Play research has demonstrated that what is common among the state of play is not its outward appearance, nor even its themes, but rather the shared features and rich internal motivation of its experience (Csikszentmihalyi, 1990). Play is images, textures, scents, sounds, tastes, motions, and emotions, all of which are foundational to language, which is in turn captured by reading. As Brown (2009, p.101) stated, “Play isn’t the enemy of learning, it’s learning’s partner. Play is like fertilizer for brain growth. It’s crazy not to use it.”

Practical Applications: Music Programs in the Classroom

Music is used in the classroom in a number of ways (Register & Humpal, 2007; Wiggins, 2007). Songs are often used to signal and facilitate transition times in preschools and other early childhood settings (Register & Humpal, 2007). Register and Humpal (2007), for example, examined the use of music in relation to activity transitions, student compliance, and on-task behavior in three early childhood classrooms. Their case studies indicated a noticeable decrease in the amount of time it took children to initiate or clean up an activity when indicated, increased compliance with adult directives, and increased engaged behavior in activities. These are important findings within the classroom setting, as fast transitions and high task engagement allow greater opportunities for learning.

It has been long suspected that music and reading have an intimate relationship with one another, but it has only been in more recent history that this theory has been tested empirically. In Butzlaff’s (2000) meta-analysis, the author computed the effect sizes for 30 studies examining the relationship between music and reading. Based on the 24 studies the author classified as correlational, Butzlaff concluded that there was evidence of a strong, positive, and reliable relationship between music study and standardized reading/verbal test performance. Butzlaff concluded that the remaining six studies that met the criteria for experimental classification did not provide sufficient evidence to label this relationship as causal in nature. Significant limitations existed in the experimental study analysis, however, even apart from the limited number of studies available. A large portion of the studies utilized high school upper class students with varying degrees of music exposure. In addition, over half of the studies utilized a measure of reading comprehension as the dependent variable. Comprehension, while an important skill (and indeed the preemptive goal of reading), is also complicated and results from numerous processes including processing speed, long-term memory recall, and working memory among others. As such, the tools employed in the various studies may not have been sensitive enough to measure any change that may have resulted from musical experience. Recent studies, utilizing a much younger participant pool, have indicated that music demonstrates an especially beneficial relationship with the critical skills underlying the process of reading, such as phonological awareness (Anvari, Trainor, Woodside, & Levy, 2002; Bolduc, 2009; Gromko, 2005; Lamb & Gregory, 1993), rhythm perception (Huss, Verney, Fosker, Mead, & Goswami, 2011), and verbal sequencing (Hurwitz, Wolff, Bortnick, & Kokas, 1975; Piro & Ortiz, 2009).

Lamb and Gregory (1993), for example, examined the relationship between musical ability and reading skills in four and five year olds in their first year of school. They found that phonemic awareness was significantly correlated with pitch discrimination (a measure of musical ability) and that both phonemic awareness and pitch discrimination correlated significantly with student performance on two tests of early reading ability. The reading tests measured diverse reading skills, including concepts about print, word matching, letter sounds, word reading, consonant blends, and nonsense syllables. Because phonemic awareness and pitch discrimination are listening skills, the authors interpreted their results as highlighting the role of auditory discrimination in both reading and music, as well as the contribution of musical and phonemic listening skills to reading.

One of the first studies to attempt an experimental investigation of connections between music and other skill areas utilized the Kodály music curriculum (Hurwitz et al., 1975). The Kodály curriculum originated in Hungary and uses folk music, sensorimotor activities, and symbolic musical notations to teach children elements such as rhythm, melody, and notation. Students participated in 40-minute Kodály sessions, five days per week, for seven months, led by an experienced music instructor. Students in the control school received no music instruction, but were considered to be equivalently matched in terms of core curriculum, age, socioeconomic status, and ordinal position within the family. At the end of the first grade year, students who had received the Kodály music instruction scored significantly higher on a standardized test of reading than they had at the beginning of the year. Girls in the Kodály experimental group, who had performed similarly to girls in the control group at the beginning of the year, received significantly higher reading scores than their control group counterparts at the end of the year. Boys in the Kodály experimental group scored significantly lower than boys in the control group at the beginning of the year, but by the end of the year demonstrated growth such that no significant differences were found. In effect, the initial achievement gap had closed. In addition, when the students continued the Kodály music instruction during the second grade year, achievement gains continued to accumulate. Boys in the Kodály experimental group outperformed boys in the control group, in effect reversing the initial achievement gap.

The authors also analyzed first grade reading scores both before and after the Kodály music instruction had been implemented in the school. They found no significant differences between the reading scores (i.e., beginning or end of year) in the two years before implementation. The researchers then compared these scores with the reading scores of first grade children who had received one year of Kodály music instruction after its implementation in the school. Reading scores after one year of Kodály music instruction were significantly higher for those who had received the Kodály music instruction compared to the reading scores in which Kodály instruction had not yet been implemented. Although the children differed in each year analyzed, the grade, time of assessment, and classroom teachers remained consistent. Because both groups were led by the same classroom teacher, whose instructional methods were likely quite similar from one year to the next (with the exception of the introduction of the Kodály music instruction), the authors reasoned that this gave additional support to the contributing factor of the Kodály music curriculum on student academic achievement.

More recently, Gromko (2005) utilized a quasi-experimental study to examine the effect of music instruction on kindergarteners' early literacy skills. Students in the experimental group participated in 30-minutes of weekly music instruction, led by advanced music-method university students. The instruction followed Jerome Butler's theory of cognitive development and experiential learning framework, utilizing folk songs as foundations for each lesson. In addition to verbal practice, students performed simple movements with their bodies, both as a means of visual representation of sound features (e.g., pitch and beat) as well as a tool for sound perception. Lessons included written symbols (e.g., beginning musical notation) as well as physical (e.g., body movements representing pitch and beat), systematically representing musical elements such as melodic contour with lines and geometric shapes. Students in the experimental music group were compared with same-grade students from a comparable neighboring school with no music instruction at the beginning and end of the four-month music instruction period. Gromko assessed reading skill development using three measures from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) curriculum-based measurement tool– Letter Naming Fluency, Phoneme Segmentation Fluency, and Nonsense Word Fluency. While students in both groups scored similarly on the Letter Naming Fluency and Nonsense Word Fluency probes, students in the experimental group demonstrated significantly higher Phoneme Segmentation Fluency scores. Gromko interpreted these results as highlighting the role of aural perception in both music and literacy, suggesting that it is this process that creates such a powerful relationship between the two.

In another quasi-experimental investigation of the impact of music instruction on specific reading skills, Piro and Ortiz (2009) compared the reading scores of second grade students from a public school utilizing a school-wide music curriculum in addition to high quality, evidence-based literacy instruction to second grade students from a nearby public school of comparable demographics and instructional quality, but without a music component. The music treatment group participated in music instruction for two 40-45 minute blocks each week, and utilized materials from the Music and the Brain (MATB) project. The curriculum taught musical concepts, such as rhythm and pitch, included instruction on the keyboard and components such as clapping and singing, and also allowed time for creative improvisation. The control group had no specialized programming, but was equivalent in other areas. Pre- and post-test scores on the vocabulary and verbal sequencing (e.g., the ability to retain and apply orally presented information with multiple elements, such as locating a square with a diamond inside) subtests of a standardized measure of reading achievement were collected from students at both schools at the beginning and end of the 10-month school year. Students from both schools performed similarly on both measures at the start of the school year, but at its commencement, students in the music treatment group demonstrated significantly higher vocabulary and verbal sequencing skills than students at the non-music control school. Due to the comparable instruction and demographics of the two schools, the authors interpreted their results as providing support for the beneficial contributions of music on the acquisition of literacy skills.

In 2013, Moritz et al. set out to find, if possible, the causal connection between music training and reading that was missing in Butzlaff's (2000) meta-analysis. The researchers used a quasi-experimental study to compare kindergarteners enrolled in two different schools. The schools were matched as closely as possible for composition, SES, Language Arts learning objectives, and classroom teaching strategies (e.g., flexible grouping, Writer's Workshop). The researchers listed three primary differences between the schools regarding literacy lesson organization, integration of music within literacy activities, and whether or not an at-home reading program was present. The experimental school kindergarten teacher appeared to use a separate lesson for each literacy topic, integrated music within literacy activities, and the school did not have a home reading program. The control school kindergarten teacher appeared to integrate multiple literacy topics into lessons and did not actively integrate music into literacy activities. The control school also had an organized at home reading program that included parent education, books for low SES children, in-class discussion, and reading logs/tracking.

The experimental school incorporated daily music instruction utilizing the Kodály structure and goals, in 45-minute lessons. The control school incorporated a single weekly music lesson using the Silver-Burdett Making Music Kindergarten Teacher Edition textbook. Subjects included 15 Kindergarten students from each school. The students were tested at the beginning of the year using six subtests from the *Phonological Awareness Test*–Rhyming Discrimination, Rhyming Production, Segmentation of Sentences, Segmentation of Syllables, Isolation of Initial Phonemes, and Deletion of Sounds: Compounds/Syllables. Music ability was also measured using the Tempo Copying, Rhythm Pattern Copying, and Rhythm Pattern Discrimination elements modified from the Music Aptitude Test (Overy, 2003). The students were tested again at the end of the year. Results indicate that both groups demonstrated significant growth in phonological awareness skills over the course of the year. The experimental daily music group, however, showed highly significant improvement in all six measures of phonological awareness, resulting in a large effect size. In contrast, the control weekly music group performed significantly better in only four of the six phonological awareness measures, resulting in a medium effect size. In music abilities, the experimental group demonstrated significant growth in Rhythm Pattern Copying and Rhythm Pattern Discrimination. The control group did not show significant growth in the musical skills assessed by these measures.

These same children were then assessed in second grade to investigate the potential correlation between the skills assessed in kindergarten and later reading skills. All of the participants had continuously attended the same school as in the first study. The investigators found that rhythm ability in kindergarten was significantly related to phonological awareness in second grade. The results of these studies provide evidence that music programs in schools can have a beneficial impact on early literacy skills, in particular phonological awareness and rhythm skills, that increase with exposure, and can persist into later schooling.

Additional research has shown that both high and low-quality elementary school music programs are related to higher student achievement scores on standardized tests of math and English than schools with no music component at all (Johnson & Memmott, 2006). The beneficial contributions of music experience to literacy and other non-musical skills have been found in participants from several countries, including the United Kingdom (Lamb & Gregory, 1993), Canada (Bolduc, 2009), and the South, Midwest, East, and West coast regions of the United States (Johnson & Memmott, 2006). They have also been demonstrated across diverse socioeconomic family backgrounds (Piro & Ortiz, 2009; Register, 2001; Register & Humpal, 2007), and in academically at-risk populations (Register, 2001). Evidence from the studies just described supports the relationship between music instruction and the development of integral early literacy skills, such as phonemic awareness, as well as more general reading ability (e.g., standardized tests of reading comprehension). Taken collectively, research indicates that music has the potential to play a commanding role in literacy development.

Education Through Music

Education Through Music (*ETM*) was originated in the 1960s as an approach for music teachers, with a primary focus of curriculum design in the instruction of music literacy. It was inspired by the Kodály method of music instruction, which also uses folk songs (from the Hungarian culture) and accompanying games/body movements (Richards, 1977). While originally tailored for music education specifically, general education teachers noticed positive changes in student behavior and attention after participation and also began attending ETM workshops very early in its history. Today ETM is used in thousands of music education, general education, and special education classrooms across the United States, and can even be found in some Canadian and Japanese classrooms (Personal Communication, ETM Summer Colloquium, July 25, 2016).

To date there have been no published experimental studies examining ETM as a program; however, a small number of qualitative and descriptive studies, summarized below, have cited a positive relationship between ETM and learning-related factors.

In a 2003 descriptive study, Chin compared student engagement across five different activity settings: phonics instruction, reading groups, read aloud, song experiences (i.e., ETM), and song books. Using a time-sampling method, Chin analyzed the occurrence of student engagement behaviors, verbal interactions (i.e., student-student and teacher-student), and characteristics of each activity setting (e.g., sensory use and open versus closed tasks). Chin found that the greatest percentage of engaged student behavior occurred in the music settings, which were also coded as being the most open-ended and multisensory in nature and also included the greatest opportunity for student participation. Conversely, the phonics instruction setting yielded the smallest percentage of engaged behavior, and was also coded as being the least open-ended and multisensory activity. Recognizing that different tasks and structures are necessary for the acquisition of different skills (e.g., direct instruction of a discrete skill such as phonics), Chin concluded that, in addition to typical literacy instruction, music-based activities may be a beneficial tool in increasing student engagement

Thornburg's (2005) exploration of educational literature concluded that programs such as ETM have a place in modern curriculum, as they capitalize on naturally motivating elements of everyday life, particularly movement, play, and music. Thornburg concluded that the interplay of these elements benefitted cognitive, social, emotional, linguistic, motivational, and aesthetic development.

Henry (2008) examined the utility of a program incorporating ETM and improvisational drama games (i.e., the Music and Dramatic Play Project) as a means of promoting engagement and community among at-risk junior high students. Over a period of 12 weeks, students participated in weekly hour-long sessions, of which 20-25 minutes was devoted to ETM. Analysis was conducted through a narrative inquiry approach. Data for analyses was collected through researcher journaling, field notes, audio recordings of the researcher meetings, and observation of engagement behaviors. Henry reported that, at the end of the study, the students demonstrated increased engagement, motivation, effort, connection to and regard for other students. Upon examination of the research summarized above, it appears that the ETM approach embraces the environmental requirements to support a brain acquiring literacy, both music and language-based.

A Reflection

The confluence of this research may best be illustrated by a recent interaction with my three-year-old nephew. One early afternoon, he asked me to sing a song with him. I asked him which one and he replied, "The one about sharks." I knew a couple songs that have a shark in them, but I asked him to sing it for me to see if it matched anything in my repertoire. He pranced down the hall a bit, came back, and with a grin exclaimed, "Here we go!" He joyfully shimmied down the hallway and back again, and then, in a voice that was barely in the human hearing range, murmured an indistinguishable few syllables with only the word shark clearly audible, bopping his head and moving his shoulders to the tune inside his head. I still had not a clue which song he was actually singing, but the point illustrated most poignantly for me how much the song (whichever one it was) was in his body, even if he didn't yet have the words to match. My guess is, that in time, those body movements, executed with only the ease that a play state can facilitate, are going to provide the perfect hook for the language, and later the written words, to stick.

While it is perhaps possible to teach the individual components of reading utilizing only such tools as flashcards, worksheets, and scripts, the question arises of what is left behind in such an approach. Just as a story is more than a simple compilation of words, the process of reading is elevated above a mere sum of its component structures. It is an elegantly complex patchwork of timing and organization, predictions and patterns, beats and boundaries. When the exploration of sound and word can be made meaningful and playful, when the abstract can be made concrete through movement, play, and music, when an entirely new brain configuration can be not only successful, but aesthetic, it seems as though we owe it to the children to try.

It is apparent from the literature that literacy is far more complex than words on paper. This multi-faceted process does not advance in isolation from other areas of development, and appears to be intertwined within the interactional web of neuropsychology, movement, play, and music. The present study aimed to extend the research base, to determine if a program that incorporates these elements, Education Through Music, might be a valuable contribution to the development of early literacy. It was the hypothesis of this study that kindergarten students who participated in an Education Through Music classroom would demonstrate significantly better phonological awareness skills than kindergarten students in a non-music-oriented classroom, over the course of a school year.

Chapter 3

Method

Research has demonstrated that active participation in musical activities contributes to enhanced auditory processing, particularly through the development of phonological awareness abilities (Anvari, Trainor, Woodside, & Levy, 2002; Bolduc, 2009; Gromko, 2005; Lamb & Gregory, 1993; Overy, 2003). Movement and play-based activities have likewise been linked to neural growth and plasticity, particularly in the acquisition of sensory knowledge about the environment (Glenberg et al., 2008; Zarr, Ferguson, & Glenberg, 2013), development and support of inner motivation (Brown, 2009; Csikszentmihalyi, 1990), language development (Roskos & Christie, 2011), and the development and application of abstract or symbolic thought (Piaget, 1962; Vygotsky, 1978). This quasi-experimental study aimed to expand the research on this interactional web of neuropsychology, movement, play, and music through an investigation of an established educational program entitled *Education Through Music*. It was the hypothesis of this study that this music and play-based program, which incorporates these elements, could uniquely contribute to early literacy development. In particular, the investigation aimed to determine if kindergarten students participating in ETM classrooms benefitted from increased phonological awareness skills and if, over the course of an academic year, their rate of acquisition of these skills surpassed those of same-age peers in a non-music-oriented classroom.

Participants

Participants were recruited from three elementary schools (one participating ETM classroom from schools one, two, and three; two participating non-music-oriented classrooms from school three) in a suburban public education school system in Sacramento County, California. Parent consent for participation was granted for 85 students; 76 participants were included in the analyses. Both genders were represented. A total of 46 participants belonged to an *Education Through Music* classroom (21 girls, 25 boys), while 30 participants belonged to a *non-music-oriented* classroom in which ETM was not conducted (14 girls, 16 boys). Information regarding participant age, years of preschool experience, and time spent reading at home was reported via parent response to a demographic survey included in the informational consent packet, not all of which were returned. See Appendix C for the survey. Of the 76 participants included in the study, 66 returned a completed demographic survey (ETM $n = 37$, non-music-oriented $n = 29$). Reported participant ages ranged from five years, zero months to 6 years, one month, and the average age at the start of the study was approximately five years, five months, as calculated from reported birthdates. While ages for ten of the children could not be calculated due to missing surveys, all kindergarten students enrolled in this district turned five years old on or before September 1 of the year in which the study took place. Prior to entering kindergarten, ETM participants completed an average of 2.01 years of preschool ($SD = 0.96$ years), while participants in the non-music-oriented group completed an average of 1.72 years of preschool ($SD = 0.81$ years). On average, parents reported that participants in the ETM group spent 31.49 minutes reading at home each day ($SD = 19.14$ minutes); parents of participants in the non-music-oriented group reported an average of 30.17 minutes ($SD = 13.91$ minutes). Participants in both groups reported similar amounts of preschool and home reading experience; no significant differences were found for either category (preschool experience $t(64) = .30$, $p = .198$; home reading time $t(64) = .31$ $p = .757$).

To help control for potentially confounding variables, the schools were matched as closely as possible regarding socioeconomic status using highest parent education level as a proxy, race/ethnicity composition, geographic location, educational resources (e.g., qualification for other Federal assistance programs such as Title I status), and methods of delivery for literacy instruction (e.g., small group instruction, literacy centers, parent participation). The schools were of comparable demographics; race/ethnicity was reported as predominately White (73.3% for school 1, 70.6% for school 2, 78.5% for school 3); none of the participating schools qualified for Title 1 assistance (the percentage of students qualified for free or reduced meal prices was 24.5% for school 1, 16.8% for school 2 and 24% for school 3). Participants' parents held, on average, a college degree or higher (ETM = 43.6% college graduate, 33.3% graduate school; non-music-oriented = 42.3% college graduate, 26.9% graduate school). School and group demographics are summarized in Tables 1 and 2. It should be noted that the highest parent education level (used as a proxy for socioeconomic status) and race/ethnicity composition listed for the groups represent the overall composition of all participating classrooms and are not limited to study participant information. Out of concern for student privacy, the school district requested these categories be removed from the original demographic survey. A revised survey was sent home in the consent packet (see Appendix C), and the school district provided the requested demographic information in aggregate form for each classroom. Schoolwide demographic information was retrieved from Ed-Data (2018).

The teachers of the classrooms included in this study each reported more than a decade of teaching experience, no less than five years of which was spent in kindergarten. For the three ETM classrooms, teacher one reported 20 years of teaching experience, 15 years in kindergarten, and 58 hours of professional development annually; teacher two reported 14 years of teaching experience, 9 years in kindergarten, and 78 hours of professional development annually; teacher three reported 34 years of teaching experience, 7 years in kindergarten, and 35 hours of professional development annually. The professional development hours reported for the ETM teachers include 30 hours of ETM training. For the two non-music-oriented teachers, teacher one reported 28 years of teaching experience, 23 years in kindergarten, and 48 hours of professional development annually; teacher two reported 26 years of teaching experience, 12 years in kindergarten, and 48 hours of professional development annually.

Education Through Music classrooms were selected with additional guidance from the Richards Institute's executive director and lead instructor who have working relationships with the teachers who utilize the ETM program. Criterion for teacher selection included at least five years of teaching experience at the kindergarten grade level, five years of ETM training for the ETM classroom teachers, and willingness to participate (Tucker & Stronge, 2005, indicate that three years of teaching experience is necessary for a teacher to become effective; Ericsson, Krampe, & Tesch-Römer, 1993, indicate that expertise in an area requires 10 years of deliberate practice). Regular teachers were selected using the same criterion, with the exception of ETM training, to attempt to have comparable groups.

Out of the 85 students whose parents signed and returned the informed consent, 76 were included in the analyses; 9 were excluded. Reasons for exclusion included: moving out of the school district partway through the year (n = 2), non-responsiveness to assessment questions (n = 1), and long absences during testing periods (n = 1), all of which resulted in incomplete data. Children participating in Individualized Education Programs (IEPs) that included additional speech and/or reading services were also not included in the analyses, as the supplemental instruction could not be ruled out as contributing to potential differences in skill acquisition beyond the general classroom experience ($n = 5$).

Setting and Curriculum

Teachers conducted curriculum and everyday learning experiences in their typical classroom settings; no daily classroom or schedule alterations were required. Two classroom types–ETM and non-music-oriented–served as the two levels of the independent variable Classroom Type.

Reading curriculum. All students received regular reading/phonics instruction, regardless of classroom type. Participants in the ETM classrooms engaged in ETM activities *in addition* to the regular reading/phonics instruction, not in place of it. Reading and phonics instruction differed slightly from classroom to classroom as there was no single district-wide curriculum. However, there were many similarities between classrooms, including method of delivery and instructional time. The primary format of instruction for all classrooms was small group and was delivered during daily language arts centers in which children rotated from one lesson to another. The centers included teacher-led, teacher-created and parent volunteer-led, and independent work stations. The time for each classroom's language arts block differed slightly and ranged from 80-90 minutes four times per week (two ETM classrooms and two non-music-oriented classrooms) to 100 minutes five times per week (one ETM classroom). Each classroom utilized the district's Benchmark Language Arts series, which included leveled readers and phonics instruction, but supplemental curriculum varied within each classroom. Additional curriculum included phonics instruction from Jan Richardson's Next Steps in Guided Reading program (one ETM classroom), components of the Teacher's College reading and writing workshop curriculum (two ETM classrooms), components of Houghton-Mifflin's Zoo Phonics (two ETM classrooms), and components of a Scholastic reading program (two non-music-oriented classrooms).

Education Through Music (ETM). Education Through Music is a unique music education program that can be implemented within the school setting by both classroom teachers and music specialists. Movement, play, and music are utilized in Song-Experience-Games, which form the foundation for instruction. ETM teachers were asked to engage in ETM activities for approximately 20-minutes daily. Self-reported time-logs indicate that, on average, teachers engaged in 15-minutes of ETM activity daily.

ETM theoretical foundations and process. The foundation of ETM is the creation of a safe community in which each person is valued; curriculum is accessible to all, regardless of developmental level; and immersion in language and motor activity within the framework of play is regarded as the key to learning and self-discovery. Learning for all, students and teachers, occurs through the process of *doing*. Physical movement coupled with simultaneous vocalization in song-experience-games contributes to multisensory mental representations of the movement, language, and musical elements of the experience (Richards, 1977). A rich background of sensory experience must occur before symbols, either music or language-based, can be used to represent those experiences (Healy, 2004b). Environments are structured in such a way to support the idea that children are in their bodies (concrete experience) before they are in their heads (symbolism/abstraction). The songs are sung and the games played in their entirety before there is discussion on individual parts, such as a movement or a word (Personal Communication, Summer Colloquium, July 16, 2015). Music is intended to become a tool for expression and communication. Participation in, and discussion of, song-experience-games creates opportunities for practicing social awareness, communication, and problem solving (Richards, 1977).

ETM teacher training. Teacher training occurs through participation in annual Winter Courses (i.e., training workshops), consisting of 30 hours of experiential instruction occurring over three weekly sessions spread throughout the course of a school year (e.g., three training days in September, January, and April, respectively). Summer Colloquia are also offered, as a weeklong period (also 30 hours) of intensive study with master teachers and daily observational teaching sessions with children. Continued participation in training sessions is stressed. It has been suggested that it takes approximately five to eight years of continued training for teachers to become proficient in the ETM process.

ETM curriculum: The song-experience-game. While ETM does not have a set *curriculum with pacing guide*, it does have a collection of *song-experience-games* that comprise the most observable and readily identifiable aspects of the program. Each song-experience-game centers around a folk song of North American/English tradition, that follows the contours of the English language (i.e., each song's rhythm, melody, and phrasing matches the rhythm, inflection, and phrasing found in spoken English). The game is an enactment of the song, literal and/or metaphorical, while the experience encompasses/represents the feeling of the child in the moment, the *aesthetic* (Richards, 1977).

Each song-experience-game is played in *turns.* One singing of the song with one playing of the game is one turn. A song's duration (and its accompanying game) may be anywhere from 10 seconds to two minutes or longer. The number of turns, however, is usually dependent on the needs and attention span of the children and is generally extended one turn beyond present ability as a challenge for growth.

Song-experience-games encompass myriad developmental levels. Within the same song there often exist multiple versions of a game, which also span several developmental levels. Depending on the needs of the students, the teacher can vary the *tightness* of structure of the song-experience-game. In play with younger children, the teacher shares each turn with the child and there is an intentional focus on the adult-child relationship. The rest of the children in the group are often either in a *bunch* (i.e., seated very close to one another, close to the teacher, not in circle formation) in front of the teacher and child or seated on the floor in a circle around the teacher and child. Developmentally older children may assume more responsibility in the play, and the language and movements are more complex as well.

As an example, the title of this thesis is a play on the song-experience-game *Oats, Peas, Beans*, a folk song from the late 1800s. In one version of the game, the children stand in a circle while the teacher walks around the inside and everyone sings. Different movements and gestures are used during different phrases of the song. When the actions of the farmer are described, “First the farmer sows his seed,” the arm is held pointed to the ground while using flicking wrist motions to mimic seeds being placed upon the soil. “Then he stands and takes his ease,” indicates that arms are crossed as a sigh is released, embodying the farmer taking a moment to relax after a full day of readying the fields for a new crop. Later in the song the words, “Looking for a partner” and “Open the ring and take one in while we all gaily dance and sing” tells the participants that it is time for the teacher to stop at the student in front of him/herself, extend a hand in welcome, and skip with that student around the inside of the circle while they and the rest of the class continue to sing, “Tra la la la la la la…”.

It takes many more words to describe a song-experience-game than it does to play one. In ETM philosophy, it is through the play that the learning occurs. Songs and games are taught simultaneously, rather than exclusively, from one another. Children learn the song-experience-games by playing the song-experience-games; at no point are they given a sheet of lyrics or movement script. This experience-based teaching style is intended to follow the developmental pattern for learning that is present from birth: concrete, sensorimotor experience precedes the ability to conceptualize and think abstractly. In addition, the flexibility within each song-experience-game allows children to have a new, but familiar experience with each playing, providing repetition with variation and challenge.

The most critical element of any song-experience-game is its structure. It has a specific starting and ending point (i.e., when the song starts and stops), and contains within it the rules for participation. The movements and words within the song-experience-game tell children what they need to be doing, where they need to be doing it, when they need to be doing it, how long they need to be doing it, and with what intensity.

Types of song-experience-games. The song-experience-games can be considered within three general categories: name games, one-on-one games, and language/movement congruent games, although many song-experience-games fit within more than one category. *Name* games incorporate the children's names within the play (e.g., "Hi, Jacob, I see you!"), creating moments of individual recognition. They increase familiarity with the individuals in the group and are intended to contribute to the formation of community. *One-on-one* games create moments of teacher-to-student, adult-to-child interactions of regard and nurturance (e.g., the adult and child link arms pretending to be a tree blowing in the wind, embracing at the words, "…when the wind blows we all come together"). *Language/movement* congruent games highlight the connection between the words and the physical gestures used to tell the song's story. The actions in the song-experience-game match what is being sung.

While some song-experience-games emphasize movement more than others, all incorporate movement of some kind. Gross motor movement (e.g., walking, running, skipping, turning, swinging arms, stomping, jumping) occurs in a variety of spatial orientations/planes (e.g., standing, sitting, moving side to side, moving forward and backward). The intensity of the movement matches the intensity of the song (larger/higher movements for higher-pitch or emphasized words). Most song-experience-games are designed for play with groups of children; some especially accentuate social interaction. These games include elements such as turns with other students and group cooperation to form the physical structure necessary to play. For example, in the song-experience-game *Pretty Bird*, students stand in a circle with arms raised and palms together to form *windows* (i.e., the space between the students) for *birds* (i.e., the selected students) to enter and exit.

ETM Techniques. Unique to ETM is the combination of music, movement, and play in the song-experience-games, as well as techniques used to transition from concrete experience to symbolic understanding and representation (i.e., literacy in both music and written language). Three of the most utilized techniques, matching movement to music, secret song, and mapping are described below.

Matching movement to music and language. The movements used within each song-experience-game are both playful and purposeful. They are used to enact the story told within the song and to highlight its salient musical features (e.g., rhythm, pitch, intensity, duration). Many song-experience-games also incorporate hand-signs, which are precise hand motions made to visually and physically represent the musical notation of the *solfa* (e.g., a fisted hand represents doh, the index finger represents ti, etc.). Hand-signs are usually credited to John Curwen, but may have been traced to ancient Egypt (Choksy, 1988).

Secret song. After a song-experience-game has been played many times, the teacher may invite the children to "Guess my song." This process can be made more or less complex based on the children's developmental and auditory abilities. A secret song for young children, for example, would likely retain a vocalized melody with a repeated syllable (e.g., lu-lu) replacing the words (ETM Winter Course 2015). As children mature, the teacher may clap the melody and/or insert a visual cue, such as a motion from the song-experience-game or solfa hand-sign instead. In any given presentation, the secret song is used to represent a song that is well-known to the children, through sound, movement experience, and play. The matching process requires retrieval of song-game experience from long-term memory and application of *inner hearing* or *audiation* (i.e., sound pattern processing) to match the melody of the claps or other clues to the features of their personal experience (Henry, 2008).

Mapping. A map is a visual symbol of the song-experience-game and also occurs after many playings (Richards, 1977, 1978). The first mapping experiences are led by the teacher using finger as marker and the air as paper. The teacher chooses specific phrases of the song to demonstrate with a motion. The children then sing and follow the motion with their own fingers. Multiple types of motions (e.g., swoops, curly-cues, loops) are demonstrated to emphasize the multiple ways sound can be represented by symbol. Finger in the air mapping is later followed by pen on paper mapping. Students create a personally-motivated symbol (i.e., a symbolic representation that is personally meaningful, but not uniformly recognized, such as a written word), representing the elements of the song-experience-game. In particular, the map should capture starting and ending points, melody, rhythm, and/or beat. The goal is to create a viable map–a map that can be *followed* (retraced) within the duration of a singing. In describing the connections between movement, language, sound, and symbolization, Richards (1973) writes that "…the mapping of songs is movement visualized – movement which leads directly to feeling, reading, and writing our language" (p. 8). In addition to its symbolic nature, mapping is also intended to provide practice in tracking, recognizing phrase boundaries, and identifying patterns (Personal Communication, ETM Winter Course, April 9, 2015).

Measures

Phonological Awareness Test 2 (PAT 2; Robertson & Salter, 2007). The dependent variable assessment measures included eight subtests from the Phonological Awareness Test, Second Edition (PAT 2). The PAT 2 is an individually-administered standardized test designed to measure a student's phonological processing and phoneme-grapheme correspondence, and to diagnose deficits therein (Robertson & Salter, 2007). Phonological awareness skills are of significant interest in this study as they are a robust predictor of reading development and significant connections have previously been demonstrated between phonological awareness skills and music education programs (Anvari, Trainor, Woodside, & Levy, 2002; Bolduc, 2009; Gromko, 2005; Lamb & Gregory, 1993; Overy, 2003; Tierney & Kraus, 2013).

The PAT 2 was standardized on 1,582 participants between the ages of five and nine years old, matched with current census data for race, gender, age, and educational placement. Reliability was found to be highly satisfactory regarding inter-rater reliability (rater agreement averaged 97%, ranging from 95% to 98%), test-retest reliability (Pearson's product-moment correlation coefficient equaled .93 for the total test), and reliability based on item homogeneity (Kuder Richardson coefficient equaled .99 for the total test). Validity was also determined satisfactory regarding contrasted groups; the test demonstrated efficacy in determining typically developing reading ability versus reading development requiring specialized education/intervention (all paired *t*-Tests for differences between normal and at-risk readers were significant at the .01 level for all age levels; $t_{.01}$, $df \geq 60 \geq 2.66$).

Student phonological skill was measured using eight tasks from the PAT 2, mirroring the phonological awareness measure utilized by Moritz et al. (2013), with the addition of blending. Each subtest included 10 items. Each item was scored as either correct or incorrect, with one point possible for each correct response. Subtest scores were computed by adding individual item scores together for a maximum of 10 points per subtest. Raw scores were utilized for analyses as each subtest was given in its entirety, progressive test items did not differ in their difficulty, and there were no discontinuation rules. The specific PAT 2 tasks included:

- *Rhyming Discrimination* measures the ability to identify rhyming words presented in pairs.
- *Rhyming Production* assesses the student's ability to provide a rhyming word when given a stimulus word.
- *Segmentation of Sentences* asks the student to divide sentences into their constituent words, using claps to designate words while speaking a given sentence.
- *Segmentation of Syllables* measures the ability to divide words into syllables, using claps to designate each syllable in a given word.
- *Segmentation of Phonemes* assesses the ability to divide words into their constituent phonemes by asking students to say each sound in a given word.

- *Isolation of Initial Phonemes* measures the student's ability to identify the initial phoneme in a word.
- *Blending Syllables* assesses the student's ability to blend syllables together to form a word when the syllables are presented individually.
- *Blending Phonemes* asks students to blend phonemes together to form a word when the phonemes are presented individually.

Procedure

Prior to its implementation, this study was approved by Alfred University's Human Subjects Research Committee, the school district's Assessment Evaluation and Planning department, as well as individual school administrators. Teachers were known to the researcher and were asked in person if they would be willing to participate in the study. This study was designed to ensure minimal risk, discomfort, and disruption to participants and their daily school routines. Participation was completely voluntary, based on both parent consent and child assent, with the option to withdraw at any point in the study without consequence.

With the exception of testing period one and allowing for make-ups due to student absences, assessment for each testing period occurred within a two-week period. In regard to testing period one, the assessment took place over approximately an eight-week period for a number of unavoidable circumstances. Participants could not be recruited until the study received final approval from the school district, which was ultimately received the first day of school. The researcher then met with each classroom teacher to discuss the best method for disbursement of the informational consent packet (e.g., at a classroom parent meeting, in the mail). The packet included a letter with an explanation of the study, its non-invasive impact on (and potential benefit to) their child's learning experience, the voluntary nature of participation and option to withdraw at any time without consequence, and a request for consent to allow their child's data to be utilized by the investigator. A space was also provided for each child to provide their assent for participation, either through signature or drawing. See Appendix C for the letter and parent consent form, and Appendix D for the child assent form.

For the experimental group, informational consent packets were distributed to parents by the participating teacher at each school's back to school night, which occurred within the first week of school. During this same time period, the initial control group teachers decided that the study was not a good fit for their classrooms at the time and withdrew their participation. Alternative control classrooms were secured in early September. The informational/consent packets were distributed at the school's monthly kindergarten parent meeting after a brief introduction and explanation by the researcher. Additional packets were sent home in the students' daily classroom mailboxes. To keep student information private, participants were assigned random identification numbers. Only these participant numbers were associated with data; no student names were written on assessment materials. All student names and data were kept private in a locked cabinet.

Data were collected at four time points over a 10-month school year (180 instructional days). The first assessments began promptly following the return of parent consent forms in late August and continued through early October. The remainder of the testing periods roughly followed the district's trimester grading periods and were designed to avoid immediate pre- and post-holiday skill and attention regression. Testing period two began in late November through early December. Testing period three occurred in early

March; testing period four took place from mid to late May. The researcher was the sole assessor due to familiarity with the participating teachers, as well as district preference.

The PAT 2 subtests were presented in the same order at each testing period as designated by the test creators. Participants were told that they would be playing some listening games and that sometimes they would know the answer and sometimes they would not and that it was okay for them to say “I don’t know.” Students were asked for verbal assent before the beginning of each assessment, which was honored. One student indicated verbally that he was disinclined to participate at the time he was asked to participate. An additional invitation was offered the next day, which was again declined. No further attempts were made and the student continued his regular school day without consequence. An additional student agreed to participate and joined the researcher in the assessment area. However, body language and a lack of response to test items indicated discomfort, resulting in a discontinuation of the assessment by the researcher. Corrective feedback was given only during practice items, as per administration protocol; no feedback was given during any of the test trials. There was no discontinue rule. All test items within a given subtest were given, regardless of number correct/incorrect, as they were not ordered by difficulty. Each administration lasted approximately 15 minutes at the beginning of the study but was reduced to between five and eight minutes by the end of the study, due to researcher familiarity with the testing items and student skill growth and overall comfort with the process and researcher. Raw scores from each subtest were analyzed separately.

Chapter 4

Results

Statistical Analyses

The data were analyzed using a Repeated Measures Analysis of Covariance (RM ANCOVA) with the statistical software SPSS version 25 (IBM Corp., 2017). The independent variable for comparison was classroom type (2 levels: ETM and non-music-oriented) and was measured during four time-intervals (Time Periods 1, 2, 3, and 4). Time period 1 was used as the covariate in each subtest analysis, to reduce unexplained variance that may have been attributable to prior knowledge. For example, because students enter kindergarten with diverse educational backgrounds and experiences (e.g., preschool, exposure to reading at home), controlling for these initial skill differences helps to illuminate the potential influence of additional factors, such as participation in ETM. Separate RM ANCOVA analyses were conducted for each of the dependent variables (Rhyming Discrimination, Rhyming Production, Segmentation of Sentences, Segmentation of Syllables, Segmentation of Phonemes, Isolation of Initial Phonemes, Blending Syllables, and Blending Phonemes), measured at four time-intervals (beginning of school year, late fall, winter, and spring/end of year trimester). The analyses examined whether or not significant differences existed between the ETM and non-music-oriented classroom scores, controlling for initial skill level. Prior to performing the analyses, the data collected were reviewed in regard to the assumptions of the analysis of covariance, including normality and homogeneity of variance, a linear relationship between the dependent variables and the covariate, and homogeneity of regression (per Howell, 2010). Greenhouse-Geisser corrections were utilized when Mauchly's test was reported as significant, indicating a violation of the assumption of sphericity. Analyses were conducted with a Bonferroni confidence interval adjustment for a more conservative interpretation of the data.

Time. There was a significant main effect for *Time* for all subtests, indicating that scores for both groups increased over the course of the school year. The *Time 1* covariate was also significant across all subtests (*Segmentation of Sentences* $F_{(1,73)} = 11.63$, $p = .001$, partial $\eta_p^2 = .137$; *Segmentation of Syllables* $F_{(1,73)} = 28.065$, $p < .001$, $\eta_p^2 = .278$; *Segmentation of Phonemes* $F_{(1,73)} = 23.795$, $p < .001$, $\eta_p^2 = .246$; *Rhyming Production* $F_{(1,73)} = 127.249$, $p < .001$, $\eta_p^2 = .635$; *Rhyming Discrimination* $F_{(1,73)} = 45.524$, $p < .001$, $\eta_p^2 = .384$; *Isolation of Initial Phoneme* $F_{(1,73)} = 20.10$, $p < .001$, $\eta_p^2 = .216$; *Blending Syllables* $F_{(1,73)} = 28.065$, $p < .001$, $\eta_p^2 = .278$; *Blending Phonemes* $F_{(1,73)} = 81.770$, $p < .001$, $\eta_p^2 = .528$), indicating that Time 1 scores had a significant influence on each of the dependent variables. Students' prior knowledge and ability (pre-kindergarten experience) played a significant role in their later performance, supporting the use of Time 1 as a covariate of interest.

PAT 2 Subtests. There was a significant main effect for group in favor of the ETM participants for *Segmentation of Sentences* ($F_{(1,73)} = 4.99$, $p = .029$, $\eta_p^2 = .064$), *Segmentation of Syllables* ($F_{(1,73)} = 13.09$, $p = .001$, $\eta_p^2 = .152$), *Segmentation of Phonemes* ($F_{(1,73)} = 6.94$, $p = .010$, $\eta_p^2 = .087$), and *Rhyming Production* ($F_{(1,73)} = 9.56$, $p = .003$, $\eta_p^2 = .116$). No significant differences were found between the ETM and control group performance on *Rhyming Discrimination* ($F_{(1,73)} = .68$, $p = .411$, $\eta_p^2 = .009$), *Isolation of Initial Phoneme* ($F_{(1,73)} = 0.46$, $p = .499$, $\eta_p^2 = .006$), *Blending Syllables* ($F_{(1,73)} = 0.38$, $p = .541$, $\eta_p^2 = .005$), or *Blending Phonemes* ($F_{(1,73)} = 2.150$, $p = .147$, $\eta_p^2 = .029$). Results are summarized in Table 3. In general, students participating in ETM classrooms performed as well or better than students in non-music-oriented classrooms on phonological awareness tasks, and demonstrated significantly more growth in the areas of segmentation (at the sentence, word, and phoneme levels) and ability to produce rhymes.

Chapter 5

Discussion

This study investigated the impact of Education Through Music (ETM), a play-based music program, on the phonological awareness skills of typically-developing kindergarten students ($N = 76$) in a Northern California school district over the course of a school year. It was hypothesized that students participating in ETM classrooms would demonstrate significantly greater growth in phonological awareness skills than same-age peers in non-music-oriented classrooms, controlling for initial skill level. The hypothesis was partially supported, with children in ETM classrooms demonstrating significantly higher skills in the areas of segmentation (sentences, syllables, and phonemes) and rhyming production. No significant differences were found in rhyming discrimination, isolation of initial phoneme, or blending (syllables or phonemes), as both groups performed similarly, with each approaching ceiling. It is important to note that, with the exception of *Rhyming Discrimination*, ETM participants initially (i.e., time period 1) scored, on average, lower than non-music-oriented participants on all subtests. By the end of the study (i.e., time period 4), however, ETM participants scored, on average, higher than non-music-oriented participants across all subtests. Despite starting out with fewer skills, students in ETM classrooms performed as well as, if not better than, students in non-music-oriented classrooms.

Key Findings of the Current Study

Students whose classrooms incorporated a play-based musical program (ETM) during their kindergarten year were better able to manage speech sound than students in non-music-oriented classrooms in a number of factors related to early literacy. The results of this study simultaneously supported part of the hypothesis, while also providing some thoughtprovoking challenges. As predicted in the hypothesis, students in the ETM classrooms demonstrated significantly higher phonological awareness skills than students in Non-Music Oriented classrooms in four out of eight areas assessed. Students in ETM classrooms were better able to segment speech sounds in all three areas assessed: word level (sentences), syllable level, and phoneme level, and were also better able to produce rhymes. In contrast to the hypothesis, students from both classroom types demonstrated similarly strong rhyme detection skills (group means at Time 4 were 9.39 for ETM and 9.07 for non-music-oriented, with a maximum possible score of 10), isolate the first sound in a word (group means at Time 4 were 9.59 for ETM and 9.37 for non-music-oriented, with a maximum possible score of 10), and to blend both syllables (group means at Time 4 were 9.11 for ETM and 8.77 for non-music-oriented, with a maximum possible score of 10) as well as individual phonemes into complete words (group means at Time 4 were 8.54 for ETM and 8.13 for non-music-oriented, with a maximum possible score of 10).

Segmentation and rhyming. It can helpful to consider segmentation and rhyming skills in terms of what is required of each, where they overlap, as well as where they diverge. For example, segmentation involves the separation of speech elements (i.e., words, syllables, and phonemes in this instance), while blending requires the assembly of speech elements (i.e., syllables and phonemes for this study). Segmentation is a critical phonological awareness skill, as it is a precursor to the ability to map speech sounds onto written symbols and is necessary for decoding (Goswami, 2002; Moritz et al., 2013). There are multiple levels at which speech sounds and written text can be segmented or broken down, including sentence, word, syllable, onset-rime, and phoneme (Joseph, 2015). Interestingly, and perhaps not coincidentally, each of these categories corresponds to the assessment areas in which children in the ETM group demonstrated abilities that surpassed those of their peers in the non-music-oriented group.

Segmentation requires adding a *boundary* of silence between the elements of speech. One's mental lexicon must contain a store of words and words parts (e.g., syllables and phonemes), as well an internalized knowledge of the rules for how they may be broken apart or manipulated. In order to perform the required divisions, the student must be able to keep the whole element (e.g., sentence or word) in auditory working memory, apply the speech rules to make the appropriate separations, remember what has been said and which parts remain, and continue in this fashion until no segments remain. This process makes extensive demands on auditory working memory, auditory processing, and long-term memory retrieval. Blending, conversely, only requires that boundaries of silence be removed. The test itself provided the parts of speech already segmented in rule-following form. While still requiring auditory working memory to maintain each of the sounds and access to words in long-term memory, this task was more similar to a matching activity in which the sounds heard were compared to known words to see if a match could be found.

It was interesting to observe the seemingly uneven skill growth over the course of the year. As students acquired more advanced phonological awareness, the new language rules they learned sometimes seeped into and influenced other areas that had appeared well-established during the prior testing period. This was particularly apparent across the segmentation tasks. For example, during testing period two, a student may have performed without errors on the syllable segmentation subtest, but was unable to segment phonemes, or did so with multiple errors. However, during testing period three, that same student may have performed much more accurately on the phoneme segmentation subtest, but with more errors on the syllable segmentation subtest. A careful error analysis in these situations often revealed that the decreased score in syllable segmentation occurred when the student began segmenting the words by phoneme, the more advanced skill, rather than by syllable, the previously established skill. Such a pattern of older skills appearing to weaken while more advanced skills are being learned as a result of newer rules being applied to an older task are not uncommon. This process is found throughout learning and development, even highlighting the balancing act described by Piaget (1962) as assimilation and accommodation attempt to reach equilibrium.

Another dichotomy presented itself in the category of rhyming, more specifically rhyming discrimination versus rhyming production. While it may at first appear contradictory that a significant difference was found in one test of rhyming but not the other, it becomes clearer when taking into consideration the skills required of each task. Discrimination tasks, are by design, inherently less demanding than production tasks, as the answer is available and only needs to be chosen, just as in multiple choice tests (e.g., for this test both words were provided; the answer was yes or no for whether or not they rhymed). The lack of a significant difference in rhyming discrimination performance between the classroom types observed here is similar to Nation and Hulme's (1997) findings that even over a four-year grade range (i.e., the equivalent of kindergarten to third grade), onset-rime discrimination ability was not significantly different from one year to the next. Production tasks, conversely, demand that the test-taker *come up* with a response from their own mental stores (e.g., this test offered a single word and required the student to provide a rhyming companion). In consideration of the categories delineated by Joseph (2015), it can be argued that rhyming production actually falls within the category of segmentation and as such necessitates some sophisticated mental manipulation. First, the onset must be segmented from the rime. Next, the rime must be maintained in auditory working memory, and finally a substitute must be found for the initial onset so that a new word can be produced (either real or nonsense) that fits the pattern of the rime. The similarity in auditory processing and mental manipulation required for rhyming production and the segmentation tasks provide potential avenues for the significant findings observed in this study.

Interdisciplinary Approach to Early Literacy Development

As in all quasi-experimental, natural-setting research, causation cannot be determined from the results of this study alone. However, the findings can contribute convergent evidence to a growing body of research in linking music, movement, and play with early literacy skill development. The findings from this study support the interdisciplinary approach of using movement, play, and music in the classroom to support early literacy growth. While previous research has studied each of these areas independently, this study is unique in its exploration of ETM, a program that integrates all three elements. The results of this study were similar to those of Moritz et al. (2013), who found that students participating in 45 minutes of daily music instruction experienced significantly more improvement in their phonological awareness skills than same-age peers participating in 35 minutes of music instruction per week. While Moritz et al. (2013) found a significant difference in the area of rhyming discrimination, the current study did not. It is surmised that the difference in outcomes between the two studies is due in part to the difference in participant skills at the start of the studies. In the Moritz et al. study, initial median scores were 8.0 and 8.5 for the experimental and control groups, respectively. In the current study, the initial median score for both groups was 9.0. This difference in initial skill level between the Moritz et al. (2013)

study and the current study may reflect a difference in participants' rhyming experience prior to entering school (e.g., home language exposure, preschool curriculum). Regardless of whether or not such participant background differences existed, this disparity in the two studies' findings also highlights challenges that can arise as a result of ceiling effects. As each subtest was worth a maximum of ten points, once participants approached or reached the maximum score, as was demonstrated in both groups' initial *Rhyming Discrimination* scores in this study, it was not statistically possible for them to demonstrate further growth. At time period 1, for example, nearly sixty percent of all participants scored either a nine or ten out of a possible ten on the *Rhyming Discrimination* subtest (29 participants scored 10; 15 participants scored 9; 76 participants total). It may be that a different assessment measure with a greater number of test items would have been more useful in the current study. Experimental group segmentation skill growth was similarly significant between the two studies, with both groups demonstrating improvement, but the experimental musical group's significantly more so. This may indicate that phonological segmentation is a skill more robustly sensitive to classroom instructional methods (e.g., musical training and phonics instruction) than rhyming discrimination or that segmentation is taught more explicitly than rhyming.

The findings from this study are also in line with other research regarding the impact of music on auditory development and phonological awareness, while expanding the research in one critical feature. Despite the various forms of musical training available, little differentiation has been made in the literature when musical training is being compared to a particular skill or skill set. Previous research regarding music and literacy development and/or related neurological functioning has focused primarily on instrumental music, most often with the piano (Nan et al., 2018; Piro & Ortiz, 2009; Tierney, Krizman, & Kraus, 2015). Few studies have examined vocal music (Moritz et al., 2013; Overy, 2003), such as was utilized in this study, leaving the question of whether the results were specific to instrumental music training, to the exclusion of other forms of musical training. While all musical training focuses on the accurate processing of sound, the method for production is quite different. Instrumental musicians produce sound through the precise placement of fingers, whether it be on string or lever or opening on a device of one kind or another. Vocal musicians have no key to depress; they are themselves the instrument. As such, they must be keenly aware of sound, both what they are producing as well as those around them, and must monitor and adjust their sound continuously (Personal Communication, Summer Colloquium, July 10, 2018). Vocal music is also steeped in language, a closer connection with literacy even than instrumental music. These close ties between vocal music and language and sound processing may have contributed to the ETM participants' greater proficiency in the segmentation of speech sounds, further indicating that vocal music may play an important role in literacy acquisition. More research is needed to examine the relationship between vocal music training, rhythm, timing, phonological awareness, and more advanced reading skills, as has been established for instrumental music. Future research should also compare vocal and instrumental music with literacy skill and neurological development to determine if functional differences exist between the types of musical training. Future research should further investigate the extent to which vocal music training is commensurate with instrumental music training in such areas as auditory development, sound processing, sensory integration, perceptual-motor synchronization, and reading development. Is one type of musical training preferable over another? Does it depend on the individual and their personal preferences? While questions certainly remain, the results of this study provide initial evidence in support of vocal music's contributions to language and literacy.

The Extended Reading Hierarchy: A Proposal

Based on the findings of previous research as well as the current study, an extension to the Big Five model of reading development is presented here. See Figure 1 for a visual of the proposed Extended Reading Hierarchy. Two additional levels of skill development, the Sensorimotor Foundation and Pre-Reading Skills are proposed, both as being necessary precursors to the Big Five and as areas of development that are addressed by ETM participation and likely contributed to the difference in phonological awareness skills observed in this study. These areas are discussed below and include the ways in which they may be addressed and expanded upon by future research. The skills described within each of these levels are recruited heavily both in the process of developing early literacy, as well as more advanced reading processes.

The sensorimotor foundation. The sensorimotor foundation refers to both the physical and neurological resources utilized during reading.

Building auditory architecture. It is possible that ETM participation contributes to the growth of phonological awareness skills through the establishment and enhancement of auditory architecture, or the neurological structures and processes necessary for successful and efficient sound processing. ETM songs are learned through the oral tradition, meaning children must listen and participate in order to learn the words rather than seeing them written on a text. The auditory system is engaged at all times. Songs are acquired through trial, error, and repetition as the child is constantly comparing her output to what she sees and hears and making corrections as a result. This makes huge demands of auditory working memory, which, according to the tenet of *use it or lose it* is likely strengthened as a result. In addition to enhanced phonological awareness skills, enhanced auditory working memory would also benefit more advanced literacy skills, such as decoding and comprehension (Wolf, 2007).

Students participating in ETM may also have benefitted from improved timing through the engagement of both the auditory and motor realms. Differentiation of speech sounds, such as that required for the segmentation of phonemes task, requires precise and rapid auditory processing (Kraus & Slater, 2015; Tierney & Kraus, 2013; Wolf, 2007). A number of studies examining the impact of musical training by recording neurological impulses have found that this kind of sound processing is improved by musical training (François, Chobert, Besson, & Schön, 2013; Strait & Kraus, 2014; Tallal & Gaab, 2006), and that significant differences can be found in as little as six months (Nan et al., 2018).

Although advanced brain scanning technology was beyond the scope of this study, and given that participants in ETM classrooms demonstrated significantly greater skill in segmenting phonemes behaviorally than participants in non-music-oriented classrooms, it would be of substantial interest to investigate whether or not such a difference is apparent neurologically, as well. Are there structural changes that occur within the brain as a result of music training with ETM as there have been with other forms of musical training, such as piano? (Kraus & Banai, 2007; Nan et al., 2018; Tierney et al., 2015).

Sensorimotor integration. While building an effective and efficient auditory system is an overarching goal in ETM, each of the sensory systems is involved in the process. In ETM song-experience-games, language and movement are intentionally and meaningfully connected. Every song is a story and each story enacted through words (language) and body (movement), engaging each of the bodily systems (e.g., vision, hearing, proprioception). Each song-experience-game follows the structure of: *what I see* (movements of others) *is what I say* (my language) *is what I hear* (the story of the song) *is what I do* (my movements and enacting the story of the song). In addition to music, the primary context in which this multi-sensory engagement occurs is play. The ETM song-experience-games that were played were chosen to meet the evolving developmental needs of the children as the year progressed. As a result, they spanned multiple levels along the developmental continuum of play complexity (Piaget, 1962; Roskos & Christie, 2011; Vygotsky, 1978). The majority of play at the beginning of the year focused on whole-body gross motor movement, starting with simple and repetitive whole-body movement and progressing to more complex patterned movement. The movements were closely aligned with the language and rhythm of the song, and may have helped to facilitate sensorimotor integration within the body, as well as cross-hemispheric communication between the sensory and movement-associated areas within the brain. Future studies may provide additional information utilizing measures that assess sensorimotor integration, either behaviorally through tests measuring sensorimotor integration or neurologically through tests that measure activity within the different sensory domains within the brain.

Having an experience recorded mentally in multiple sensory systems affects not only how it is stored in long-term memory, but also how it is recalled in the future, as when reading a text or in conversation. It is the difference between reading the word *banana* and calling to mind either a two dimensional, vaguely crescent-shaped line-drawing centered on a three by five inch index card or the sticky residue and lingering aroma left on every surface after watching its mass ooze through the crevices between fisted fingers before massaging it into the cheeks, tasting it ever so cautiously on the tongue, and finally applying it like a mask to the hair. One is constrained to a limited representation in the visual sphere, a label with little meaning, while the other engages and integrates information from multiple sensory systems, increasing exponentially the ways in which *banana* and other related experiences may come to have meaning and be represented. ETM song-experience-games provide a comparable three-dimensional sound experience. Body movements and hand-signs represent not only the language and story of the song, but also characteristics of sound, such as high and low, long and short, beat, and rhythm, with time acting as a unique and almost concrete dimension in which the experience occurs. It could be that this multi-sensorial experience with sound in ETM contributed to participants' ability to mentally represent and manipulate sound, which then translated into the greater proficiency in segmenting speech sounds that was observed in this study. The potential connection between sound processing and body movement could be examined further through a study design that compared the phonological awareness skills of children participating in ETM with children who sang songs and moved or danced to music at random (i.e., no prescribed set of movements or game). This would leave intact the group experience of singing and moving, while helping to isolate the potential contribution of a shared movement-sound symbol (i.e., the game played by the group, which matches the song intentionally).

It is also possible that the increased skill development had more to do with time engaged with language and sound in general, resulting from the ETM experience on top of the typical reading and phonics instruction. These potentially contributing factors could be further teased apart through a study design comparing the phonological awareness skills of children: (1) participating in ETM, with (2) participating in ETM and supplemental phonics instruction, and (3) phonics only, with an equivalent amount of combined instruction in each group. From a more basic physiological level, it is also possible that the gross-motor movement within the song-experience-games increased oxygen and blood flow to the brain and body, making the children more alert and able to attend to classroom instruction as well as the assessment. It would be interesting to measure and compare stress, oxygenation levels, and alertness before and after an ETM session.

Pre-reading skills. The pre-reading skills level highlights skills that are built upon the sensorimotor foundation, but also contribute reciprocally to its development.

Beat, stress, and rhythm. Because the ETM song-experience-games frequently involve movement that is coordinated with the beat of the song, participants may have benefitted from increased neural communication and integration that supported early literacy skill development. For example, moving to a beat inherently requires communication and synchronization between the motor and auditory systems (Patel, 2008), two systems that are prominently involved in all levels of reading development (Wolf, 2007, 2018). Although the current study did not measure rhythm skills, specifically, other studies that have included this component have found a relationship between musical training, rhythm, and reading skills (Overy, 2003; Patel, 2008). It is possible that students in the ETM group benefitted from increased rhythmic skills, in particular the regularly occurring steady beat found in Western music and language (Patel, 2008), which increased their awareness of the weak-strong stress relationship in words, and therefore their ability to segment sentences into words and words into syllables. Future research should explore this potential link between rhythmic skill development, ETM participation, and segmentation ability to determine if this was a contributing factor. Children participating in ETM could be compared with children in a non-music control group, assessing both segmentation abilities as well as tests of rhythmic perception, such as tapping to a beat.

Related to weak-strong stress patterns of beat and rhythm is the concept of sound boundaries. The perception of boundaries is crucial in language, music, and reading. One must be able to determine where a sound or grouping of sounds starts and stops in order to discriminate everything from a phrase to a word to an individual phoneme. In reading, this awareness of sound boundaries facilitates each level in the process from decoding (e.g., being able to differentiate individual sounds within a word to determine its identity) to comprehension (e.g., being able to differentiate individual words within a sentence so that their meaning may be retrieved from long-term memory in order to make sense of the sentence or phrase). In ETM, these boundaries between sound and silence are referred to as points of enclosure. Western music, through its rhythmic structures and melody, inherently highlights segments of sound. ETM song-experience-games capitalize on this feature by pairing distinct patterns of movements with different musical phrases. During one version of the song-experience-game, Clickety Clack, for example, participants are standing behind one another in a line, in essence becoming a train. During the first phrase, “Clickety clickety clack,” the train moves forward with the feet falling on each syllable. At the end of the phrase the train stops (e.g., highlighting both the musical and linguistic phrase as well as the musical rest) and then moves backward for the duration of the next phrase, “clickety clickety clack,” pausing at the last word. For the final phrase, “clickety clickety clickety clickety clickety clickety clack,” the train once again moves forward, but for a longer period of time, as the phrase itself is also longer. As immature or atypically functioning auditory systems often have difficulty locating sound boundaries (François et al., 2013; Goswami, 2008), body movements which also stop and start with the sound help to make the experience more concrete. It is possible that this structuring of musical phrases with a matching set of movements better enabled the ETM participants to find the boundaries of sound in music, facilitating the identification of sound boundaries in speech, and further contributing to the overall higher segmenting abilities observed in this study.

Symbolism. Another route through which ETM experience may have contributed to the growth in phonological awareness skills is the development of symbolism, in particular moving from sound to symbol (i.e., moving from a physical experience to an abstract representation of it). In order to be literate, a child must first be able to think symbolically. In the earliest of phonics instruction, letters become the symbols for the sounds of speech. But there is much that must precede. Even before learning the symbols of written text (e.g., written words standing in place of oral language), children must learn the symbols of language (e.g., spoken words standing in place of objects and emotions). There must be a system in place in which one thing can call to mind something that is not physically present. ETM participation may help to strengthen this system by facilitating the leap from concrete experience to abstract representation. For example, in the song-experience-game, High Stepping Horses, the body becomes a symbol for both the language of the song (e.g., different body parts enact the movement of a horse, such as the arms and feet) as well as the melody and rhythm (e.g., movements are made to the beat and also move physically higher in space as the melody rises). In this way the concept of *horse* moves from an actual separate physical creature to one that is represented by the child's body. Likewise, the abstract sound movement concepts of melody and rhythm become physical and tangible as felt through the child's body. As a child enacts the story of the song through the game, their body becomes a symbol for song and sound experience.

This development of symbolism may have benefitted from and contributed sociodramatic play found within the ETM song-experience-games. Each song tells a story through words, while the game tells the story through the body, effectively allowing participants to become a character within it. In the game Oats, Peas, Beans described earlier, children become the Farmer; in Clickety Clack, the train; and in The Farmer in the Dell, an entire cast of roles is possible, all the way down to a piece of cheese, which is then miraculously transformed into a different farmer through one form of enchantment or another. According to Wolf (2018), this kind of play experience is just as important in the development of a reading brain as being held and read to as a child, both of which are considered irreplaceable. "All of these earliest experiences provide the ideal beginnings of the reading life: first and foremost human interaction and its associations with touch and feeling; second, the development of shared attention through shared gaze and gentle directives; and third, daily exposure to new words and new concepts as they reappear every day like magic in the same place on the same page" (p. 132). In this sense, ETM song-experience-games are like opening a well-loved book, possessing a magic of their own. Each time the story reappears, it is not only being told, but enacted. Children quite literally become the story. It is familiar and safe, a journey of shared experience between child and teacher, child and peer, and one in which its future recollection may be brought to mind with the fullest of meaning. These playful transformations may hold power even beyond the world of play. Sociodramatic play has, for example, been linked with reading comprehension, perspective taking and empathy, contributing to the ability to connect with characters in a text and think more deeply about their experiences, which are important aspects of higher-level processing in text and real-world situations (Marbach & Yawkey, 1980 as cited in Singer & Lythcott, 2004; Wolf, 2018). Although the current study focused on the development of early literacy skills, future studies should address whether these kinds of ETM experiences may also contribute to more advanced reading skills, such as comprehension. Does the adoption of different roles within the context of the ETM song-experience-games also contribute to the development of perspective-taking and empathy? It would also be interesting to examine the neurological structural and behavioral correlates of an ETM experience. Are similar areas of the brain active during both the play of a song-experience-game and reading a story with a comparable theme (e.g., playing The Farmer in the Dell song-experience-game and then reading a Farmer in the Dell storybook)? This might also indicate that the ETM experience and related reading activity had successfully recruited the Mirror Neuron System, which has been shown to contribute to language comprehension, both oral and written (Lahav, Saltzman & Schlaug, 2007; Zarr, Ferguson & Glenberg, 2013).

Patterns and predictions. Listed in the pre-reading level due to its reliance on experience and integration of information from the brain and body, the ability to recognize patterns and make predictions is actually reciprocally influential with both the skills and processes of the neurological foundation as well as the more traditional and higher-level reading skills (Goswami, 2008). Within each element and level discussed here, experience plays a critical role. As experience in the world increases, so too does the ability to recognize patterns and make predictions, which in turn affects how an individual is able to interact with the world and with text. The cyclical pattern is infinite.

The first patterns that are recognized are sensory in nature, occurring even in the womb, as the infant becomes aware of and accustomed to the different aspects of their environment. The move from concrete experience (e.g., sensorimotor exploration, play) and pattern recognition to abstract and representational (e.g., letter and word symbol identification) is gradual, and necessarily so, if meaning is to develop. Recognizing patterns is a crucial step in prediction. According to Wolf (2018), prediction is an integrated effort by the brain at large, in which previous experience and knowledge is applied to the situation at hand. The process of reading recruits this process extensively. Reading a sentence is, in Wolf's words, like a "sum of predicted thoughts" (p. 37). These prior experiences can also include images, feelings, and understandings that occur through real-world and play scenarios, such as those in ETM. In the early steps of reading, prediction assists processes such as decoding. The brain may be better able to predict when a sound will occur or which sounds may occur next in a word, resulting in part because of the improved sound processing associated with musical training and experience with language in general. Later in the reading process, prediction assists such processes as comprehension. A child may, for example, be able to predict words or events in a written story based on personal background knowledge of what happened when they were in a similar situation, either in real life or in play. The brain's anticipation of what could be coming makes it more likely to find and understand what actually does come along, helping to make the process of reading faster and more efficient. Personal experience readies the brain to see the world in a written scenario. This increased automaticity frees the mental energy necessary for the deeper comprehension that is the ultimate goal of all reading instruction and education in general (Wolf, 2007, 2018).

It may be that a fatal flaw of modern reading programs is a too abrupt leap into attempting to teach children to recognize the abstract patterns of written language before they have built a solid foundation of physical and auditory proficiency. In Vygotskyan terminology, phonics lessons may be operating outside the bounds of children's Zone of Proximal Development (Vygotsky, 1978). ETM participation may provide the unifying experiences that bridge these two necessary aspects of reading development. ETM's grounding in physical, sensate experience, with the body enacting the story of the song (i.e., the body acts as a symbol for music and language), may provide the intermediary steps that make the transition from sound to symbol possible.

Implications of Music and Play on Learning

Classroom music programs and time for play have been steadily decreasing over the last three decades, at times due to lack of funding, but more often out of an attempt to create more time for more traditional academic learning and the view that music and play impeded this goal. Research is increasingly contradicting this perspective. Children whose school days incorporate play opportunities, movement, as well as musical training have demonstrated improved attention (Elkind, 2007; Jarrett et al., 1998; Pellegrini & Bjorklund, 1997; Pellegrini, Huberty, & Jones, 1995), sound processing, sensory coordination, and brain plasticity (Tierney, Krizman, & Kraus, 2015), all of which are significantly related to learning. The results of the current study provide additional evidence in support of this inclusive view. Not only did the classroom time taken for the music and play in the ETM program not detract from skill development, the children who participated in the ETM classrooms actually demonstrated significantly more improvement in key phonological awareness skills than children in non-music-oriented classrooms. In the areas in which their performance did not exceed that of their peers, the ETM group's performance was commensurate with the control group, indicating that the ETM group performed as well as or better on every measure given.

The findings of this study increase the research base regarding vocal music and indicate that ETM may be a valuable and complementary addition to typical classroom instruction to aid in the development of phonological awareness, language, and literacy skills. In addition, its grounding in vocal music makes it accessible to a wide-ranging student population, as it requires no external hardware, save a voice.

Limitations of the Current Study

With any study, there are tradeoffs between a high degree of variable control (e.g., conducted in a laboratory) and the ease with which it may be generalized to a given population (e.g., occurring in natural settings), in this instance kindergarten classrooms. One of the strengths of this study is that it was conducted in the natural classroom setting, with children from the general population, making it easier to generalize the results to other kindergarten classrooms. ETM was already an established part of the daily curriculum and routine, indicating that it may feasibly be implementable in other classrooms as well. Important questions do still remain, however, such as its generalizability with kindergarten classrooms with different demographics (e.g., socioeconomic status, English Language Learners, reading disabilities, geographic location).

While this study was designed to control for as many variables as possible, including teacher experience (i.e., at least ten years of teaching experience, at least five years in kindergarten, and at least five years of ETM training for ETM teachers), school demographics, participant age, and use of music in the classroom, it was a quasi-experiment performed in a natural setting (i.e., the classroom), with humans (i.e., adults and children), and as such there were a number of variables that remained inherently elusive to control.

Student variables. People are notoriously susceptible to changes in the environment. Performance on any given day is related not only to actual ability, but also time of day, level of hunger, sleepiness, mood, and other state-dependent factors, which were beyond the control of this research. In addition, one non-music-oriented classroom was an afternoon kindergarten, resulting in assessment that occurred during a later time of the day for this group of children than for the other classrooms, potentially contributing to changes in state-dependent performance. However, scores were quite similar between the different classrooms (e.g., classrooms in which testing occurred in the morning for some and the afternoon for another) on the tests in which no significant differences were found. Therefore, it does not appear as though these potentially confounding variables created systematic differences between the groups beyond that which was being measured. Nevertheless, they cannot be ruled out as contributing factors.

Reading curriculum. Reading instruction varied among the classrooms included in the current study. Because no singular reading series was utilized among the participants, it is possible that differences observed in the study may be attributable to differences in the classroom curricula, rather than the addition of ETM alone. However, the similarities in daily reading instruction duration and delivery (i.e., similar lengths of time, primarily small group instruction) among the classrooms may help to mitigate the potentially confounding influence of curriculum. It would be useful for classrooms to utilize the same curriculums, with the exception of ETM, in future studies to reduce or eliminate its potentially confounding role.

Assignment to condition. The current study utilized classrooms that had been arranged during an open-enrollment period prior to its initiation. As such, students were not randomly assigned to classroom condition (ETM or Non-Music Oriented). School assignment is based on a lottery, with parents indicating their preference. As a result, it is possible that the parents may have requested a given school based on the presence of music in the classroom, perhaps reflecting systemic differences in approaches to education and educational values. The potential impact of this is lessened, however, due to the lottery-based procedure for school assignment (first choice is not guaranteed), the presence of ETM and non-music-oriented classrooms within the same grade level at each school (student placement with a requested teacher is also not guaranteed), and the fact that many students are unaware of the nature and use of ETM in the classroom until after the start of school. These factors make self-selection bias (e.g., a student is in a particular classroom specifically because music is or is not valued at home) and its potential influence less likely.

Knowledge about condition. As both the teachers and the researcher knew whether or not ETM was occurring in the classroom, neither were blind to condition. It remains possible that despite best efforts, the results could have been unconsciously biased. Being aware of the basic premise of the experiment and wanting their particular teaching methods and students to be seen in the best light, teachers in both groups may have emphasized phonological awareness more in the curriculum. Likewise, implicit researcher bias is always a possibility. Two factors lessen this potential impact in this study. First, teachers in both the experimental and control groups were aware of the study’s purpose, meaning that both groups were equally as likely to modify their instruction more heavily in favor of phonics, reducing the likelihood that a systematic increase in phonics instruction led to observed differences. Second, the researcher had equal reason to hope for favorable outcomes from both classroom types, both due to the nature of this thesis, and friendships with each of the teachers involved in the study. These equal and opposing pulls limited the influence of this potential unconscious bias.

Teacher training. It should also be noted that the teachers of the ETM classrooms participate in approximately 30 hours of ETM training annually, in addition to 18 hours of professional development, which all school district teachers are obligated to fulfill each year. It can be argued that those who are drawn to the profession of teaching, with its long hours both with students and preparing to be with students, are unique individuals. Furthermore, it takes no small degree of courage to sing and play with an entire classroom of children, particularly for those who are not trained music educators. Could it be that the teachers who regularly participate in ETM training and apply it within their classrooms are a categorically different type of teacher than those who do not? Might this have an impact on the teaching strategies employed within the classroom and/or the student outcomes?

Future Investigations – Changes to Research Design and Variables of Interest

Replication and experimental design. This study found initial evidence that supports ETM's claim to be a program that enhances early language and literacy development. As it is one of the first to examine ETM experimentally, future studies should address both replication as well as variable manipulation to see what can or cannot be added to a body of evidence in support of Education Through Music. Moving closer to a true experimental design, it would provide valuable information to alter additional variables of interest, such as random assignment, ETM duration, and age of participants. Would similar or different results be seen if students were randomly assigned to an ETM group or control?

Is there a correlation between amount of time spent participating in ETM activities and early literacy and reading skill growth? The teachers in this study approached an average of 20 minutes daily, but would more ETM time correspond with greater growth, and how might the results differ if there is less time? What results might be seen in older or younger children? This kind of information would contribute greatly to the knowledge base and would also help teachers and schools maximize their instructional time.

Longevity. If the differences observed in this study can be attributed to ETM, one of the next questions to ask is, are the benefits maintained over time? While this study found a significant difference in skill growth over the course of a single school year, it is important to examine whether these benefits are maintained over time, through the use of longitudinal study designs. Would a significant difference be found if these same children were reassessed at the end of their first-grade year, given appropriate reading instruction, but no further ETM experience? Does the earlier acquisition of phonological skills contribute to more proficient reading and comprehension in later grades, perhaps due in part to more automatic lower-level reading processes (e.g., accurate sound differentiation, sound to letter mapping, and word meaning recall)? Closely behind the issue of longevity is the question of whether there may be cumulative benefits to multiple years of participation in ETM activities. Do students who participate in ETM in kindergarten, first, and second grade benefit from more advanced reading skills than students who only participated in ETM for one of those years? Another important factor to consider is the age at which participation first occurs. Research has shown that musical training has an impact on sound processing and reading skills that is related not only to length of musical training (Corrigall & Trainor, 2011), but also to the age at which it was initiated (Penhune, 2011). Would greater or earlier differences in areas such as sound processing, early literacy, and even later reading development, be found in children who participated in Education Through Music before their kindergarten year (e.g., preschool or younger)? Would any potential differences be maintained as they progressed through later school years?

Students who are English language learners. Because the current study found significant differences in phonological awareness skill growth within typically-developing native speakers of English, it is important to examine the use of Education Through Music with other populations to determine if significant differences can be found and to better understand how the results may be generalizable within and across various populations. English language learners are one such group of interest. Learning a first language is a process that begins before birth. Acquiring proficiency and fluency in additional languages utilizes much of the native language neural architecture, but also requires construction of new pathways of sound and meaning (Ludke, Ferreira, & Overy, 2014). While there is a critical period for acquisition of a first language, there is not a definite window for learning additional languages, although the process typically becomes more arduous over time (Arshavsky, 2009; Tierney, Krisman, & Kraus, 2015). Musical training has been shown to lengthen the period of time this window for language learning is open, keeping the critical neural components for language acquisition active (Tierney et al., 2015). Could similar effects be seen in children who are learning English as an additional language and participating in ETM? Might the results be even greater given that language is an integral part of the ETM experience? Research has also shown that musical structure may provide an important key to unlocking language. Tone and stress patterns may serve as a gateway to perceived fluency in speech (Ludke, Ferreira, & Overy, 2014; Patel, 2008). Likewise, the melody in music helps convey meaning, as does the prosody in speech (Wolf, 2018). Longitudinal research has also demonstrated that phonological segmentation, an area in which the students participating in ETM demonstrated significantly higher ability in this study, is a significant predictor of later reading ability, regardless of native language (Muter & Diethelm, 2001). Might ETM experience, with its focus on songs that match the flow and stress patterns of English speech, enable greater fluency for non-native speakers? It would be of particular interest to examine the experience of students whose initial language was tonally-based as they begin to make their way within the more phoneme-structured maze of English.

Students with dyslexia. In addition to English language learners, ETM could potentially be a useful tool in the literacy development of students with dyslexia. Dyslexia is a complex learning disability. While it is commonly thought of as a disorder of the visual system (e.g., letter reversals, inability to successfully track lines of text) among the general population, research is increasingly identifying it as a multifaceted auditory and sensory processing and integration issue (Goswami et al.; 2011; Kraus & Slater, 2015; Wolf, 2007). These deficits can manifest themselves in myriad ways throughout the reading process, including poor phonological awareness, segmentation in particular, decoding, and comprehension (Thatcher, 2010). Among children with dyslexia, specific deficits have been demonstrated in the areas of timing, rhythm and beat perception, and sensorimotor synchronization (Flaugnacco et al., 2015; Overy 2003; Wolf, & Bowers, 1999), which are believed to be linked to these core deficits in reading. Research has increasingly found a link between musical ability and language and reading ability in both children with normal reading ability and children with dyslexia (Forgeard, Schlaug, Norton, Rosam, & Iyengar, 2008; Overy, 2003). Among interventions, it has been demonstrated that music training, both vocal and instrumental can be effective in strengthening these areas, leading to neurological changes (e.g., more efficient neural processing, structural changes within the brain), as well as behavioral (e.g., improved rhythm and timing, increased phonological awareness skills) (Flaugnacco et al., 2015; Huss, Verney, Fosker, Mead, & Goswami, 2011; Overy, 2000; Overy, 2003). Based on this study's findings with a typically-developing reading population, particularly regarding segmentation, future research might investigate whether ETM experience may also be associated with significant growth in phonological awareness skills with children either diagnosed with a reading disability or displaying notable reading difficulty.

In consideration of its potential utility with reading-impaired, English-language-learners, and low SES populations, in addition to typical learners, the answers to these questions may demonstrate themselves to be of highest value. Research across widespread disciplines has emphasized the importance of early intervention from disability categories such as Autism and speech and motor delays to enriched early childhood education settings in impoverished communities. Should these avenues of research prove fruitful, ETM may show itself to be a valuable instrument in the school and intervention settings.

Concluding Thoughts

The dissemination of effective and engaging methods of instruction is something that is owed to all educators and all students. Acquiring literacy is without a doubt one of the most challenging tasks placed on children today, and the instruction of it as much so for teachers. Wolf (2018) acknowledges, "The teaching of reading is hard, full of pitfalls, with obstacles all along the way until children reach the level of proficiency that allows them, whatever their learning trajectory, to pass over from the text to their own thoughts and return enriched" (p.166). Difficult, however, does not inherently translate to painful, boring, or narrow in focus. Traditional curriculum, including explicit phonics instruction is certainly a valuable and necessary component in the process of learning to read. However, it too requires a foundation, one that we are beginning to recognize is far broader and more inclusive than was previously considered. What might it look like if, instead of beginning literacy instruction at the level in which sound is already represented by symbol, classrooms were able to include experiences that furthered the development of a sensorimotor foundation and pre-reading skills and prepared the neural architecture necessary for managing and making meaning from sound and language.

Allow me to apply, if you will, one last example from my own experience. My nephew, who is now five, is utterly in love with stories. He brings the book, deposits himself in a lap and waits (not always so patiently) for the reading to begin. Immediately following its telling he asks for it to be told again, but this time there is a catch. This time he wants to *play* the story. Become the story, with not just his mind but with his body. To live the story again and again and again. As someone with more than two dozen train rides (including steam engine, diesel engine, trolley car, and electric) worth of experience in his personal repertoire, these stories and their dramatic reenactments often center on the railway and its piston-pumping inhabitants. When we play Clickety Clack, an ETM song-experience-game, there is no question that he has been transformed. He is a shining blue steam engine, number five, the fastest train to have ever existed on the rails. His experience gives life to the stories we read, which in turn enrich the complexity and language of his play, adding still more to the meaning of the words in the text. It is a drive that comes from deep within him. He requires no audience, receives no external reward, and yet he is fueling the very resources that will enable him to be literate.

For those who enter school lacking this kind of play life, their needs are no less, but the self-driven methods for obtaining them (e.g., demanding a story or play) may be less sophisticated or even nonexistent; they may not know what they need or how to get it. What better way to involve an entire classroom of children than a story that tells itself through the song, through a game, and through the children themselves? While it may not be possible to put a classroom of children to a work on a farm, or to purchase fare for an entire passenger car on a steam train, or to become part of the crew of a ship at storm in the middle of the ocean, ETM can create these experiences within the classroom. Each song-experience-game is a story unto itself. A story into which the children transport themselves, body and mind, again and again. And with each singing and each playing, hearing is hooking up with vision, is hooking up with movement, is hooking up with language, is hooking up with emotion, is building attention, is building motivation, is creating a brain and a body ready for learning, and already on the pathway to literacy.

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Table 1

*Participating School Demographics**

	School 1 **	School 2 **	School 3 **
Free and Reduced Meals	24.5 %	16.8 %	24.0 %
Race/Ethnicity			
American Indian or Alaska Native	0.0%	0.3 %	0.0 %
Asian	2.5	6.4	1.1
Black or African American	2.8	1.5	1.4
Filipino	0.7	0.2	0.5
Hispanic or Latino	14.2	11.9	13.6
Native Hawaiian or Pacific Islander	0.7	0.5	0.3
White	73.3	70.6	78.5
Two or More Races	5.7	8.4	4.5
None Reported	0.2	0.2	0.0
English Language Learners	4.4 %	3.5%	2.5 %

*School demographic information for 2017-2018 school year retrieved from Ed-Data (2018).
**Schools one and two each had one participating ETM classroom. School three had one participating ETM classroom and two participating non-music-oriented classrooms.

Table 2

Participant Demographics by Group

	Education Through Music	Non-Music-Oriented
Gender		
Female	21	14
Male	25	16
Highest Parent Education Level*		
High School Graduate	3.8%	3.8%
Some College	11.5	23.1
College Graduate	43.6	42.3
Graduate School	33.3	26.9
Unknown	7.7	3.8
Race/Ethnicity*		
Asian	6.4	1.9
Black or African American	2.6	0.0
Hispanic	24.4	1.9
Two or More Races	6.4	3.8
White	60.3	92.3
Individualized Education Program*		
Percentage of Students With	12.8	13.5
Percentage of Students Without	87.1	86.5
Preschool Experience**	2.02 years (SD = 0.96)	1.72 years (SD = 0.81)
Daily Reading at Home**	31.49 minutes (SD = 19.14)	30.17 minutes (SD = 13.91)

SD = Standard Deviation
*Results are presented as percentages of entire participating classroom composition (i.e., all students within the three ETM and two non-music-oriented classrooms), not only those students included in the study. Demographics and category labels were provided by the school district.
**Data calculated from parent responses to Parent and Child Information Surveys (Appendix C) that were returned.

Table 3

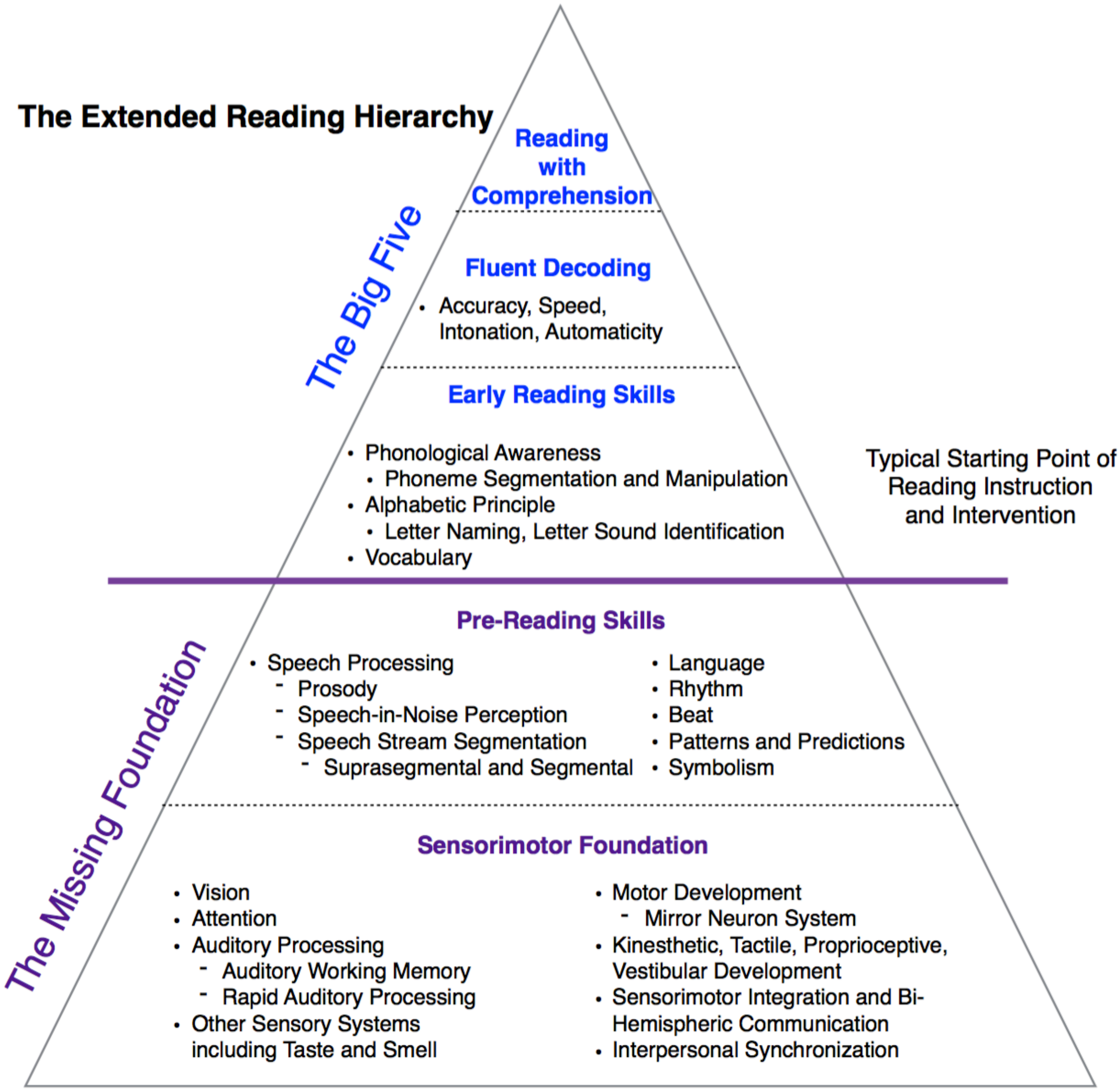
Repeated Measures Analysis of Covariance Regarding PAT 2 Subtest Scores

	Education Through Music				Non-Music-Oriented							
PAT 2 subtests	T1 M (SD)	T2 M (SD)	T3 M (SD)	T4 M (SD)	T1 M (SD)	T2 M (SD)	T3 M (SD)	T4 M (SD)	*df*	*F*	η_p^2	*p*
Segmentation-Sentences	3.74 (3.07)	6.35 (2.35)	8.02 (1.56)	8.74 (1.34)	4.90 (2.95)	6.47 (2.45)	7.50 (2.08)	7.43 (2.24)	(1,73)	4.986	.064	.029*
Segmentation-Syllables	4.07 (2.61)	5.24 (2.51)	6.78 (2.34)	7.89 (2.09)	4.73 (2.69)	5.03 (2.44)	5.53 (2.47)	5.70 (2.63)	(1,73)	13.086	.152	.001***
Segmentation-Phonemes	.80 (1.53)	3.00 (2.41)	4.37 (2.42)	6.93 (2.24)	1.40 (1.92)	3.07 (2.45)	3.93 (2.18)	4.93 (2.55)	(1,73)	6.944	.087	.010**
Rhyming-Production	5.67 (3.46)	7.17 (3.10)	7.91 (2.89)	8.46 (2.24)	6.23 (3.34)	7.10 (3.13)	7.10 (3.13)	6.83 (3.03)	(1,73)	9.562	.116	.003**
Rhyming-Discrimination	8.46 (1.99)	9.02 (1.47)	8.96 (1.53)	9.39 (1.34)	8.27 (1.66)	8.53 (1.61)	8.90 (1.40)	9.07 (1.66)	(1,73)	.684	.009	.411
Isolation-Initial Phoneme	5.54 (4.09)	7.87 (3.08)	9.26 (1.60)	9.59 (1.54)	6.07 (3.13)	8.17 (2.96)	8.73 (2.49)	9.37 (1.40)	(1,73)	.461	.006	.499
Blending-Syllables	5.96 (2.79)	7.61 (2.15)	8.59 (1.54)	9.11 (.74)	6.13 (2.54)	7.90 (1.75)	8.33 (1.16)	8.77 (1.57)	(1,73)	.378	.005	.541
Blending-Phonemes	3.52 (3.22)	6.07 (3.33)	7.67 (2.47)	8.54 (1.92)	4.47 (3.13)	6.40 (3.08)	7.57 (2.58)	8.13 (2.35)	(1,73)	2.150	.029	.147

* $p < .05$, ** $p < .01$, *** $p < .001$
(M) Means and (SD) Standard Deviations
T1 = Time period 1, covariate, data collected from late August through early October
T2 = Time period 2, data collected from late November through early December
T3 = Time period 3, data collected in early March
T4 = Time period 4, final data collected from mid to late May

Figure 1

Proposed Extended Reading Hierarchy Graphic



Supporting References (Bolduc, 2009; Brown, 2009; Flaugnacco et al., 2015; Glenberg et al., 2008; Goswami, 2008; Gromko, 2005; Healy, 2004b; Holliman, Wood, & Sheehy, 2012; Kraus & Slater, 2015; Lamb & Gregory, 1993; Leisman, Braun-Benjamin & Melillo, 2014; Molnar-Szakacs et al., 2006; Moritz, Yampolsky, Papadelis, Thomson, & Wolf, 2013; National Institute of Child Health & Human Development, 2000; Overy, 2000; Overy, 2003; Overy & Turner, 2009; Patel, 2008; Phillips-Silver, 2009; Piaget, 1962 ; Piro & Ortiz, 2009; Tierney & Kraus, 2013; Trainor, Gao, Lei, Lehtovaara, & Harris, 2009; Wolf, 2007; Zhang & McBride-Chang, 2010)

Appendix A

Music and Language/Reading Comparison Chart

	Language/Reading	**Music**
Direction of written notation	• Read left to right	• Read left to right
Symbol	• Written – sound mapped onto letter, punctuation • Physical – gesture	• Written – sound mapped onto note, rhythm patterns, paper mapping • Physical – air mapping, hand signals
Auditory Sensitivity Needed	• Phonological perception required • Perception and manipulation of sound and time intervals between in a speech stream	• Tonal perception required • Perception and manipulation of sound and time intervals between in stream
Sound Units	• Word o Syllable o Morpheme o Phoneme	• Tone o Loudness o Pitch o Timbre o Duration
How meaning is conveyed through sound	• Rhythm patterns and stress/inflection help convey emotion and meaning, aids in prediction	• Rhythm patterns, pitch, melody, beat help convey emotion and meaning
Structure	• Order ruled by syntax, grammar	• Melody and harmony creation driven by rules • Scales • Interval structure

Supporting References (Brown, Martinez, & Parsons, 2006; Moritz et al., 2013; Richards, 1977)

Appendix B

Parent Consent Form

Date, 2017

Dear Parents/Guardians,

Your child's class has the opportunity to participate in a research project examining early literacy practices. Tremendous learning and growth occurs in the kindergarten year, making it an ideal time to study the teaching strategies that contribute to the development of good readers. It is my goal with this study to find out which practices most contribute to children's reading development so that they may be shared with other teachers and classrooms.

(Teacher Name) has agreed to open her classroom to this study, both to support this area of research and to grow her own learning about reading development.

About the Researcher
My name is Laura Lehman. I attended school in the San Juan Unified School District from kindergarten through 12th grade (Orangevale Open K-8 and Casa Roble) before completing a Bachelor's degree at UC Santa Cruz. I hold a Master's degree in school psychology, and am currently completing my doctorate through Alfred University (in upstate New York). Although my graduate training took me to the opposite side of the country, I would love to complete this research within the educational community that nurtured my own lifelong love of learning.

About the Study
The study will take place over the length of the school year. Your child's everyday learning environment, including curriculum and activities, will not change. The only modification will be the addition of the brief testing component. Data collection will occur four times, at the beginning of the year (end of August to beginning of September), November/December, March, and May. During each data collection period your child will be engaged with assessment material for approximately 10-15 minutes in a quiet area in the classroom, during a time that your child's teacher determines to be least disruptive to classroom routines. The assessment will be composed of a series of quick activities related to early reading, and will look at skills such as rhyming and knowledge about words and sounds. I would be happy to share an example of the materials I will be using.

Confidentiality
Privacy will be maintained at all times; no student names will be written on any assessment material. Any publication using the data will not include information that makes it possible to identify your child, and will include group averages, not individual results. Electronic data files will be encrypted; physical materials will be kept in a secure, locked cabinet.

Potential Risks and Benefits
There is minimal potential risk for participants. Students may potentially feel a small degree of anxiety completing the assessment measures, but I will do everything within my power to help them feel comfortable with the process. There will be no consequences for answers,

whether right or wrong – the students will be praised for their effort and will not be given feedback about their performance. I will ask each student whether or not they agree to participate before each assessment session, and anyone who disagrees or indicates discomfort will be excused from the assessment activities. Any information learned in this study that has the potential to enhance the kindergarten learning experience will be shared with the learning community.

Voluntary Nature of the Study
Please remember that participation is voluntary and permission can be withdrawn at any time, without consequence to you or your child.

Contacts and Questions
Feel free to contact either myself, or my dissertation supervisor, Dr. Jana Atlas, at any point if you have questions or concerns. You may also contact Dr. Steve Byrne, Chair of the Alfred University Human Subjects Research Committee (HSRC@alfred.edu) for questions related to research integrity.

Kindergarten students are an amazing bunch of children and I am very excited about the opportunity to learn more about how caring adults can help children grow into readers and lifelong learners.

Sincerely,

Laura Lehman, M.A.
Doctoral Candidate
School Psychology
Alfred University
Ldl1@alfred.edu

Jana Atlas, Ph.D.
Dissertation Chair/Professor
School Psychology
Alfred University
Atlasj@alfred.edu

Statement of Consent
Please sign below to state that you have read the above information and consent for your child to participate in the study.

I, _____________________________, give permission for, _____________________________,
(print parent/guardian name) (print child name)
to participate in the Early Literacy Exploration Project for the duration of the 2017-2018 school year.

X____ ____________________________
(parent/guardian signature) (date)

Appendix C

Parent and Child Information Survey

I am asking for a bit of information about your child's home life and previous school experience. This will help me to understand your child's unique background. This information will only be reported as a summary (e.g., the average child age) and individual information will not be shared. This survey is optional and not required. Thank you!

Child Name (first and last): ____

Child Birthdate: ________________ Child Gender: ________________________

What is your child's previous school experience (circle all that apply)?

- Transitional Kindergarten (T-K) – How long:__________________________
- Montessori Preschool – How long:__________________________________
- Waldorf Preschool – How long:____________________________________
- Head Start – How long:____
- Private or Other Preschool: – How long:____________________________
- Daycare – How long:____
- Friends / Relatives – How long:___________________________________
- None

How many hours do you spend reading with your child each night? __________________

Does your child participate in music activities outside school? ______________________

If yes, when did they begin and for how many hours each week?________________

Appendix D

Child Assent Form

Parents/Guardians: please read this to your child. I want to make sure that they feel like they have a choice in whether or not to participate. Please write their first and last name and the date on the line under the box (I know writing is only beginning to come along for them at this point).

My name is Laura. I am doing a project to learn about how kids learn to read and about the things their teachers do to help them. I would like to meet with you a few times this year to play some listening games for my project. I am asking the grown-ups to make sure it is okay with them, but I'd also like to make sure it's okay with you. If you would like to help with my project, write your name in this box - you can also draw a picture!

Child's Name (first and last):____

Biographical Data

Laura D. Lehman
Ldl1@alfred.edu

Education

- Alfred University, Certificate of Advanced Study in School Psychology May 2013
  Alfred, NY
- Alfred University, Master of Arts in School Psychology May 2011
  Alfred, NY
- University of California, Santa Cruz, Bachelor of Arts in Psychology June 2008
  Santa Cruz, CA
  Graduated with honors in the major

Academic Honors and Awards

- Nationally Certified School Psychologist 2013-present
  National Association of School Psychologists
- Leah R. Powell Fellow, Alfred University 2013
  Honors award given to one doctoral student annually in recognition of outstanding scholarship and achievement in research and service to the profession of school psychology
- Rural Justice Institute Fellow, Alfred University 2010-2012
- Olin Carpenter Fellow, Alfred University 2009-2010
  First year doctoral student fellowship
- Outstanding Undergraduate Scholar Award, UC Santa Cruz 2008
  Achievement award presented by the University of California, Santa Cruz Psychology Department to recognize the top three graduating seniors
- Regents Scholar, UC Santa Cruz 2006-2008
  The University of California's most prestigious scholarship, awarded in recognition of outstanding academic records and personal achievement

Publications

- Young, H. L., **Lehman, L. D.**, Faherty, E., & Sandefer, K. N. (2016). Examining the long-term effects of a domestic violence training for educators. *Journal of Aggression, Maltreatment & Trauma*. doi: 10.1080/10926771.2015.1081659
- Lehman, L. D. (2009). Who's going to tell the teacher? Divorce education for today's educator. *Family Mediation News*, Winter, Washington D.C.: Association for Conflict Resolution.

Academic Presentations

- Young, H. L., Faherty, E., **Lehman, L. D.**, Sandefer, K., & McClaren, J. A. (2011, February). *Teaching teenagers about teen dating violence and healthy relationships*. Poster presented at the 2011 National Association of School Psychologists (NASP) annual convention, San Francisco, CA.
- Young, H. L., Faherty, E., McClaren, J. A., **Lehman, L. D.**, & Sandefer, K. (2011, February). *Increasing prosocial behavior through violence prevention programming*. Poster presented at the 2011 National Association of School Psychologists (NASP) annual convention, San Francisco, CA.

Professional Membership

- Phi Kappa Phi 2013-Present
- American Psychological Association, Division 16 2009-Present
- National Association of School Psychologists 2009-Present
- Phi Beta Kappa 2008-Present
- Golden Key International Honour Society 2008-Present
- Psi Chi 2007-Present